City of Milwaukee

Department of Public Works

Infrastructure Services Division

Bridges and Buildings

Milwaukee Streetcar Operations and Maintenance Facility
450 N. 5th St.
Milwaukee, Wisconsin

April, 2016

CITY OF MILWAUKEE, WISCONSIN

DEPARTMENT OF PUBLIC WORKS

INFRASTRUCTURE SERVICES DIVISION

BRIDGES AND BUILDINGS SECTION

PROJECT MANUAL

GOVERNING THE

MILWAUKEE STREETCAR

OPERATIONS AND MAINTENANCE FACILITY

450 N. 5TH ST.

MILWAUKEE, WISCONSIN

April, 2016

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2. Department of Public Works General Specifications:

Provisions of the Department of Public Works General Specifications dated January 31, 1992, and subsequent addenda except as may be modified or expanded upon in this project manual, shall apply to all contractors and subcontractors working on the project. Copies of the General Specifications may be obtained from the Department of Public Works General Office, Room 501 Zeidler Municipal Building, 841 North Broadway, Milwaukee, Wisconsin, or from BRIDGES AND BUILDINGS SECTION, Room 602, Zeidler Municipal Building.

3. Definitions:

A. Owner: City of Milwaukee.

B. Facilities Operations Manager: The Facilities Operations Manager of BRIDGES AND BUILDINGS SECTION.

C. Project Inspector: The authorized representative of the Commissioner assigned to make detailed inspection of any or all portions of the work and materials thereof. These inspections are not a substitute to those required by the Department of Neighborhood Services for permit and code compliance.

D. Addenda: Written or graphic instruments issued prior to the execution of the contract which modify or interpret the bidding documents, including drawings and project manual by additions, deletions, clarifications or corrections. Addenda will become part of the contract documents when the contract is executed.

E. Contract Drawings: Drawings of the work to be done shown in the OMF plans.

F. Utility: WE Energies.

G. End User: City of Milwaukee.

4. Control of Work and Materials:

A. Detail and Shop Drawings: Shop drawings and other additional drawings which may be required for each contract of the work shall be prepared by each respective contractor unless

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otherwise directed by the Facilities Operations Manager. Prints shall be the same size as contract documents when practical. Prints of each drawing shall be submitted to the Facilities Operations Manager for approval before proceeding with the work. Changes ordered by the Facilities Operations Manager shall be made and revised prints submitted as above. The Facilities Operations Manager's approval of drawings shall not relieve the contractor of responsibility for errors.

B. Primary Lines and Grades: The contractor shall establish a benchmark, with a relative elevation, within close proximity to the site using information in the contract documents. Once established, the contractor shall preserve all points and benchmark as long as needed during construction. The contractor will bear all costs associated with re-establishing points and benchmark.

C. Construction Lines and Grades: The contractor must bear sole responsibility for the correct transfer of all construction lines and grades from the primary lines and grades points. He shall take such measurements from existing work as may be necessary to insure the proper construction of his work.

D. Material Orders and Shipping Statements: The contractor shall furnish to the Facilities Operations Manager at least two (2) copies of all material orders and shipping statements. Itemized weights of the materials and individual units of finished work shall be shown.

E. Weighing of Materials and Fabricated Units: The weighing of materials and fabricated units such as structural steel, casings, etc., when required, shall be done in the presence of the Commissioner's representative. The contractor shall be responsible for the satisfactory weighing of such materials and units.

F. Consignment and Delivery of Materials: The materials for the work shall be consigned to the contractor and he shall be responsible for the delivery of all materials required for the completion of the contract.

5. Samples and Tests:

A. Method of Sampling: Samples of the materials proposed or furnished for the work may be taken by the Commissioner at any time; at the point of manufacture, point of delivery or site of work. They will be selected, as far as practicable, in accordance with standard methods of sampling such materials as specified in the standard of the American Society for Testing Material. All sampling shall be done by authorized representatives of the Commissioner. Selections will be in an orderly and systematic manner, insuring samples representative of the lot.

B. A.S.T.M. Standards: Wherever the abbreviation A.S.T.M. is used in connection with the number of a standard specification, the specification referred to shall be the Standard of the American Society for Testing Materials, designated by that number, including all revisions in effect on the date of award of the contract. Should a revised or amended standard be issued by the American Society for Testing Materials which, in the opinion of the Commissioner,

conflicts with or causes undesirable changes in the standards referred to herein, the Commissioner reserves the right, by means of addenda to the project manual, to continue under the provisions of the pertinent standard referred to herein.

C. Cost of Test Specimens and Samples: All test specimens of metals and all samples of non-metals required for tests shall be furnished by the contractor without cost to the City.

D. Costs of Tests: All tests on test specimens of metals will be made at the expense of the

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contractor and the original test on samples of non-metals will be made at the expense of the City. In all cases, the testing procedure will be in accordance with Standard A.S.T.M. tests for such materials. Subsequent tests of non-metals requested by the contractor, when such tests are permitted by A.S.T.M. Specifications and approved by the Commissioner or subsequent tests ordered by the Commissioner will be made at the expense of the contractor.

6. Project Coordination:

A. Contractors are required, so far as possible; to arrange work and to dispose of materials so as not to interfere with the work or storage of materials of other contractors or City forces engaged upon the work.

B. Contractors shall give full cooperation to other trades and furnish any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.

C. Where the work of a contractor will be installed in close proximity to the work of other trades, or where there is evidence that the work of a contractor will interfere with the work of other trades, he shall assist in working out space conditions to make satisfactory adjustments.

D. If a contractor installs work before coordinating it with other trades or so as to cause interference with work of other trades, he shall make necessary changes in his work to correct the condition without extra charge.

E. Contractors are required to join their work to that of others in a proper manner, and in accordance with the spirit of the plans and project manual, and to perform the work in the proper sequence in relation to that of other contractors, and as may be directed by the Project Inspector.

7. Supervision of Work:

A. Contractors shall furnish the services of an experienced engineer or superintendent.

B. He shall be constantly in charge of the installation of the work together with all subcontractors, skilled workers, helpers, and labor required to unload, transfer, erect, connect up, adjust, start, operate and test each system.

C. He shall be thoroughly acquainted with and be responsible for the various subcontractors' work so that it is properly coordinated and supervised to the satisfaction of the Commissioner of Public Works or his representative.

D. Upon written notice to a contractor of the lack of such coordination and supervision, the Commissioner of Public Works may authorize such services as may be required and deduct the cost of this service at an hourly rate of $60.00 per hour per worker from the contract for the work.

8. Technical Specifications and Drawings:

A. Governing order of Contract Documents:

1. The following provision modifies DPW General Specifications Item 2.1.3.1:

Anything mentioned in the Technical Specifications and not shown on the drawings or shown on the drawings and not mentioned in the Technical Specifications, shall be as if shown on or mentioned in both. In case of difference between drawings and Technical Specifications, the Technical Specifications shall govern. In case of any discrepancy in drawings or Technical Specifications, the matter shall be immediately submitted to BRIDGES AND BUILDINGS SECTION for decision. Said discrepancy shall not be adjusted by the contractor.

B. All contractors shall have complete sets of plans and project manuals on the job site at all times.

9. Safety Regulations:

All work shall be done in accordance with the safety requirements referenced in the International Building Code, as adopted and amended by the State of Wisconsin and OSHA standards.

10. Code Rules:

The rulings, regulations and laws of the following shall be complied with in the completion of this project:

International Building Code, as amended and adopted by the State of Wisconsin
Plumbing and Drainage Codes of the City of Milwaukee
Ordinances of the City of Milwaukee
National Board of Fire Underwriters
OSHA
NFPA
FAA
NEC
IEEE
UL

SECTION 00821: INSPECTION CHARGES

The contractor will be charged a fee for inspection for each and every day such inspection is required after the time allowed for completion has expired.

The amount of the fee for inspection shall be $325.00 per day.
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The time allowed for completion is stated in the Specific Official Notice and shall start with the date on the Notice to Proceed which will be sent to the contractor directly following the signing of the contract. The time allowed includes the time required for fabricating and procuring material and doing the work at the building site.

SECTION 01010: SUMMARY OF WORK:

1. SCOPE:

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1. Scope
2. Project Description
3. Work by Others
4. Scheduling of Work

2. PROJECT DESCRIPTION:

A. Work illustrated in documents applies to the Milwaukee Streetcar Operations and Maintenance Facility at 450 N. 5th St.

B. The Milwaukee Streetcar Operations Facility is a non-separated mixed used Type II-B construction. The building shall comply with all local building code and accessibility requirements where applicable. The project work shall include the Project Specifications, Contract drawings, and all associated construction activities required to complete construction of the Operations and Maintenance Facility. Contract documents shall include:

1. All Contract drawings including Civil, Structural, Architectural, Mechanical, Plumbing, Fire Protection, Electrical, and Equipment.
2. Project Manual Specifications including:
   a. Division 3 – Concrete
   b. Division 4 – Masonry
   c. Division 5 – Metals
   d. Division 6 – Wood, Plastics, and Composites
   e. Division 7 – Thermal and Moisture Protection
   f. Division 8 – Openings
   g. Division 9 – Finishes
   h. Division 10 – Specialties
   i. Division 11 – Equipment
   j. Division 12 – Furnishings
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   l. Division 21 – Fire Protection
   m. Division 22 – Plumbing
   n. Division 23 – Heating, Ventilating and Air Conditioning (HVAC)
   o. Division 26 – Electrical
   p. Division 27 – Communications
   q. Division 28 – Electronic Safety and Security
   r. Division 31 – Earthwork
   s. Division 32 – Exterior Improvements
   t. Division 41 – Material Processing and Handling Equipment
   u. Division 45 – Industry –Specific Manufacturing Equipment

C. It is understood that the submittal of a proposal shall include furnishing all labor, materials, equipment, and incidentals necessary for completion of the work required, including that which may not be directly shown on the drawings or in the specifications, but are necessary for proper operation and approval.

D. The following outline is intended to serve as a general guide only, and not as a complete listing of work, operations, or materials. Consult the Table of Contents for a complete listing of items included.

E. Examine Documents and Visit Site:

1. Before submitting a bid proposal, bidders should carefully examine the drawings and specifications; visit the site of work; fully inform themselves as to all existing conditions and limitations, including those of labor; and shall include in the bid proposal a sum sufficient to cover the cost of all items contemplated by the construction documents.

2. Each sub-bidder further represents that he has inspected the site of the proposed work to ascertain any obstacles that might be encountered and other matters and conditions relevant to this work.

3. The nature of the work required demands thorough review of all drawings and the project manual, and diligent and careful site inspection by all prospective sub-bidders as a means of determining the extent of work and conditions under which the work is to be performed.

4. Additional charges will not be as considered for work which, prior to bidding, could reasonably be inferred as appropriate by examination of the drawings and specifications, visiting the site, and closely reviewing the work as indicated above. No representations as to subsurface conditions are made.

F. Notice to Contractor – WisDOT-Owned Structures on Site: The Operations and Maintenance Facility site is located beneath bridges for I-794 which are owned by the Wisconsin Department of Transportation (WisDOT). The site consists of 2 parcels - the OMF building site bounded by N. 4th St, N. 5th St, W. Clybourn St, and an east-west alley; and future expansion parcel bounded by N. 3rd St, N. 4th St, W. Clybourn St, and an east-west alley. The future expansion parcel will be available for contractor staging. Specific requirements for construction on the site and contractor staging in relation to the bridge structures are in the process of being developed in conjunction with WisDOT and will be made available to the contractor when finalized. The requirements may include but not be limited to restrictions on material storage, construction equipment parking, and excavation activities adjacent to piers and footings; providing access for bridge inspection and maintenance during construction; protocols for communicating with WisDOT; restrictions on storage of flammable materials beneath the bridge structures; and requirements for aesthetic protection of bridge piers and girders.

3. WORK BY OTHERS:

A. Not Applicable

4. SCHEDULING OF WORK:

A. The contractor shall provide a construction schedule which includes all phases of construction, indicating the anticipated start and completion times for each of those phases. The contractor shall provide that complete schedule at the Pre-Construction Meeting arranged by the City.

B. All work, unless otherwise specifically approved, is to be done during normal working hours.

C. Contractor must notify the City 48 hours in advance before starting work.

D. The contractor shall sign in and identify all personnel working at the site on a daily basis with the supervisor in charge at the site. All personnel leaving the site will sign out prior to departure.

E. Shut downs of any equipment and connections to any equipment must be arranged in advance with the Project Inspector from BRIDGES AND BUILDINGS. Power outages must be scheduled for Saturdays.

F. Dispose of all removed materials in legal manner.

G. The contractor shall provide a construction schedule which includes all phases of construction. The contractor shall provide that complete schedule at the Pre-Construction Meeting arranged by the City.

H. Project Total working days does not include submittals and submittal approval, acquisition and preparation of materials, and work off-site.

END OF SECTION

SECTION 01210: PROJECT MEETINGS

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2. Pre-Construction Meeting
3. Progress Meetings

2. PRE-CONSTRUCTION MEETING:

A. Soon after the award of the contract and prior to the start of construction, the contractor shall attend a pre-construction conference with representatives of the City.

B. The contractor shall have at the meeting responsible representatives from subcontractors who are to perform major work on the project.

C. The purpose of the meeting is to discuss in detail the plans and specifications. The discussion shall include:

1. Schedule
2. Equipment
3. Material Storage
4. Traffic Control
5. Inspection Requirements
6. Protection Procedures for the structure, adjacent facilities, environment, and personnel.
7. Hours of Work

D. The contractor shall submit the construction schedule to the architect/engineer at this meeting and a listing of subcontractors and their work. The contractor shall describe, in detail, when each portion of the work is expected to be accomplished. The subcontractors shall participate in the discussion. The architect/engineer will serve to interpret the contract documents should such questions arise.

E. Any other questions that the contractor or his subcontractors have about the work or its scheduling shall be raised at these meetings.

F. Requirements for contract administration and construction operations will be defined for participants.

G. The architect/engineer will determine time, date, and place of the meeting.

3. PROGRESS MEETINGS:

A. Bi-weekly meetings will be held for the purpose of coordinating and expediting the work.

B. Attendance at project meetings by the contractor is mandatory. These meetings shall also be attended by representatives of each subcontractor who is either working at the site or is affected

by work being done at the site. The contractor shall submit an updated construction schedule at these meetings and a short narrative should be written, describing the cause of any delays and intended action to remedy these delays.

C. Contractors shall give a verbal report of progress on the project, discuss the work schedule for the coming period, and present all conflicts, discrepancies, or other difficulties for resolution.

END OF SECTION

SECTION 01300: SUBMITTALS/PERMITS

1. SCOPE:

A. Index:

1. Scope
2. Submittals
3. Permits
4. Inspection

2. SUBMITTALS:

A. Comply with the requirements of the General Conditions and as follows:

1. Forward Submittals not more than 20 calendar days after the Notice to Proceed date. No work, as indicated on any shop drawing, samples, hardware list, etc., shall be started until those submittals have been reviewed and work authorized.

2. All submittals must be thoroughly reviewed by the prime contractor for conformance to contract documents, prior to submission to the City, or its agents, for review. Shop drawings and catalog information shall be stamped "Reviewed By" and signed by the contractor's reviewer. The prime contractor shall review all subcontractor submittals prior to submittal to the City for compliance with contract documents and to coordinate all work.

3. Include with each submittal a transmittal letter signed and dated by the prime contractor containing the following:

a. Name of Contractor
b. Name of Project
c. List of Submittals
d. Name of Manufacturer or Supplier
e. Additional information as required for the items being provided.

B. Shop Drawings, Catalog Information, Calculations, and Samples:

1. Shop Drawings: Submit one blue/black line print review. The City will notify the contractor in writing and return one copy marked "REVIEWED - NO EXCEPTIONS TAKEN" with minor or no notations. The City will also notify the contractor in writing and return one copy, along with comments, when the drawings are marked either "REJECTED" or "REVISE AND RESUBMIT". For those shop drawings, the contractor will be responsible for resubmitting a new print.

2. Catalog Information and Calculations: Submit four copies for City's record and additional numbers of copies required for the contractor's purpose. The City will notify the contractor in writing and return the contractor's copies, with or without notation,

marked either "REVIEWED - NO EXCEPTIONS TAKEN", "REVISE AND RESUBMIT",

OR "REJECTED". Catalog information or calculations marked "REVISE AND RESUBMIT" or "REJECTED" must be resubmitted in the same quantities as originally required.

3. Samples: Submit two samples of requested materials for the City's records and additional samples, if desired, to be returned to the contractor. The City will notify the contractor in writing, whether the samples are approved or rejected. If they are rejected, new samples must be resubmitted as originally required.

4. Corrections or comments made on the submittals during the review do not relieve the contractor from compliance with requirements of the contract documents. The check is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. Contractors are responsible for conforming and correlating all quantities and dimensions; selecting fabrication processes and techniques of construction; coordinating their work with that of all other trades; and performing their work in a safe manner.

C. "Or Equal": Whenever the words "or equal" or similar term is used, it shall mean as determined by the Commissioner of Public Works or agent. All drawings, data and bulletins necessary to make an "or equal" determination shall be submitted to the Facilities Operations Manager of BRIDGES AND BUILDINGS SECTION. Such review shall apply to design only and shall in no way relieve the contractor from the responsibilities as outlined in Item 2B above. Evaluation of "or equal" products will be made at the time of shop drawing submission. Any change required in design and coordination between all contractors, subcontractors, or trades due to the use of "or equal" materials shall become the contractor's responsibility. Any costs for detailed engineering reviews and/or any costs to incorporate "or equal" products will be borne by the contractor.

3. PERMITS:

A. The City of Milwaukee will provide the general building and occupancy permits.

B. Contractors shall obtain, from the City of Milwaukee Department of City Development and/or other government or private agencies, all special permits as may be necessary in their work.

C. Contractors shall obtain all permits to occupy or work in the public way as may be necessary for their work.

D. Contractors shall notify the City and/or appropriate utilities when making utility connections as part of the project.

4. INSPECTION:

A. BRIDGES AND BUILDINGS SECTION will provide daily inspection to verify compliance with contract documents, identify contractors and crews on the job, verify compliance with contract conditions (EBE, residency, wage requirements), and record job progress and conditions.

B. Contractors shall arrange with the Department of Neighborhood Services/Construction Trades Division and permit issuing agencies for all code compliance inspections as required by all permits including, but not limited to, the general building and all special permits issued by that agency.

C. Contractors shall arrange with the appropriate City agency for compliance inspections, as required, for all permits including, but not limited to, curb and pavement cuts and patches, and public way occupancy and utility connections.

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END OF SECTION

SECTION 01500: JOB SITE UTILITIES, FACILITIES, AND SECURITY

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4. Occupancy During Construction
5. Temporary hoists, Lifts
6. Temporary Ladders, Scaffolds
7. Electrical Power
8. Water
9. Toilet Facilities
10. Parking
11. Barricades and Signage
12. Construction Reference and Storage Area

2. BUILDING SECURITY:

A. General

1. The City Hall Complex is open to the public from 8:00 a.m. until 4:45 p.m., Monday through Friday excluding Holidays. It is essential that contractors and their City agents understand and abide by security policy. Any work performed at any time in the Mayor's Office, City Clerk, Treasurer, Budget, or City Attorney offices must be cleared in advance with representatives from those offices.

2. Outlying buildings are not generally open to the public. Contracted work in these buildings can take place at any time. It is essential that contractors and their City agents understand and abide by security policy.

B. Scope

At the beginning of any project, a copy of this policy and procedure statement will be added to specifications for bid consideration and shall be distributed at the pre-construction meeting. All City agents/officials responsible for engaging contractors, all contractors, and all sub-contractors shall be held responsible for following the procedures.

C. City Agents

Any City agent who commissions outside contractors to work in any of the facilities managedby DPW-BRIDGES AND BUILDINGS shall provide a completed Contractor Authorization form to DPW-Facilities no less than twenty-four (24) hours in advance of the work.

1. The completed form will be provided to the Security Operations Manager and the City Hall Information Center. The inspector or city agent managing the project will provide this information in conjunction with the contractor. If the work is completed in outlying buildings

the City agent shall be responsible for gaining and controlling access in that facility.

2. All access requirements must be included on the Contractor Authorization form. Critical information includes a list of keys and/or access cards required. In addition, access to more secure areas shall be explicitly requested. Secure areas may require additional scrutiny. Work in secure areas will not commence until all necessary approvals have been obtained. More secure areas may include private offices, inventory rooms, mechanical areas, data rooms, etc. In most cases keys or access cards required to do work in the outlying buildings will be the responsibility of the Maintenance Technician or Construction Inspector. Keys or access cards needed for work in the City Hall Complex will be checked out by the Information Center, once approved.

D. Contractors

Contractors shall abide by City Security Policy and Procedures at all times during the scope of their participation in a project. Failure to comply will result in the contracted employee being escorted from the premises, and the resulting lost time and expense shall be deducted from the contractor's invoice or penalties of $50.00 per occurrence as determine by the contracting City agent/official.

1. All access should be arranged in advance through the City agent. Contractors shall enter and exit only through those doors designated by City agents (ex: the Market Street entrance to City Hall, doors established by the person responsible for access at the outlying buildings). All other exterior doors are locked and alarmed and are not to be used as delivery points unless the City agent/officials has been provided 24 hour notification to provide additional security coverage at that point while the delivery is in progress.

2. All of the contractor's employees and all of the employees of any sub-contractor shall be clearly identifiable as a contractor via uniform or clearly visible company picture ID.

3. Contractors will sign in on pre-approved forms and also wear City issued identification badges (in the City Hall Complex).

4. Keys or access cards will be signed out as necessary with approval from the City agent/official. The contractor must leave their drivers license. All keys, cards, and badges must be returned at the end of each shift before the contractor's driver license will be returned. Failure to do so will result in a $50.00 penalty for each occurrence.

5. Contractors shall not ask custodians or mechanics to unlock doors. All access should be provided in advance through the City agent/official. In the rare case where access is not provided, the City Hall operator may be contacted to assist in providing access. The contractor shall cooperate with security personnel at all times. The contractor should be prepared to allow searches of equipment when leaving and should remain only in the areas designated on the sign-in sheets. Security will question a contractor who has an identification badge that indicates a work area other than the area he or she is in.

6. If the contractor requires use of the loading dock in Upper Parking, 24 hour advanced notice shall be given to the City agent/official to make arrangements to provide additional security coverage while the delivery is in progress. The contractor or subcontractor shall meet the delivery driver and take delivery at that point. At no time shall a driver be allowed in the

facilities without following the access procedure stated above.

7. If after hours work is required in the outlying buildings, all subcontractors and trades will arrange appropriate security and lock-up procedures with the contractor, in advance and in writing to the satisfaction of the City agent. Any work completed at night shall be left “open” for City inspection of the work. The contractor shall notify the City agent/official 24 hours in advance of after-hours work in writing, indicating the type of work to be done and the security measures to be taken by the contractor.

8. The contractor shall provide plywood door and window closures during construction to secure the structure from weather and damage from vandalism. The contractor is responsible to maintain the security of the space they are working during construction to the satisfaction of DPW-BRIDGES AND BUILDINGS and the City agent (if different).

9. If proper notification is not provided to the contractor, the subcontractor or trades shall be liable for any subsequent damage/vandalism/inspection cost etc. due to lack of security/inspection coordination.

10. Use of City materials is strictly prohibited unless pre-arranged through the City employee contact.

11. At no time shall any interior doors that control access or exterior doors be propped open.

3. TEMPORARY OR TRIAL USAGE:

The owner shall have the right to make temporary or trial usage of any mechanical device, machinery, apparatus, equipment, work, material or construction supplied under contract before final completion or acceptance of the work, and the same shall not be construed as evidence of acceptance of the work by the owner.

4. OCCUPANCY DURING CONSTRUCTION:

The owner will occupy the premises while work is in progress. Contractor is to coordinate his work as to not interfere with the owner's operation or compromise building security.

5. TEMPORARY HOISTS, LIFTS:

Contractors and subcontractors requiring hoists or lifts shall provide their own and remove upon completion of work.

6. TEMPORARY LADDERS, SCAFFOLDS:

A. Contractors and subcontractors requiring scaffolds, chutes, and ladders shall provide their own and remove them upon completion of work.

B. Each contractor shall furnish and maintain equipment such as fixed ladders, chutes, and the like as required for proper execution of their work.

7. ELECTRICAL POWER:

A. Contractor may use existing outlets for power. Contractor is to supply his own extension cords. All current used will be provided and paid by the City of Milwaukee.

B. OSHA regulations require that employers use either ground fault circuit interrupters or an assured equipment grounding conductor problem in addition to any other regulations for equipment grounding conductors.

8. WATER:

Contractor may use existing hose bibs for water. Contractor is to supply his own hoses. Contractor's hoses shall be leak free and contractor is to regulate the flow to limit it to project related use. The cost of the water will be paid for by the City.

9. TOILET FACILITIES:

Contractor may use existing toilet facilities in the building but will then be responsible to ensure that the facility is kept in a sanitary condition.

10. PARKING:

Contractor is responsible for parking of vehicles. No parking areas will be provided by the City.

11. BARRICADES AND SIGNAGE:

Contractor is to provide barricades and signage as required by OSHA and City/State Codes for their work.

12. CONSTRUCTION REFERENCE AND STORAGE AREA:

The contractor is to provide desks or other suitable surfaces for himself, his subcontractors, and the City Project Inspector for the purpose of viewing plans, project manuals, and other construction related documents. The contractor is also to provide filing cabinets or document boxes or other suitable containers for himself, his subcontractors, and the City Project Inspector for the purpose of storing plans, project manuals, shop drawings, and other construction related documents that he is required by this contract to keep on site.

END OF SECTION

SECTION 01600: MATERIALS AND EQUIPMENT

1. SCOPE:

   A. Index:

      1. Scope
      2. Materials
      3. Equipment
      4. Hazardous Material Requirements
      5. Material Storage
      6. Protection
      7. Revisions

2. MATERIALS:

   A. Furnish materials of the type, qualities, and characteristics specified. The specification of a trade name and catalog number is intended to establish quality, type, character, and operating characteristics of the material required. Materials by other manufacturers of equal specifications will be accepted, excepting as may be specifically stated otherwise.

   B. Materials shall be delivered adequately protected, in merchantable condition, and in original unbroken packages if normally packaged. They shall be stored and handled so as to protect and maintain their merchantable condition.

   C. The Commissioner of Public Works or his representative shall have the right to reject material not in compliance with the project manual, as well as damaged material, and the contractor shall remove such material from the construction site when and as directed.

3. EQUIPMENT:

   A. Internal combustion engine and compressor shall be equipped with mufflers to reduce noise to a minimum and shall not be operated in enclosed areas without adequate ventilation.

   B. All materials and work procedures used shall be in accordance with all air pollution control regulations in effect at the work site.

4. HAZARDOUS MATERIAL REQUIREMENTS:

   A. The requirements set forth in the OSHA Hazard Communication Standard, 29CFR19101.1200, U.S. Environmental Protection Agency (EPA), and Wisconsin Department of Natural Resources in the Wisconsin Administrative Code NR600, shall be met by each on-site contractor.

      1. Material Safety Data Sheets (M.S.D.S.):

         a. All contractors, which may/may not include the City of Milwaukee, shall provide the M.S.D.S. for all hazardous chemicals to which any person may be exposed at the work site.

b. A master list will be kept in the office of the Project Supervisor/Construction Manager and updated as materials are delivered.

2. Container Labeling:

a. Each container of hazardous material at the work site shall be clearly labeled with:

(1) Identity of the hazardous chemical(s).

(2) Appropriate hazard warning(s).

(3) Name and address of the manufacturer.

B. The City of Milwaukee reserves the right to stop the work of a contractor if compliance with OSHA regulations is inadequate. Work will not proceed until all applicable safety and health procedures are implemented by the contractor.

5. MATERIAL STORAGE:

A. The storage areas shall be kept in good order and free of all rubbish and debris.

B. Coordinate the delivery and storage of all materials and equipment with the BRIDGES AND BUILDINGS Section Project Inspector.

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

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

E. Store with seals and labels intact and legible.

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

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

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

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

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

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

6. PROTECTION:

A. The premises and the work shall be adequately protected from damage from the commencement of work to the date of final acceptance.

B. All construction work and traffic shall remain within the construction area.

C. All damage shall be corrected or repaired by the contractor or contractors causing same at his or their own expense.

D. All open pipes, pipe threads, fittings, and insulation must be protected during construction.

7. REVISIONS:

The right is reserved to make modifications to a reasonable extent as building conditions may require, or as may be required to conform to code rulings, or manufacturer's standards without extra cost to the City.

END OF SECTION

SECTION 01700: CLEANING AND PROJECT CLOSE-OUT

1. SCOPE:

A. Index:

1. Scope
2. General
3. Safety Cleaning
4. Progress Cleaning
5. Disposal
6. Final Cleaning
7. Charges
8. Record Drawings
9. Operating Instructions and Maintenance Manuals
10. Guarantees

2. GENERAL:

Article 2.5.4 of the General Requirements of City of Milwaukee Department of Public Works shall be supplemented as specified hereinafter.

3. SAFETY CLEANING:

Safety cleaning: Each contractor is responsible for safety cleaning, which includes but is not limited to the following:

A. Keep work areas, passageways, ramps, stairs, free of debris and scrap.

B. Form and scrap lumber shall have nails withdrawn or bent over and lumber shall be stacked or removed.

C. Remove spills of oil, grease, or other liquids immediately or sprinkle with sand.

D. Hazardous material shall be handled in accordance with Section 01600. Each container of hazardous material at the work site shall be clearly labeled with:

a. Identity of the hazardous chemical(s).

b. Appropriate hazard warning(s).

4. PROGRESS CLEANING:

A. Prime Contractor and subcontractor shall remove his rubbish and debris from building site promptly upon its accumulation, and prior to the contractor's regular Friday general clean up. Contractor shall perform broom cleaning of all appropriate surfaces each Friday afternoon.

B. Combustible waste shall be stored in fire resistive containers and disposed of regularly.

C. Oily, flammable or hazardous wastes such as caustics, acids, harmful dusts, etc., shall be stored in appropriate covered containers.

D. All solvents and cleaners used on this project must be rated as containing low or no volatile organic compounds (VOC's).

5. DISPOSAL:

A. No burning of rubbish or debris will be allowed at site. No rubbish shall be thrown through opening or from heights without proper protection. Where dust will be generated or flying debris is likely to occur, provide dust tight chutes or other means to control dust.

B. Containers: Contractor shall provide mobile industrial type waste containers in the number and size required, placed at adequate locations to handle debris or provide other methods of disposing of debris.

C. Oil, flammable or hazardous wastes such as, but not limited to, caustics, acids, harmful dusts, etc., shall be placed in properly marked containers as necessary and disposed of at a site designed for such wastes.

6. FINAL CLEANING:

A. Immediately prior to substantial completion.

B. Contractors shall expedite or perform thorough cleaning, sweeping, washing and polishing of work to remove from work and equipment provided under his contract, all foreign matter, spots and soil, so as to put all such work and equipment, including finishes, in a complete and finished condition ready for acceptance and use intended.

C. The contractor is responsible for final sweeping and dusting not covered by other subcontractors. This general cleaning shall include all areas and floors of the building, including the site outside the building.

D. All solvents and cleaners used on this project must be rated as containing low or no volatile organic compounds (VOC's).

7. CHARGES:

A. If prime contractors do not remove rubbish or clean building as specified above, owner reserves right to have work done by others at contractor's expense.

B. Employees of the owner who are required to clean up any rubbish or to sweep any floors will record all hours involved to complete such work. The cost incurred by the owner for this special cleaning and sweep-up work shall be charged against the contract price of the contractor as determined by owner.

8. RECORD DRAWINGS:

A. At the completion of work and prior to final payment, the contractor shall provide DPW BRIDGES AND BUILDINGS SECTION with three (3) marked up sets of prints showing all changes or variations from contract drawings, and not specified on change order drawings theretofore issued.

B. Other contractors shall provide one (1) marked up set of prints showing all changes or variations from contract drawings.

C. Drawings shall show complete layout of revised piping, equipment, etc., as actually installed.

9. OPERATING INSTRUCTIONS AND MAINTENANCE MANUALS:

A. The contractor shall, upon completion of all work, furnish the necessary skilled labor to instruct City personnel in the operation, adjustment, and maintenance of all equipment furnished.

B. At termination of work, the contractor shall submit maintenance and operating manuals presenting full details of care and maintenance and operation of mechanical and electrical equipment of every nature. See specific requirements in relevant sections as applicable.

C. The manual shall include manufacturer's instructions for maintenance and operation and shall be completely indexed, including the spare parts list. See specific requirements in relevant sections.

D. Submit three (3) final copies in hard bound cover to DPW BRIDGES AND BUILDINGS.

10. GUARANTEES:

A. Each contractor shall guarantee to replace or repair promptly at his own expense, as directed by the Commissioner of Public Works or his agent, all workmanship or materials in which defects may develop within one (1) year from the date of final acceptance of his work. This guarantee includes all damage done to the City due to faulty equipment, poor installation or poor construction.

B. Guarantee periods other than the one year time period are indicated in specific specification sections.

END OF SECTION

SECTION 01740 - WARRANTY

PART 1 - GENERAL

1. RELATED DOCUMENTS

   A. Drawings and general provisions of the Contract, including General and other Division 1 Specification sections, apply to work of this section.

   B. Related Sections

      1. Section 01300 - Submittals

2. WARRANTY

   A. Provide special written warranties or guarantees or both for products, equipment, systems and installations required by other sections of Contract Documents for duration indicated.

   B. Provide manufacturer's warranties or guarantees or both for products, equipment, systems and installations required by other sections of Contract Documents for duration indicated.

      1. Where manufacturer's standard warranties or guarantees or both expire before duration required by other sections of Contract Documents, obtain and pay for extensions as part of Contract Price.

   C. Provide warranties or guarantees or both prior to final payment.

      1. Provide in electronic data format

         a. Coordinate with Owner.

   D. Warranties or guarantees or both required by Contract Documents shall commence on date of Substantial Completion of Work, or designated portion thereof, unless otherwise indicated in Certificate of Substantial Completion.

3. SUBMITTALS

   A. Contract Closeout Information

      1. Fully executed and notarized Project Warranty.
      2. Transmittal letter indicating Owner's receipt of electronic data format containing product equipment and system warranties or guarantees or both required by other sections for the Contract Document.

4. JOB CONDITIONS

   A. If for any reason, Contractor cannot warrant or guarantee or both any portion of Work using products or construction methods indicated or required by other sections of Contract Documents, notify Architect in writing during bid period, and before contracts are awarded, indicating reasons and names of products and data on substitutions that can be warranted or guaranteed or both.

      1. Should Contractor fail to notify Engineer/Architect, Contractor will be considered as

having agreed to warrant or guarantee or both for Work indicated.

PART 2 - PRODUCTS

NOT USED

PART 3 – EXECUTION

1. PROJECT WARRANTY

A. Execute and provide notarized Project Warranty on form furnished at end of section.
   1. Provide Contractor's name, address, signature and date.
   2. Notarial Act and notarization: Warranty document is required to be signed, dated, and sealed with Notary Public seal or stamp in accordance with state and territorial notary laws.

2. PRODUCT, EQUIPMENT AND SYSTEM WARRANTIES AND GUARANTEES

A. Compile approved warranties and guarantees or both required by other sections of Contract Documents.

B. Index by specification section, with each warranty, guarantee, or both clearly labeled.
   1. Identify each volume with Project name and contents.

C. Identify each warranty or guarantee or both in manner consistent with names and identification numbers used in Contract Documents.

D. Provide transmittal letter containing:
   1. Date
   2. Project title
   3. Contractor's name and address
   4. Title and number of warranties, guarantees, or both
   5. Indication of Owner's receipt

E. Deliver to Owner prior to final payment with copy of transmittal letter indicating Owner's receipt.

END OF SECTION

SECTION 03 05 05 - CONCRETE TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Contractor requirements for testing of concrete and grout.
   2. Definition of Owner provided testing.
   3. Acceptance criteria for concrete.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 03 21 00 - Reinforcement.
   4. Section 03 31 30 - Concrete, Materials and Proportioning.
   5. Section 04 20 00 – Unit Masonry

1.2 RESPONSIBILITY AND PAYMENT

A. Owner will hire an independent Testing Agency/Service Provider to perform the following testing and inspection and provide test results to the Engineer and Contractor.
   1. Testing and inspection of concrete and grout produced for incorporation into the work during the construction of the Project for compliance with the Contract Documents.
   2. Additional testing or retesting of materials occasioned by their failure, by test or inspection, to meet requirements of the Contract Documents.
   3. Strength testing on concrete required by the Engineer or Special Inspector when the water-cement ratio exceeds the water-cement ratio of the typical test cylinders.
   4. In-place testing of concrete as may be required by Engineer when strength of structure is considered potentially deficient.
   5. Other testing services needed or required by Contractor such as field curing of test specimens and testing of additional specimens for determining when forms, form shoring or reshoring may re removed.
   6. Owner will pay for services defined in Paragraph 1.2A.1.
   7. See Division 1.

B. Contractor shall hire a qualified testing agency to perform the following testing and provide test results to the Engineer.
   1. Testing of materials and mixes proposed by the Contractor for compliance with the Contract Documents and retesting in the event of changes.
   2. Additional testing and inspection required because of changes in materials or proportions requested by Contractor.
   3. Contractor shall pay for services defined in Paragraphs 1.2B.1. and 1.2B.2.

4. Contractor shall reimburse Owner for testing services defined in Paragraphs 1.2A.2., 1.2A.3., 1.2A.4. and 1.2A.5.
5. See Division 1.

C. Duties and Authorities of Testing Agency/Service Provider:
1. Any Testing Agency/Service Provider or agencies and their representatives retained by Contractor or Owner for any reason are not authorized to revoke, alter, relax, enlarge, or release any requirement of Contract Documents, nor to reject, approve or accept any portion of the Work.
2. Testing Agency/Service Provider shall inform the Contractor and Engineer regarding acceptability of or deficiencies in the work including materials furnished and work performed by Contractor that fails to fulfill requirements of the Contract Documents.
3. Testing Agency to submit test reports and inspection reports to Engineer and Contractor immediately after they are performed.
   a. All test reports to include exact location in the work at which batch represented by a test was deposited.
   b. Reports of strength tests to include detailed information on storage and curing of specimens prior to testing.
4. Owner retains the responsibility for ultimate rejection or approval of any portion of the Work.

1.3 QUALITY ASSURANCE

A. Referenced Standards:
1. American Concrete Institute (ACI):
   a. 318, Building Code Requirements for Structural Concrete.
2. ASTM International (ASTM):
   a. ASTM Cement and Concrete Reference Laboratory (CCRL).
   b. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   c. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   d. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
   e. C138, Standard Test Method for Density (Unit Weight), Yield, and Air Content (Gravimetric) of Concrete.
   f. C143, Standard Test Method for Slump of Hydraulic-Cement Concrete.
   g. C172, Standard Practice for Sampling Freshly Mixed Concrete.
   h. C173, Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
   i. C1019, Standard Test Method for Sampling and Testing Grout.
   j. C1218, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
   k. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.

B. Qualifications:
1. Contractor’s Testing Agency:
   a. Meeting requirements of ASTM E329.

b. Provide evidence of recent inspection by CCRL of NBS, and correction of deficiencies noted.

C. Use of Testing Agency and approval by Engineer of proposed concrete mix design shall in no way relieve Contractor of responsibility to furnish materials and construction in full compliance with Contract Documents.

1.4 DEFINITIONS

A. Testing Agency/Service Provider: An independent professional testing/inspection firm or service hired by Contractor or by Owner to perform testing, inspection or analysis services as directed, and as provided in the Contract Documents.

1.5 SUBMITTALS

A. Shop Drawings:
1. See Division 1 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
a. Concrete materials and concrete mix designs proposed for use.
1) Include results of all testing performed to qualify materials and to establish mix designs.
2) Place no concrete until approval of mix designs has been received in writing.
3) Submittal for each concrete mix design to include:
a) Sieve analysis and source of fine and coarse aggregates.
b) Test for aggregate organic impurities.
c) Proportioning of all materials.
d) Type of cement with mill certificate for the cement.
e) Brand, quantity and class of fly ash proposed for use along with other submittal data as required for fly ash by Specification Section 03 31 30.
f) Slump.
g) Brand, type and quantity of air entrainment and any other proposed admixtures.
h) Shrinkage test results.
i) Total water soluble chloride ion concentration in hardened concrete from all ingredients determined per ASTM C1218.
j) 28-day compression test results and any other data required by Specification Section 03 31 30 to establish concrete mix design.
3. Certifications:
a. Testing Agency qualifications.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION

3.1 TESTING SERVICES TO BE PERFORMED SERVICE PROVIDER/TESTING AGENCY

A. The following concrete testing will be performed by the Service Provider/Testing Agency:
   1. Concrete strength testing:
      a. Secure concrete samples in accordance with ASTM C172.
         1) Obtain each sample from a different batch of concrete on a random basis, avoiding selection of test batch other than by a number selected at random before commencement of concrete placement.
      b. For each strength test, mold and cure cylinders from each sample in accordance with ASTM C31.
         1) Record any deviations from requirements on test report.
         2) Cylinder size: Per ASTM C31.
            a) 4 IN cylinders may not be used for concrete mixes with concrete aggregate size larger than 1 IN.
         3) Quantity:
            a) 6 IN DIA by 12 IN high: Four (4) cylinders.
            b) 4 IN DIA by 8 IN high: Six (6) cylinders.
      c. Field cure one (1) cylinder for the seven (7) day test.
         1) Laboratory cure the remaining.
      d. Test cylinders in accordance with ASTM C39.
         1) 6 IN DIA cylinders:
            a) Test two (2) cylinders at 28 days for strength test result and the one (1) field cured sample at seven (7) days for information.
            b) Hold remaining cylinder in reserve.
         2) 4 IN DIA cylinders:
            a) Test three (3) cylinders at 28 days for strength test result and the one (1) field cured cylinder at seven (7) days for information.
            b) Hold remaining cylinders in reserve.
      e. Strength test result:
         1) Average of strengths of two (2) 6 IN DIA cylinders or three (3) 4 IN DIA cylinders from the same sample tested at 28 days.
         2) If one (1) cylinder in a test manifests evidence of improper sampling, molding, handling, curing, or testing, discard and test reserve cylinder(s); average strength of remaining cylinders shall be considered strength test result.
         3) Should all cylinders in any test show any of above defects, discard entire test.
      f. Frequency of tests:
         1) Concrete topping, concrete fill and lean concrete: One (1) strength test for each 10 CY of each type of concrete or fraction thereof placed.
         2) All other concrete:
            a) One (1) strength test to be taken not less than once a day, nor less than once for each 60 CY or fraction thereof placed in any one (1) day.
            b) Once for each 5000 SQ FT of slab or wall surface area placed each day

c) If total volume of concrete on Project is such that frequency of testing required in above paragraph will provide less than five (5) strength tests for each concrete mix, tests shall then be made from at least five (5) randomly selected batches or from each batch if fewer than five (5) batches are provided.

2. Slump testing:
   a. Determine slump of concrete sample for each strength test.
      1) Determine slump in accordance with ASTM C143.
   b. If consistency of concrete appears to vary, the Engineer or Owner's Representative shall be authorized to require a slump test for each concrete truck.
      1) This practice shall continue until three consecutive batches are determined to be consistent and meet the slump requirements specified.
3. Air content testing: Determine air content of concrete sample for each strength test in accordance with either ASTM C231, ASTM C173, or ASTM C138.
4. Temperature testing: Determine temperature of concrete sample for each strength test.
5. In-place concrete testing (if required).

3.2 SAMPLING ASSISTANCE AND NOTIFICATION FOR OWNER

A. To facilitate testing and inspection, perform the following:
   1. Furnish any necessary labor to assist Testing Agency in obtaining and handling samples at site.
   2. Provide and maintain for sole use of Testing Agency adequate facilities for safe storage and proper curing of test specimens on site for first 24 HRS as required by ASTM C31.
   3. Take samples at point of placement.

B. Notify Owner's Testing Agency sufficiently in advance of operations (minimum of 24 hours) to allow completion of quality tests for assignment of personnel and for scheduled completion of quality tests.

3.3 ACCEPTANCE

A. Completed concrete work which meets applicable requirements will be accepted without qualification.

B. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance will be accepted without qualification.

C. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Contract Documents.
   1. In this event, modifications may be required to assure that concrete work complies with requirements.
   2. Modifications, as directed by Engineer, to be made at no additional cost to Owner.

D. Dimensional Tolerances:
   1. Formed surfaces resulting in concrete outlines smaller than permitted by tolerances shall be considered potentially deficient in strength and subject to modifications required by Engineer.
   2. Formed surfaces resulting in concrete outlines larger than permitted by tolerances may be rejected and excess material subject to removal.
      a. If removal of excess material is permitted, accomplish in such a manner as to maintain strength of section and to meet all other applicable requirements of function and appearance.
   3. Concrete members cast in wrong location may be rejected if strength, appearance or function of structure is adversely affected or misplaced items interfere with other construction.
   4. Inaccurately formed concrete surfaces exceeding limits of tolerances and which are exposed to view, may be rejected.
      a. Repair or remove and replace if required.
   5. Finished slabs exceeding tolerances may be required to be repaired provided that strength or appearance is not adversely affected.
      a. High spots may be removed with a grinder, low spots filled with a patching compound, or other remedial measures performed as permitted or required.

E. Appearance:
   1. Concrete surfaces exposed to view with defects which, in opinion of Engineer, adversely affect appearance as required by specified finish shall be repaired by approved methods.
   2. Concrete not exposed to view is not subject to rejection for defective appearance unless, in the opinion of the Engineer, the defects impair the strength or function of the member.

F. High Water-Cement Ratio:
   1. Concrete with water in excess of the specified maximum water-cement ratio will be considered potentially deficient in durability.
   2. Remove and replace concrete with high water-cement ratio or make other corrections as directed by Engineer.

G. Strength of Structure:
   1. Strength of structure in place will be considered potentially deficient if it fails to comply with any requirements which control strength of structure, including but not necessarily limited to following:
      a. Low concrete strength:
         1) Test results for standard molded and cured test cylinders to be evaluated separately for each mix design.
            a) Such evaluation shall be valid only if tests have been conducted in accordance with specified quality standards.
            b) For evaluation of potential strength and uniformity, each mix design shall be represented by at least three (3) strength tests.
            c) A strength test shall be the average of two (2) 6 IN diameter cylinders or three (3) 4 IN diameter cylinders from the same sample tested at 28 days.
         2) Acceptance:
            a) Strength level of each specified compressive strength shall be considered satisfactory if both of the following requirements are met:

(1) Average of all sets of three (3) consecutive strength tests equal or exceed the required specified 28-day compressive strength.
(2) No individual strength test falls below the required specified 28-day compressive strength by more than 500 psi.

b. Reinforcing steel size, configuration, quantity, strength, position, or arrangement at variance with requirements in Specification Section 03 21 00 or requirements of the Contract Drawings or approved Shop Drawings.
c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.
d. Curing time and procedure not meeting requirements of this Specification Section.
e. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
f. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
g. Concrete defects such as voids, honeycomb, cold joints, spalling, cracking, etc., likely to result in deficient strength or durability.

2. Structural analysis and/or additional testing may be required when strength of structure is considered potentially deficient.
3. In-place testing of concrete may be required when strength of concrete in place is considered potentially deficient.
   a. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer to determine relative strengths at various locations in the structure or for selecting areas to be cored.
      1) Such tests shall not be used as a basis for acceptance or rejection.
   b. Core tests:
      1) Where required, test cores will be obtained in accordance with ASTM C42.
         a) If concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 DegF, relative humidity less than 60 percent) for seven (7) days before test then test dry.
         b) If concrete in structure will be wet or subjected to high moisture atmosphere under service conditions, test cores after immersion in water for at least 40 HRS and test wet.
         c) Testing wet or dry to be determined by Engineer.
      2) Three (3) representative cores may be taken from each member or area of concrete in place that is considered potentially deficient.
         a) Location of cores shall be determined by Engineer so as least to impair strength of structure.
         b) If, before testing, one (1) or more of cores shows evidence of having been damaged subsequent to or during removal from structure, damaged core shall be replaced.
      3) Concrete in area represented by a core test will be considered adequate if average strength of three (3) cores is equal to at least 85 percent of specified strength and no single core is less than 75 percent of specified strength.
      4) Fill core holes with nonshrink grout and finish to match surrounding surface when exposed in a finished area.
4. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm safety of structure, load tests may be required and their results evaluated in accordance with ACI 318, Chapter 20.

5. Correct or replace concrete work judged inadequate by structural analysis or by results of core tests or load tests with additional construction, as directed by Engineer, at Contractor's expense.
6. Contractor to pay all costs incurred in providing additional testing and/or structural analysis required.

END OF SECTION

SECTION 03 11 13 - FORMWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Formwork requirements for concrete construction.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 116R, Cement and Concrete Terminology.
      b. 347, Guide to Formwork for Concrete.
   2. Building code:
      a. International Code Council (ICC):
         1) International Building Code and associated standards, 2009 Edition including all amendments, referred to herein as Building Code.

B. Qualifications:
   1. Formwork, shoring and reshoring to be designed by a professional structural engineer currently registered in the state where the Project is located and having a minimum of three (3) years experience in this type of design work.
      a. Above qualifications apply to slabs and beams not cast on the ground, wall and column pours over 15 FT high.

C. Miscellaneous:
   1. Design and engineering of formwork, shoring and reshoring as well as its construction is the responsibility of the Contractor.
   2. Design requirements:
      a. Design formwork for loads, lateral pressures and allowable stresses outlined in ACI 347 and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local Building Code.
         1) Where conflicts occur between the above two (2) standards, the more stringent requirements shall govern.
      b. Design formwork to limit maximum deflection of form facing materials reflected in concrete surfaces exposed to view to 1/240 of span between structural members.

1.3 DEFINITIONS

A. Words and terms used in these Specifications are defined in ACI 116R.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Division 1 for the requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Manufacturer and type of proposed form materials.
      d. Manufacturer and type of proposed form ties.
      e. Manufacturer and type of proposed form coating material.
      f. Manufacturer and type of void forms including compressive strength.

B. Samples:
   1. A 12 IN SQ sample of each of the following form finishes.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Void forms:
      a. SureVoid Products, Inc.
      b. Deslauriers, Inc.
   2. Stay-in-place forms:
      a. Alabama Metal Industries Corporation.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Forms for Surfaces Exposed to View:
   1. Wood forms:
      a. New 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.
      b. Built-in-place or prefabricated type panel.
      c. 4 x 8 FT sheets for built-in-place type except where smaller pieces will cover entire area.
      d. When approved, plywood may be reused.
   2. Metal forms:
      a. Metal forms excluding aluminum may be used.
      b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.

B. Forms for Surfaces Not Exposed to View:
   1. Wood or metal sufficiently tight to prevent leakage.
   2. Do not use aluminum forms.

2.3 ACCESSORIES

A. Form Ties:
   1. Commercially fabricated for use in form construction.
      a. Do not use wire ties.
   2. Constructed so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete.
   3. 3/4 IN minimum to 1 IN maximum diameter cones on both ends.
   4. Embedded portion of ties to be not less than 1-1/2 IN from face of concrete after ends have been removed.

B. Void Forms:
   1. Continuous void forms.
   2. Specially designed and manufactured for the purpose of creating a void area directly under concrete members which will allow a space for soil vertical upward movement.
   3. Able to support the weight of concrete and construction loads to be placed thereon with no decrease in required void form depth.
   4. Constructed from double faced corrugated cardboard or fiberboard which is wax impregnated and laminated with moisture-resistant adhesive.
   5. Capable of resisting moisture with no loss of load carrying strength or change in depth or configuration.

C. Stay-In-Place Forms:
   1. Ribbed expanded metal leave-in-place concrete forms commercially fabricated to provide an intentionally rougher surface.
   2. Hot-dipped galvanized.
   3. Alabama Metal Industries Corporation "Stay-Form."

PART 3 - EXECUTION

3.1 PREPARATION

A. Form Surface Treatment:
   1. Before placing of either reinforcing steel or concrete, cover surfaces of forms with an approved coating material that will effectively prevent absorption of moisture and prevent bond with concrete, will not stain concrete or prevent bonding of future finishes.
      a. A field applied form release agent or sealer of approved type or a factory applied nonabsorptive liner may be used.
   2. Do not allow excess form coating material to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.

B. Provide temporary openings at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed, and to limit height of free fall of concrete to prevent aggregate segregation.
   1. Temporary openings to limit height of free fall of concrete shall be spaced no more than 8 FT apart.

C. Clean surfaces of forms, reinforcing steel and other embedded materials of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.

3.2 ERECTION

A. Install products in accordance with manufacturer's instructions.

B. Tolerances:
   1. Variation from plumb:
      a. In lines and surfaces of columns, piers, walls, and in risers.
         1) Maximum in any 10 FT of height: 1/4 IN.
         2) Maximum for entire height: 1/2 IN.
      b. For exposed corner columns, control-joint grooves, and other exposed to view lines:
         1) Maximum in any 20 FT length: 1/4 IN.
         2) Maximum for entire length: 1/2 IN.
   2. Variation from level or from grades specified:
      a. In slab soffits, ceilings, beam soffits and in arises, measured before removal of supporting shores.
         1) Maximum in any 10 FT of length: 1/4 IN.
         2) Maximum in any bay or in any 20 FT length: 3/8 IN.
         3) Maximum for entire length: 3/4 IN.
      b. In exposed lintels, sills, parapets, horizontal grooves, and other exposed to view lines:
         1) Maximum in any bay or in 20 FT length: 1/4 IN.
         2) Maximum for entire length: 1/2 IN.
   3. Variation of linear structure lines from established position in plan and related position of columns, walls, and partitions:
      a. Maximum in any bay: 1/2 IN.
      b. Maximum in any 20 FT of length: 1/2 IN.
      c. Maximum for entire length: 1 IN.
   4. Variation in sizes and location of sleeves, floor openings, and wall openings: Maximum of +1/2 IN.
   5. Variation in horizontal plan location of beam, column and wall centerlines from required location: Maximum of +1/2 IN.
   6. Variation in cross sectional dimensions of columns and beams and in thickness of slabs and walls: Maximum of -1/4 IN, +1/2 IN.
   7. Footings and foundations:
      a. Variations in concrete dimensions in plan: -1/2 IN, +2 IN.
      b. Misplacement or eccentricity:
         1) 2 percent of footing width in direction of misplacement but not more than 2 IN.

c. Thickness:
   1) Decrease in specified thickness: 5 percent.
   2) Increase in specified thickness: No limit except that which may interfere with other construction.

8. Variation in steps:
   a. In a flight of stairs:
      1) Rise: +1/8 IN.
      2) Tread: +1/4 IN.
   b. In consecutive steps:
      1) Rise: +1/16 IN.
      2) Tread: +1/8 IN.
9. Establish and maintain in an undisturbed condition and until final completion and acceptance of Project, sufficient control points and bench marks to be used for reference purposes to check tolerances.
10. Regardless of tolerances listed allow no portion of structure to extend beyond legal boundary of Project.
11. To maintain specified tolerances, camber formwork to compensate for anticipated deflections in formwork prior to hardening of concrete.

C. Make forms sufficiently tight to prevent loss of mortar from concrete.

D. Place 3/4 IN chamfer strips in exposed to view corners of forms to produce 3/4 IN wide beveled edges.

E. At construction joints, overlap contact surface of form sheathing for flush surfaces exposed to view over hardened concrete in previous placement by at least 1 IN.
   1. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain a true surface.
   2. Where possible, locate juncture of built-in-place wood or metal forms at architectural lines, control joints or at construction joints.

F. Where circular walls are to be formed and forms made up of straight sections are proposed for use, provide straight lengths not exceeding 2 FT wide.
   1. Brace and tie formwork to maintain correct position and shape of members.

G. Construct wood forms for wall openings to facilitate loosening, if necessary, to counteract swelling.

H. Anchor formwork to shores or other supporting surfaces or members so that movement of any part of formwork system is prevented during concrete placement.

I. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing steel.

J. Provide positive means of adjustment (wedges or jacks) of shores and struts and take up all settlement during concrete placing operation.
   1. Securely brace forms against lateral deflection.
   2. Fasten wedges used for final adjustment of forms prior to concrete placement in position after final check.

K. Void Forms:
   1. After void forms are in place and before concrete is placed thereon, cover joints between abutting form sections and cover ends of forms to prevent intrusion of soil, concrete or any other materials.
   2. Install void forms in accordance with manufacturer's instructions.

3.3 REMOVAL OF FORMS

A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads places thereon.

B. When required for concrete curing in hot weather, required for repair of surface defects or when finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations or lack of support.

C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging.
   1. Perform any needed repairs or treatment required on such sloping surfaces at once, followed by curing specified in Specification Section 03 31 31.

D. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete.

E. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.

F. Where no reshoring is planned, leave forms and shoring used to support weight of concrete in place until concrete has attained its specified 28 day compressive strength.
   1. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.

G. When shores and other vertical supports are so arranged that non-load-carrying form facing material may be removed without loosening or disturbing shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.

3.4 RESHORING

A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.

B. While reshoring is underway, no superimposed dead or live loads shall be permitted on the new construction.

C. During reshoring do not subject concrete in structural members to combined dead and construction loads in excess of loads that structural members can adequately support.

D. Place reshores as soon as practicable after stripping operations are complete but in no case later than end of working day on which stripping occurs.

E. Tighten reshores to carry their required loads without overstressing.

F. Shoring, reshoring and supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.

G. For floors supporting shores under newly placed concrete leave original supporting shores in place or reshore.
   1. Reshoring system shall have a capacity sufficient to resist anticipated loads.
   2. Locate reshores directly under a shore position above.

H. In multi-story buildings, extend reshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms, and construction live loads in such a manner that design superimposed loads of floors supporting shores are not exceeded.

END OF SECTION

SECTION 03 21 00 - REINFORCEMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Reinforcing bar requirements for concrete construction.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. SP 66, ACI Detailing Manual.
      b. 318, Building Code Requirements for Structural Concrete.
   2. ASTM International (ASTM):
      a. A185, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
      b. A497, Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete.
      c. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
      d. A706, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
      e. A775, Standard Specification for Epoxy-Coated Steel Reinforcing Bars.
      f. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
   3. American Welding Society (AWS):
      a. D1.4, Structural Welding Code - Reinforcing Steel.
   4. Concrete Reinforcing Steel Institute (CRSI):
      a. Manual of Standard Practice.

B. Qualifications:
   1. Welding operators, processes and procedures to be qualified in accordance with AWS D1.4.
   2. Welding operators to have been qualified during the previous 12 months prior to commencement of welding.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Division 1 for requirements for the mechanics and administration of the submittal process.

2. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Manufacturer's installation instructions.
    c. Mill certificates for all reinforcing.
    d. Manufacturer and type of proprietary rebar mechanical splices.
    e. Manufacturer and type of rebar adhesive anchor including installation instructions.
3. Qualifications of welding operators, welding processes and procedures.
4. Rebar number, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and rebar supports.
5. Sufficient rebar details to permit installation of reinforcing.
6. Rebar details in accordance with ACI SP 66.
7. Locations where proprietary rebar mechanical splices are required or proposed for use.
8. Shop Drawings shall be in sufficient detail to permit installation of reinforcing without reference to Contract Drawings.
    a. Shop Drawings shall not be prepared by reproducing the plans and details indicated on the Contract Drawings but shall consist of completely redrawn plans and details as necessary to indicate complete fabrication and installation of all reinforcing steel.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Support and store all reinforcing above ground.

B. Ship to jobsite with attached plastic or metal tags with permanent mark numbers which match the Shop Drawing mark numbers.

C. Handling of Epoxy-Coated Rebar:
1. Use padded or nonmetallic slings and padded straps to protect coated reinforcement from damage.
2. Handle bundled bars to prevent sagging that could damage the coating.
3. Do not drop or drag rebars.
4. Store on wooden cribbing.
5. Coated rebars subject to rejection by Engineer if rebar coating has been damaged.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Rebar adhesive anchors:
    a. HIT-HY200 System by HILTI FASTENING SYSTEMS, INC.
    b. Epcon Adhesive Anchoring System by ITW Ramset/Red Head.
    c. Power-Fast by Powers Fastening, Inc.
2. Rebar mechanical splices:
    a. Lenton Rebar Splicing by Erico, Inc.
    b. Richmond dowel bar splicer system by Richmond Screw and Anchor Co., Inc.

c. Bar-Grip Systems by Barsplice Products, Inc.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Reinforcing Bars: ASTM A615, grade 60, deformed.

B. Reinforcing Bars to be Welded: ASTM A706.

C. Welded Wire Reinforcement: ASTM A185, ASTM A497 or ASTM A1064.

D. Smooth Dowel Bars: ASTM A615, grade 60 with metal end cap to allow longitudinal movement equal to joint width plus 1 IN.

E. Epoxy-Coated Rebars: ASTM A775 and ASTM A615, Grade 60, meeting Annex A1 for epoxy coating.

F. Epoxy-Coated Rebar Patching Material:
1. Compatible with the coating material.
2. Inert in concrete.
3. Meet requirements of Annex A1 of ASTM A775.
4. Obtained from the manufacturer of the epoxy resin that was used to originally coat the rebars.

G. Proprietary Rebar Mechanical Splices: To develop in tension and compression a minimum of 125 percent of the yield strength of the rebars being spliced.

H. Welding Electrodes:
1. E90 meeting requirements of AWS D1.4.

I. Rebar Adhesive Anchors:
1. Manufactured for the specific purpose of embedding and developing 125 percent of the yield strength of rebars in hardened concrete.

2.3 ACCESSORIES

A. Metal Chairs, Runners, Bolsters, Spacers, Hangers, and Other Rebar Supports:
1. Plastic-coated tips in contact with forms.
2. Plastic coating meeting requirements of CRSI Manual of Standard Practice.

B. Protective plastic caps at mechanical splices.

2.4 FABRICATION

A. Tolerances:
1. Sheared lengths: +1 IN.
2. Overall dimensions of stirrups, ties and spirals: +1/2 IN.
3. All other bends: +0 IN, -1/2 IN.

B. Minimum diameter of bends measured on the inside of the rebar to be as indicated in ACI 318 Paragraph 7.2.

C. Ship rebars to jobsite with attached plastic or metal tags.
   1. Place on each tag the mark number of the rebar corresponding to the mark number indicated on the Shop Drawing.
   2. Mark numbers on tags to be so placed that the numbers cannot be removed.
   3. For epoxy-coated rebars, use only plastic tags secured to rebars by nylon or plastic ties.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Tolerances:
   1. Rebar placement:
      a. Clear distance to formed surfaces: +1/4 IN.
      b. Minimum spacing between bars: -1/4 IN.
      c. Top bars in slabs and beams:
         1) Members 8 IN deep or less: +1/4 IN.
         2) Members between 8 IN and 2 FT deep: -1/4 IN, +1/2 IN.
         3) Members more than 2 FT deep: -1/4 IN, +1 IN.
      d. Crosswise of members: Spaced evenly within +1 IN.
      e. Lengthwise of members: +2 IN.
   2. Minimum clear distances between rebars:
      a. Beams, walls and slabs: Distance equal to rebar diameter or 1 IN, whichever is greater.
      b. Columns: Distance equal to 1-1/2 times the rebar diameter or 1-1/2 IN, whichever is greater.
      c. Beam and slab rebars shall be threaded through the column vertical rebars without displacing the column vertical rebars and still maintaining the clear distances required for the beam and slab rebars.

B. Minimum concrete protective covering for reinforcement: As shown on Drawings.

C. Minimum concrete protective covering for reinforcement, unless indicated otherwise on Drawings:
   1. Interior surfaces:
      a. 1-1/2 IN for beams and columns/pedestals.
      b. 3/4 IN for slabs and walls.

D. Unless indicated otherwise on Drawings, provide splice lengths for reinforcing as follows:
   1. For rebars: Class B splice meeting the requirements of ACI 318, Paragraph 12.15.
   2. For welded wire reinforcement:
      a. Splice lap length measured between outermost cross wires of each fabric sheet shall not be less than one (1) spacing of cross wires plus 2 IN, nor less than 1.5 x development length nor less than 6 IN.
      b. Development length shall be as required for the yield strength of the welded wire reinforcement in accordance with ACI 318, Paragraph 12.8.

3. Provide splices of reinforcing not specifically indicated or specified subject to approval of Engineer.
    a. Mechanical proprietary splice connectors may only be used when approved or indicated on the Contract Drawings.

E. Welding:
1. Welding reinforcing is not allowed.

F. Placing Rebars:
1. Assure that reinforcement at time concrete is placed is free of mud, oil or other materials that may affect or reduce bond.
2. Reinforcement with rust, mill scale or a combination of both will be accepted as being satisfactory without cleaning or brushing provided dimensions and weights including heights of deformations on a cleaned sample is not less than required by applicable ASTM specification that governs for the rebar supplied.
3. Rebar support:
    a. Uncoated rebar:
        1) Support rebars and fasten together to prevent displacement by construction loads or placing of concrete.
            a) Locate and support reinforcement with bar supports to maintain minimum concrete cover.
            b) Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
        2) Rebar supported on ground:
            a) Slab on grade and other members with only one mat of reinforcing:
                (1) Provide metal bar supports with bottom plate.
                (2) Do not use concrete blocks to support slab-on-grade reinforcing.
            b) All other members: Provide supporting concrete blocks or metal bar supports with bottom plate.
        3) Rebar supported on formwork:
            a) Concrete surfaces in contact with or over process liquid: 100 percent non-metallic, non-corrosive chairs.
            b) All other formed surfaces:
                (1) Provide plastic-coated metal chairs, runners, bolsters, spacers, hangers and other rebar support.
                (2) Only tips in contact with the forms need to be plastic coated.
    b. Coated rebar:
        1) Support coated rebars and fasten together to prevent displacement.
        2) Use plastic or nylon ties to hold rebars rigidly in place.
        3) Support rebars by use of plastic or plastic-coated chairs, runners, bolsters, spacers, hangers and rebar supports as required.
4. Support rebars over cardboard void forms by means of concrete supports which will not puncture or damage the void forms during construction nor impair the strength of the concrete members in any way.
5. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, rebars in the upper layers shall be placed directly above rebars in the bottom layer with clear distance between layers to be 1 IN.
    a. Place spacer rebars at 3 FT maximum centers to maintain the required 1 IN clear distance between layers.

6. Extend reinforcement to within 2 IN of concrete perimeter edges.
    a. If perimeter edge is formed by earth or stay-in-place forms, extend reinforcement to within 3 IN of the edge.
7. To assure proper placement, furnish templates for all column vertical bars and dowels.
8. Do not bend reinforcement after embedding in hardened concrete unless approved by Engineer.
    a. Do not bend reinforcing by means of heat.
9. Do not tack weld reinforcing.
10. Embed rebars into hardened concrete utilizing adhesive anchor system specifically manufactured for such installation:
    a. Drill hole in concrete with diameter and depth as required to develop 125 percent of the yield strength of the bar according to manufacturer's requirements.
    b. Clean holes per manufacturer's recommendations.
    c. Place adhesive in drilled hole.
    d. Insert rebar into hole and adhesive in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL

A. Reinforcement Congestion and Interferences:
    1. Notify Engineer whenever the specified clearances between rebars cannot be met.
    2. Do not place any concrete until the Engineer submits a solution to rebar congestion problem.
    3. Rebars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.
    4. If rebars are moved more than one bar diameter, obtain Engineer's approval of resulting arrangement of rebars.
    5. No cutting of rebars shall be done without written approval of Engineer.

B. Inspection of Epoxy-Coated Rebars:
    1. Coated rebars will be inspected on the jobsite for handling defects, coating abrasion, coating thickness and continuity of coating.
    2. Engineer may defer final inspection of rebar coating integrity and repairs until the rebars have been erected and all handling is completed.
    3. Repair coated areas as directed by Engineer.
        a. Do not place concrete until all repairs to coatings have been completed.

C. Patching of Epoxy-Coated Rebar:
    1. Patching and repair to be performed in accordance with the instructions of patching material manufacturer.
    2. Patching material to provide a minimum film thickness of 5 mils over the bare area.
        a. Thickness of area adjacent to patched area not to exceed 15 mils.
    3. Areas to be patched to be clean and free of surface contaminants.
        a. Treat areas in accordance with patching material manufacturer's instructions before oxidation occurs.

4. Total surface area covered by patching material not to exceed 2 percent of total surface area of the rebar.
5. Rebar welds and adjacent bare rebar areas to also be patched after welding is completed.

D. Employ a testing laboratory to perform and report following:
1. Review and approve Contractor proposed welding procedures and processes for conformance with AWS D1.4.
2. Qualify welders in accord with AWS D1.4.
3. Test three (3) samples of each bar size and each type of weld in accord with AWS D1.4.
   a. The tensile strength of each test shall be not less than 125 percent of the required yield strength of the rebar tested.
4. Conduct nondestructive field tests (radiographic or magnetic particle) on not less than one (1) random sample for each 10 welds.
   a. In addition if any welds are found defective, test five (5) previous welds performed by same welder.
5. Visually inspect each weld for presence of cracks, undercuts, inadequate size and other visible defects.

END OF SECTION

SECTION 03 31 30 - CONCRETE, MATERIALS AND PROPORTIONING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete materials, strengths and proportioning for concrete work.
   2. Grouting:
      a. Base plates for columns and equipment.
      b. Dowels and anchors into concrete.
      c. Patching cavities in concrete.
      d. As specified and indicated in the Contract Document.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 03 05 05 - Testing.
   4. Section 03 41 33 - Precast and Prestressed Concrete.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 116R, Cement and Concrete Terminology.
      b. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
      c. 212.3R, Chemical Admixtures for Concrete.
      d. 318, Building Code Requirements for Structural Concrete.
      e. 350, Code Requirements for Environmental Engineering Concrete Structures.
   2. ASTM International (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
      c. C94/C94M, Standard Specification for Ready-Mixed Concrete.
      d. C150, Standard Specification for Portland Cement.
      e. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete.
      f. C192, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
      g. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
      h. C494, Standard Specification for Chemical Admixtures for Concrete.
      i. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

3. Corps of Engineers (COE):
   a. CRD-C621, Standard Specification for Packaged, Dry, Hydraulic-Cement Grout (NonShrink).

1.3 DEFINITIONS

A. Words and terms used in these Specifications are defined in ACI 116R.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Division 1 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's instructions.
      c. Concrete mix designs as required by Specification Section 03 05 05.
      d. Manufacturer and type of proposed admixtures.
      e. Manufacturer and type of proposed nonshrink grout and grout cure/seal compound.
   3. Certifications:
      a. Certification of standard deviation value in psi for ready mix plant supplying the concrete.
      b. Certification that the fly ash meets the quality requirements stated in this Specification Section, and fly ash supplier's certified test reports for each shipment of fly ash delivered to concrete supplier.
      c. Certification that the class of coarse aggregate meets the requirements of ASTM C33 for type and location of concrete construction.
      d. Certification of aggregate gradation.
   4. Test reports: Cement mill reports for all cement to be supplied.

1.5 DELIVERY, STORAGE AND HANDLING

A. Storage of Materials:
   1. Store cement and pozzolan in weathertight buildings, bins, or silos which will exclude moisture and contaminants.
   2. Arrange aggregate stockpiles and use in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of like aggregates.
   3. Allow natural sand to drain until it has reached a relatively uniform moisture content before use.
   4. Store admixtures in such a manner as to avoid contamination, evaporation, or damage.
      a. For those used in form of suspensions or non-stable solutions, provide agitating equipment to assure thorough distribution of ingredients.
      b. Protect liquid admixtures from freezing and temperature changes which would adversely affect their characteristics and performance.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Submit request for substitution in accordance with Division 1.

2.2 MATERIALS

A. Cement:
1. ASTM C150, Type II.
2. Cement type used shall correspond to that upon which selection of concrete proportions was based in the mix design.

B. Fly Ash:
1. ASTM C618, Class F or Class C.
2. Non-staining.
3. Suited to provide hardened concrete of uniform light gray color.
4. Maximum loss on ignition: 4 percent.
5. Compatible with other concrete ingredients and having no deleterious effects on the hardened concrete.
6. Produced by source approved by WisDOT for use in concrete for bridges.
7. Cement and fly ash type used shall correspond to that upon which selection of concrete proportions was based in the mix design.

C. Admixtures:
1. Air entraining: ASTM C260.
2. Water reducing, retarding, and accelerating: Conform to ASTM C494, Types A through E, and provisions of ACI 212.3R.
3. High range water reducers (superplasticizers): Conform to ASTM C494, Types F or G.
4. Admixtures to be chloride free.
   a. Do not use calcium chloride.
5. Provide admixtures of same type, manufacturer and quantity as used in establishing required concrete proportions in the mix design.

D. Water:
1. Potable.
2. Clean and free from deleterious substances.
3. Free of oils, acids and organic matter.

E. Aggregates for Normal Weight Concrete:
1. ASTM C33.
2. Fine and coarse aggregates to be regarded as separate ingredients.
3. Fine aggregates to be natural, not manufactured.

4. Coarse aggregate sieve analysis:
    a. For lean concrete, concrete topping, and integral wearing course: ASTM C33, size number 7 (maximum 1/2 IN).
    b. For all other concrete: ASTM C33, size number 57 (maximum 1 IN).
5. Provide aggregates approved for bridge construction by the State Highway Department in the State where the Project is located.
6. Pozzolan or other additives shall not be used to compensate for alkali reactivity of aggregates.

F. Maximum total chloride ion content for concrete mix including all ingredients measured as a weight percent of cement:
    1. All concrete: 0.10.

G. Sand Cement Grout:
    1. Approximately three (3) parts sand, one (1) part Portland cement, 6 $\pm$1 percent entrained air and water to produce a slump which allows grout to completely fill required areas and surround adjacent reinforcing.
        a. Provide sand in accordance with requirements for fine aggregate for concrete.
    2. Minimum 28 day compressive strength: 3000 psi.

H. Nonshrink Grout:
    1. Nonshrink, nonmetallic, noncorrosive, and nonstaining.
    2. Premixed with only water to be added in accordance with manufacturer's instructions at jobsite.
    3. Grout to produce a positive but controlled expansion.
        a. Mass expansion shall not be created by gas liberation or by other means.
    4. Minimum 28 day compressive strength: 6500 psi.
    5. Acceptable manufacturers:
        a. BASF Admixtures, Inc. “Masterflow, 713 Plus”.
        b. Euclid Chemical "NS Grout".
        c. Sauereisen Cements “F-100 Level Fill Grout”.
        d. U.S. Grout “Five Star Grout”.
        e. Set Products, Inc. “Set NonShrink Grout”.
        f. The Upco Corp “Upcon”.
        g. L&M “Crystex”.
        h. Sika Corporation "Sika Grout 212".
    6. In accordance with COE CRD-C621.

I. Epoxy Grout:
    1. Three-component epoxy resin system:
        a. Two (2) liquid epoxy components.
        b. One (1) inert aggregate filler component.
    2. Adhesive acceptable manufacturers:
        a. BASF “Masterflow 648 CP”.
        b. Exxon Chemical Company “Escoweld 2505.”
        c. Sika “Sikadur Hi-Mod.”
        d. U.S. Grout “Five Start Epoxy Grout."
        e. Euclid Chemical “E3-G.”

3. Aggregate acceptable manufacturers:
   a. BASF “Masterflow 648 CP”.
   b. Exxon Chemical Company “Escoweld 2510.”
   c. Sika aggregate.
   d. U.S. Grout aggregate.
   e. Euclid Chemical “Euclid aggregate.”
4. Aggregate manufacturer shall be the same as the adhesive manufacturer.
5. The aggregate shall be compatible with the adhesive.
6. Each component furnished in separate package for mixing at jobsite.

2.3 MIXES

A. General:
   1. Provide concrete capable of being placed without aggregate segregation and, when cured, of developing all properties specified.
   2. Ready-mixed concrete shall conform to ASTM C94/C94M.
   3. All concrete to be normal weight concrete, weighing approximately 145 to 150 LBS per cubic foot at 28 days after placement.

B. Minimum 28 Day Compressive Strengths:

Normal weight all other concrete	4500 psi
Normal weight concrete pavements	5000 psi

C. Air Entrainment:
   1. Provide air entrainment in all concrete resulting in a total air content percent by volume as follows:
      a. 1-1/2 IN maximum aggregate size: 4-1/2 to 6-1/2 percent total air content.
      b. 1 IN maximum aggregate size: 5 to 7 percent total air content.
      c. 3/4 IN maximum aggregate size: 5 to 7 percent total air content.
      d. 1/2 IN maximum aggregate size: 5-1/2 to 8 percent total air content.
      e. Interior slabs and mats with power trowel finish: Maximum 3 percent total air content.

D. Slump:
   1. Walls and columns:
      a. 8 IN maximum, 4 IN minimum measured at the point of discharge into the concrete member.
      b. Slump shall be obtained by use of mid-range or high-range water reducer in accordance with ASTM C494.
   2. All other members: 6 IN maximum, 2 IN minimum measured at point of discharge into the concrete construction member.
   3. Concrete of lower than minimum slump may be used provided it can be properly placed and consolidated.

4. Provide additional water or water reducing admixture at ready mix plant for concrete that is to be pumped to allow for slump loss due to pumping.
   a. Provide only enough additional water so that slump of concrete at discharge end of pump hose does not exceed maximum slump specified and the maximum specified water-cement ration is not exceeded.
5. Slump may be adjusted in the field through the use of water reducers.
   a. Coordinate dosage and mixing requirements with concrete supplier.

E. Proportioning:
1. General:
   a. Proportion ingredients to produce a mixture which will work readily into corners and angles of forms and around reinforcement by methods of placement and consolidation employed without permitting materials to segregate or excessive free water to collect on surface.
   b. Proportion ingredients to produce proper placability, durability, strength and other required properties.
2. Normal weight concrete minimum cement contents and maximum water cement ratios:

SPECIFIED STRENGTH (PSI)	MINIMUM CEMENT (LBS/CY)	MAXIMUM WATER CEMENT RATIO BY WEIGHT
4500	611*	0.42
5000	611*	0.45

* If fly ash is proposed for use, the weight of fly ash plus weight of Portland cement shall equal these values.

3. Fly ash:
   a. For cast-in-place concrete only, a maximum of 25 percent by weight of Portland cement content per cubic yard may be replaced with fly ash at a rate of 1 LB fly ash for 1 LB cement.
   b. If fly ash is used, the water to fly ash plus cement ratio not to exceed the maximum water cement ratio specified in this Specification Section.
4. Water reducing, retarding, and accelerating admixtures:
   a. Use in accordance with manufacturer's instructions.
   b. Do not use unless required by these specifications or approved for use by Engineer.
5. High range water reducers (superplasticizers):
   a. Use in accordance with manufacturer's instructions.
   b. Do not use unless required by these Specifications or approved for use by Engineer.
6. Concrete mix proportioning methods for normal weight concrete:
   a. Method 1:
      1) Used when combination of materials proposed is to be evaluated and proportions selected to be on a basis of trial mixes.

2) Produce mixes having suitable proportions and consistencies based on ACI 211.1, using at least three (3) different water cement ratios or cement contents which will produce a range of compressive strengths encompassing the required average strength.
3) Design trial mixes to produce a slump within 0.75 IN of maximum specified, and for air entrained concrete, air content within 0.5 percent specified.
4) For each water cement ratio or cement content, make at least three (3) compression test cylinders for specified test age, and cure in accordance with ASTM C192.
   a) Test for strength at 28 days in accordance with ASTM C39.
5) From results of these tests, plot a curve showing relationship between water cement ratio or cement content and compressive strength.
6) From this curve select water cement ratio or cement content to be used to produce required average strength.
7) Use cement content and mixture proportions such that maximum water cement ratio is not exceeded when slump is maximum specified.
8) Base field control on maintenance of proper cement content, slump, air content and water cement ratio.
9) See paragraph hereafter for definition of required average strength.

b. Method 2:
1) In lieu of trial mixes, field test records for concrete made with similar ingredients may be used.
2) Use of proposed concrete mix proportions based on field test records subject to approval by Engineer based on information contained in field test records and demonstrated ability to provide the required average strength.
3) Field test records to represent materials, proportions and conditions similar to those specified.
   a) Changes in the materials, proportions and conditions within the test records shall have not been more restricted than those for the proposed concrete mix.
   b) Field test records shall meet the requirements of ACI 318 Paragraph 5.3.1.
4) Required concrete proportions may be established by interpolation between the strengths and proportions of two (2) or more test records each of which meets the requirements of this Specification Section.

7. Required average strength to exceed the specified 28 day compressive strength by the amount determined or calculated in accordance with Paragraph 5.3 of ACI 318 using the standard deviation of the proposed concrete production facility as described in Paragraphs 5.3.1 and 2 of ACI 318.

F. Allowable Shrinkage: 0.048 percent per ASTM C157.

2.4 SOURCE QUALITY CONTROL

A. To assure stockpiles are not contaminated or materials are segregated, perform any test for determining conformance to requirements for cleanness and grading on samples secured from aggregates at point of batching.

B. Do not use frozen or partially frozen aggregates.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Perform concrete tests per Specification Section 03 05 05.
   1. Perform a strength test on all concrete to which water or superplasicizer, above the amount stated in the approved concrete mix design, has been added.
      a. Perform sampling after water or superplasticizer has been added and additional mixing has been performed.

B. Perform strength test on any concrete to which water has been added at the jobsite.

END OF SECTION

SECTION 03 31 31 - CONCRETE MIXING, PLACING, JOINTING, AND CURING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mixing, placing, jointing, and curing of concrete construction.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 03 05 05 - Testing.
   4. Section 03 11 13 - Formwork.
   5. Section 03 21 00 - Reinforcement.
   6. Section 03 31 30 - Concrete, Materials and Proportioning.
   7. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
   8. Section 07 26 00 - Under Slab Vapor Retarder.
   9. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 116R, Cement and Concrete Terminology.
      b. 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
      c. 304.2R, Placing Concrete by Pumping Methods.
      d. 305R, Hot Weather Concreting.
      e. 306R, Cold Weather Concreting.
      f. 308R, Guide to Curing Concrete.
      g. 309R, Guide for Consolidation of Concrete.
   2. ASTM International (ASTM):
      a. C94/C94M, Standard Specification for Ready-Mixed Concrete.
      b. C156, Standard Test Method for Water Loss (from a Mortar Specimen) Through Liquid Membrane-Forming Curing Compounds for Concrete.
      c. C171, Standard Specification for Sheet Materials for Curing Concrete.
      d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
      e. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
      f. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
      g. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
   3. Corps of Engineers (COE):
      a. CRD-C572, Specifications for Polyvinylchloride Waterstop.

4. National Ready Mixed Concrete Association (NRMCA):
   a. Checklist for Certification of Ready Mixed Concrete Production Facilities.
5. NSF International (NSF).

B. Qualifications:
   1. Ready Mixed Concrete Batch Plant: Certified by NRMCA.

1.3 DEFINITIONS

A. Words and terms used in this Specification Section are defined in ACI 116R.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Division 1 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
         1) Procedure for adding high-range water reducer at the jobsite.
      c. Scaled (minimum 1/8 IN per foot) drawings showing proposed locations of construction joints and joint keyway dimensions.
      d. Manufacturers and types:
         1) Joint fillers.
         2) Curing agents.
         3) Construction joint bonding adhesive.
         4) Pressure relief valves.
         5) Waterstops.
   3. Certifications:
      a. Ready mix concrete plant certification.
      b. Waterstops: Products shipped meet or exceed the physical properties specified.

B. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Copies of concrete delivery tickets.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery:
   1. Concrete:
      a. Prepare a delivery ticket for each load of ready mixed concrete.
      b. Truck operator shall hand ticket to Contractor at the time of delivery.
      c. Ticket to show:
         1) Mix identification.
         2) Quantity delivered.
         3) Amount of material in each batch.
         4) Outdoor temperature in the shade.

5) Time at which cement was added
6) Time of delivery.
7) Time of discharge.
8) Amount of water that may be added at the site without exceeding the specified water-cement ratio.
9) Amount of water added at the site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 COMPONENTS

A. Neoprene Expansion Joint Fillers:
1. Acceptable manufacturers:
a. Permaglaze.
b. Rubatex.
c. Williams Products.
2. Materials:
a. Closed cell neoprene.
b. ASTM D1056, Type 2, Class C.
c. Compression deflection: As required to limit deflection to 25 percent of joint thickness under pressure from concrete pour height.

B. Asphalt Expansion Joint Fillers:
1. Acceptable manufacturers:
a. J and P Petroleum Products.
2. Materials: ASTM D994.

C. Fiber Expansion Joint Fillers:
1. Materials: ASTM D1751.

D. Waterstops, PVC Type:
1. Acceptable manufacturers:
a. Greenstreak Plastic Products.
b. Vinylex Corporation.
2. Materials:
a. Virgin polyvinyl chloride compound not containing any scrap or reclaimed materials or pigment.
b. Standard: COE CRD-C572.
3. In expansion joints:
a. 9 IN wide by 3/8 IN thick tear web type waterstop.
b. 2 IN minimum horizontal movement without rupturing.
c. Greenstreak Plastic Products Style #700.

4. In joints as indicated on Drawings:
    a. 4 IN wide by 3/16 IN thick bulb type waterstop.
    b. Greenstreak Plastic Products Style #701.
5. In all other joints:
    a. 6 IN wide by 3/8 IN thick with ribs and center bulb.
    b. Greenstreak Plastic Products Style #705, #679 or #783.
6. Provide hog rings or grommets at maximum 12 IN OC along the length of the waterstop.
7. Provide factory-made waterstop fabrications at all changes in direction, intersections and transitions, leaving only straight butt splices for the field.

E. Waterstops, Preformed Strip Type:
1. Acceptable manufacturers:
    a. Hydrotite CJ by Greenstreak Plastics, Inc.
    b. Adeka Ultra Seal USA.
2. Materials:
    a. Hydrophilic type waterstop manufactured solely for the purpose of preventing water from traveling through construction joints.
    b. Hydrotite type CJ-0725-3K.

F. Bonding Agent:
1. Acceptable manufacturers:
    a. L&M Construction Chemicals, Inc.
    b. Sika.
    c. Euclid Chemical Co.
2. Materials:
    a. Latex: ASTM C1059, Type II.
    b. Epoxy: ASTM C881, Type V.

G. Vapor Retarder: See Specification Section 07 26 00.

H. Sand cement grout, non-shrink grout and epoxy grout: See Specification Section 03 31 30.

PART 3 - EXECUTION

3.1 PREPARATION

A. General:
1. Complete formwork.
    a. See Specification Section 03 11 13.
2. Remove earth, snow, ice, water, and other foreign materials from areas that will receive concrete.
3. Secure reinforcement in place.
    a. See Specification Section 03 21 00.
4. Position expansion joint material, anchors and other embedded items.
5. Obtain approval of reinforcement erection and placement prior to placing concrete.

6. Do not place concrete during rain, sleet, or snow, unless adequate protection is provided and approval is obtained.
    a. Plan size of crews with due regard for effects of concrete temperature and atmospheric conditions on rate of hardening of concrete as required to obtain good surfaces and avoid unplanned cold joints.
    b. Do not allow rainwater to increase mixing water nor to damage surface finish.
7. Prepare all construction joints for proper bond per the Construction Joints - Bonding Paragraph in PART 3 of this Specification Section.
8. Coat all construction joints with an approved bonding material, before new concrete is placed.
    a. Apply proprietary bonding adhesive in accordance with manufacturer's instructions.
9. Remove hardened concrete and foreign materials from inner surfaces of conveying equipment and formwork.
10. Provide slabs and beams of minimum indicated required depth when sloping structural foundation base slabs and elevated slabs to drains.
    a. For floor slabs on grade, slope top of subgrade to provide slab of required uniform thickness.

B. Preparation of Subgrade for Slabs On Ground:
1. Subgrade drained and of adequate and uniform load-bearing nature.
2. Obtain approval of subgrade compaction density prior to placing slabs on ground.
3. Maintain subgrade at a temperature above 32 DegF before concrete placing begins for a sufficient amount of time to remove frost.
4. Moisten subgrade to eliminate absorption.
    a. Keep subgrade moist at time of concreting.
    b. Allow no free-standing water on subgrade or soft or muddy spots when concrete is placed.

C. Edge Forms and Screeds:
1. Set accurately to produce designated elevations and contours of finished surface.
2. Sufficiently strong to support vibrating screeds or roller pipe screeds, if required.
3. Use strike off templates, or approved vibrating type screeds, to align concrete surfaces to contours of screed strips.

3.2 CONCRETE MIXING

A. General:
1. Provide all concrete from a central plant conforming to Checklist for Certification of Ready Mixed Concrete Production Facilities of the NRMCA.
2. Batch, mix, and transport in accordance with ASTM C94/C94M.

B. Control of Admixtures:
1. Charge admixtures into mixer as solutions.
    a. Measure by means of an approved mechanical dispensing device.
    b. Liquid considered a part of mixing water.
    c. Admixtures that cannot be added in solution may be weighed or measured by volume if so recommended by manufacturer.

2. Add separately, when two or more admixtures are used in concrete, to avoid possible interaction that might interfere with efficiency of either admixture, or adversely affect concrete.
3. Complete addition of retarding admixtures within one minute after addition of water to cement has been completed, or prior to beginning of last three quarters of required mixing, whichever occurs first.

C. Tempering and Control of Mixing Water:
1. Mix concrete only in quantities for immediate use.
2. Discard concrete which has set.
3. Discharge concrete from ready mix trucks within time limit and drum revolutions stated in ASTM C94/C94M.
4. Addition of water at the jobsite:
   a. See Specification Section 03 31 30 for specified water cement ratio and slump.
   b. Do not exceed maximum specified water cement ratio or slump.
   c. Incorporate water by additional mixing equal to at least half of total mixing required.
   d. Perform strength test on any concrete to which water has been added at the jobsite.
      1) See Specification Section 03 05 05.

3.3 PLACING OF CONCRETE

A. General:
1. Comply with ACI 304R and ACI 304.2R.
2. Deposit concrete:
   a. Continuously to avoid cold joints.
   b. In layers of 12 to 18 IN.
3. Locate construction joints at locations approved by Engineer.
   a. Plan size of crews with due regard for effects of concrete temperature and atmosphere conditions to avoid unplanned cold joints.
4. Place concrete at such a rate that concrete, which is being integrated with fresh concrete, is still workable.
5. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
6. Spreaders:
   a. Temporary: Remove as soon as concrete placing renders their function unnecessary.
   b. Embedded:
      1) Obtain approval of Engineer.
      2) Materials: Concrete or metal.
      3) Ends of metal spreaders coated with plastic coating 2 IN from each end.
7. Deposit concrete as nearly as practicable in its final position to avoid segregation.
   a. Maximum free fall: 4 FT.
   b. Free fall exceeding 4 FT: Place concrete by means of hopper, elephant trunk or tremie pipe extending down to within 4 FT of surface placed upon.
8. Perform the following operations before bleeding water has an opportunity to collect on surface:
   a. Spread.

b. Consolidate.
c. Straightedge.
d. Darby or bull float.

B. Admixtures:
1. All admixtures to be introduced at the batch plant in accordance with manufacturer's recommendations.

C. Cold Weather Concrete Placement:
1. Comply with ACI 306R.
2. Do not place concrete on substrates that are below 32 DegF or contain frozen material.
3. Maintain all materials, forms, reinforcement, subgrade and any other items which concrete will come in contact with free of frost, ice or snow at time of concrete placement.
4. Temperature of concrete when discharged at site:

AIR TEMPERATURE DEGF	MINIMUM CONCRETE TEMPERATURE, DEG F FOR SECTIONS WITH LEAST DIMENSION LESS THAN 12 IN	MINIMUM CONCRETE TEMPERATURE, DEG F FOR SECTIONS WITH LEAST DIMENSION 12 IN OR GREATER
30 to 45	60	55
0 to 30	65	55
below 0	70	60

5. Heat subgrade, forms, and reinforcement so the temperature of the subgrade, forms, and reinforcement will be between 45 and 70 DegF, when temperature of surrounding air is 40 DegF or below at time concrete is placed.
   a. Remove all frost from subgrade, forms and reinforcement before concrete is placed.
6. Combine water with aggregate in mixer before cement is added, if water or aggregate is heated above 90 DegF.
7. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 90 DegF.
8. Do not place slabs on ground if temperature is below 40 DegF or if temperature surrounding the slab will be below 40 DegF before structure is enclosed and heated.

D. Hot Weather Concrete Placement:
1. Comply with ACI 305R.
2. Cool ingredients before mixing, or add flake ice or well crushed ice of a size that will melt completely during mixing for all or part of mixing water if high temperature, low slump, flash set, cold joints, or shrinkage cracks are encountered.
3. Temperature of concrete when placed:
   a. Not to exceed 90 DegF.
   b. Not so high as to cause:
      1) Shrinkage cracks.
      2) Difficulty in placement due to loss of slump.
      3) Flash set.

4. Temperature of forms and reinforcing when placing concrete:
    a. Not to exceed 90 DegF.
    b. May be reduced by spraying with water to cool below 90 DegF.
        1) Leave no standing water to contact concrete being placed.

E. Consolidating:
1. Consolidate in accordance with ACI 309R except as modified herein.
2. Consolidate by vibration so that concrete is thoroughly worked around reinforcement, embedded items and into corners of forms.
    a. Eliminate:
        1) Air or stone pockets.
        2) Honeycombing or pitting.
        3) Planes of weakness.
3. Internal vibrators:
    a. Minimum frequency of 8000 vibrations per minute.
    b. Insert and withdraw at points approximately 18 IN apart.
        1) Allow sufficient duration at each insertion to consolidate concrete but not sufficient to cause segregation.
    c. Use in:
        1) Beams and girders of framed slabs.
        2) Columns and walls.
    d. Size of vibrators shall be in accordance with ACI 309R, Table 5.1.5.
4. Obtain consolidation of slabs with internal vibrators, vibrating screeds, roller pipe screeds, or other approved means.
5. Do not use vibrators to transport concrete within forms.
6. Provide spare vibrators on jobsite during all concrete placing operations.
7. Bring a full surface of mortar against form by vibration supplemented if necessary by spading to work coarse aggregate back from formed surface, where concrete is to have an as-cast finish.
8. Use suitable form vibrators located just below top surface of concrete, where internal vibrators cannot be used in areas of congested reinforcing.
9. Prevent construction equipment, construction operations, and personnel from introducing vibrations into freshly placed concrete after the concrete has been placed and consolidated.

F. Handle concrete from mixer to place of final deposit by methods which will prevent segregation or loss of ingredients and in a manner which will assure that required quality of concrete is maintained.
1. Use truck mixers, agitators, and non-agitating units in accordance with ASTM C94/C94M.
2. Horizontal belt conveyors:
    a. Mount at a slope which will not cause segregation or loss of ingredients.
    b. Protect concrete against undue drying or rise in temperature.
    c. Use an arrangement at discharge end to prevent segregation.
    d. Do not allow mortar to adhere to return length of belt.
    e. Discharge conveyor runs into equipment specially designed for spreading concrete.
3. Metal or metal lined chutes:
    a. Slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal.

b. Chutes more than 20 FT long and chutes not meeting slope requirements may be used provided they discharge into a hopper before distribution.
c. Provide end of each chute with a device to prevent segregation.

4. Pumping or pneumatic conveying equipment:
   a. Designed for concrete application and having adequate pumping capacity.
   b. Control pneumatic placement so segregation is avoided in discharged concrete.
   c. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 1-1/2 IN.
   d. Do not convey concrete through pipe made of aluminum or aluminum alloy.
   e. Provide pumping equipment without Y sections.

G. Placing of Concrete on Metal Deck:
1. Prior to concrete placement, the metal deck shall be free of soil, debris, standing water, loose mill scale, and all other foreign matter.
2. Care shall be exercised when placing concrete so that the deck will not be subject to construction loads or impact that exceed the design capacity of the deck.
3. Concrete shall be placed in a uniform manner and spread toward the center of the deck span.
4. If buggies are used to place concrete, runways shall be planked, and the buggies shall only operate on planking.
   a. Planks shall be of adequate stiffness to transfer loads to the steel supports without damaging the deck.
5. Deck damage caused by careless placement of concrete shall be repaired or replaced.

3.4 JOINTS AND EMBEDDED ITEMS

A. Construction Joints - General:
1. Locate joints as indicated on Contract Drawings or as shown on approved Shop Drawings.
   a. Where construction joint spacing shown on Drawings exceeds the joint spacing indicated in Paragraph B. below, submit proposed construction joint location in conformance with this Specification Section.
2. Unplanned construction joints will not be allowed.
   a. If concrete cannot be completely placed between planned construction joints, then it must be removed.
3. In general, locate joints near middle of spans of slabs, beams and girders unless a beam intersects a girder at this point, in which case, offset joint in girder a distance equal to twice the width of the beam.
4. Locate joints in walls and columns at underside of floors, slabs, beams, or girders, and at tops of foundations or floor slabs, unless shown otherwise.
   a. At Contractor's option, beam pockets may be formed into concrete walls.
   b. Size pockets to allow beam reinforcing to be placed as detailed on Drawings.
5. Place beams, girders, column capitals and drop panels at same time as slabs.
6. Place corbels monolithically with walls.
   a. Locate wall vertical construction joints midway between corbels.
   b. Where only a single corbel is located place it also monolithically with wall and locate wall vertical construction joint a minimum of 3 FT from face of corbel.

7. Make joints perpendicular to main reinforcement with all reinforcement continuous across joints.
8. Provide roughened construction joints at all construction joints unless indicated otherwise on Drawings.
    a. Clean the previously hardened concrete interface and remove all laitance.
    b. Intentionally roughen the interface to a full amplitude of 1/4 IN.
    c. Provide recessed flat surface as required to install strip type waterstops.
9. Provide continuous keyways only where indicated on Drawings.
    a. Construction joint keyways shall have the following dimensions, unless shown otherwise on Drawings or directed otherwise by Engineer.
    b. Construction joint keyways in walls:
        1) Keyway width, not less than 1/3 and not more than 1/2 the wall thickness measured perpendicular to wall faces.
        2) Keyway depth to be not less than 1-1/2 IN.
        3) Place keyway in wall center unless shown otherwise on Drawings.
    c. Construction joint keyways in footings, foundations, base slabs, and structural or elevated slabs:
        1) Keyway height not less than 1/3 and not more than 1/2 the footing or slab thickness.
        2) Keyway depth not less than 1-1/2 IN.
        3) Keyway in footing or slab center unless shown otherwise on Drawings.
    d. Construction joint keyways in beams:
        1) Keyway height not less than 1/3 and not more than 1/2 the beam depth.
        2) Keyway depth not less than 1-1/2 IN.
        3) Keyway in beam center unless shown otherwise on Drawings.
10. Allow a minimum of 48 HRS before placement of adjoining concrete construction.

B. Construction Joints - Spacing:
1. General - Structures not intended to contain liquid:
    a. Wall vertical construction joints:
        1) 60 FT maximum centers.
        2) At wall intersections, 30 FT maximum from corner.
    b. Wall horizontal construction joints: 20 to 25 FT centers.
    c. Base slab, floor, and roof slab construction joints:
        1) Placements to be approximately square and not to exceed 3500 SF.
        2) Maximum side dimension of a slab pour to be less than:
            a) Twice the length of the short side.
            b) 80 FT.
2. Structures intended to contain liquids:
    a. Wall vertical construction joints:
        1) 30 FT maximum centers.
        2) At wall intersections, 15 feet maximum from corner.
    b. Wall horizontal construction joints: 12 to 18 centers.
    c. Walls that are thicker than 18 IN may be poured less than 30 feet tall in one (1) pour provided the following requirements are satisfied:
        1) A test wall of similar size, height and thickness will be poured to demonstrate the quality of the concrete work.
        2) The test wall will be located as a portion of a non-water bearing wall.
            a) The test wall will include a waterstop at the bottom of the wall.

b) Alternatively, a separate test wall, not part of the final work, may be constructed.

3) The concrete placement and concrete quality of the test wall will be observed by the Engineer.

a) Concrete will be judged on the following:

(1) Ability to keep bottom of the pour clean and free from trash and debris.

(2) Ability to protect the waterstop from folding over due to the force of falling concrete.

(3) Ability to properly consolidate all concrete in the wall pour, including below formed openings.

4) Engineer will evaluate the Contractor's work and may recommend taller concrete wall pours if concrete quality is acceptable.

5) Preparation for all subsequent wall pours over 18 feet tall must be the same as the preparation of the test wall.

6) Should the quality of concrete work on subsequent wall pours be judged inadequate, the Contractor may be directed to limit wall pour heights to 18 feet as originally specified.

7) Should the quality of concrete work on the test wall be judged inadequate, additional test walls will not be observed and judged to allow pour heights greater that 18 FT unless allowed by Engineer.

d. Base slab, floor, and roof slab construction joints:

1) Placements to be approximately square and not to exceed 2000 SF.

2) Maximum side dimension of a slab pour to be less than:

a) Twice the length of the short side.

b) 60 feet.

C. Construction Joints - Bonding:

1. Obtain bond between concrete pours at construction joints by thoroughly cleaning and removing all laitance from construction joints.

a. Before new concrete is placed, all construction joints shall be coated with cement grout, or dampened.

1) General: Use cement grout or dampening for all construction joints.

2. Roughened construction joints:

a. Roughen the surface of the concrete to expose the aggregate uniformly

b. Remove laitance, loosened particles of aggregate or damaged concrete at the surface, or at the Contractor's option, use an approved chemical retarder which delays but does not prevent setting of the surface of the mortar in accordance with the manufacturer's recommendations.

1) Retarded mortar shall be removed within 24 HRS after placing to produce a clean exposed aggregate bonding surface.

c. Cover the hardened concrete of horizontal joints with a coat of cement grout of similar proportions to the concrete, except substitute fine aggregate for coarse aggregate.

3. Other keyed construction joints:

a. Thoroughly clean construction joints and remove all laitance.

b. Dampen the hardened concrete (but do not saturate) immediately prior to placing of fresh concrete.

D. Locate control joints in slabs on grade as indicated on Drawings.

1. Time cutting properly with set of concrete, if saw cut joints are required or permitted.
    a. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates being dislodged by saw.
    b. Complete before shrinkage stresses become sufficient to produce cracking.

E. Expansion Joints:
1. Do not permit reinforcement or other embedded metal items bonded to concrete (except smooth dowels bonded on only one side of joint) to extend continuously through an expansion joint.
2. Use neoprene expansion joint fillers, unless noted otherwise on Drawings.
3. Seal expansion joints as shown on Drawings.
    a. See Specification Section 07 92 00 for requirements.

F. Waterstops:
1. Preformed strip type:
    a. Install on smooth surface of hardened concrete by use of nails, adhesive or other means as recommended by manufacturer to prevent movement of waterstop during placement of concrete.
    b. Waterstop to be continuous with splices in accordance with manufacturer's instructions.
    c. Use in joints against existing concrete and where indicated on Drawings.
2. PVC type:
    a. Position waterstop accurately in forms.
    b. Secure waterstops in correct position using hog rings or grommets spaced along the length of waterstop and tie wire to adjacent reinforcing.
    c. Hold horizontal waterstops in place with continuous supports.
    d. Install according to manufacturer's instructions.
        1) Do not displace reinforcement from required location.
    e. Waterstops to be continuous.
    f. Splice ends with perpendicular butt splice using electrical splicing iron in accordance with manufacturer's instructions.
    g. Unless otherwise noted, use for all construction joints in new construction for all structures indicated on Drawings.

G. Other Embedded Items:
1. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for its support, prior to initiating concreting.
2. Do not place electrical conduit, drains, or pipes in or thru concrete slabs, walls, columns, foundations, beams or other structural members unless approved by Engineer.

H. Placing Embedded Items:
1. Position expansion joint material, waterstops, and other embedded items accurately.
2. Support against displacement.
3. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent entry of concrete into voids.
4. Provide adequate means for anchoring waterstop in concrete.
    a. Provide means to prevent waterstops in the forms from being folded over by the concrete as it is placed.

b. Work concrete under the waterstops by hand, so as to avoid the formation of air and rock pockets, when placing roof and floor slab concrete around waterstops.

3.5 FINISHING

A. See Specification Section 03 35 00.

B. Coordinate mixing and placing with finishing.

3.6 INSTALLATION OF GROUT

A. Grout Schedule of Use:
1. Sand cement grout:
   a. Fill keyways if precast HCU.
   b. General use.
2. Non-shrinking non-metallic grout:
   a. Filling form tie holes.
   b. Under column and beam base plates.
   c. Other uses indicated on the Drawings.
3. Epoxy grout:
   a. Patching cavities in concrete.
   b. Grouting of dowels and anchor bolts into existing concrete.
   c. Grouting of equipment base plates where driving motor is 500 HP and above.
   d. Other uses indicated on the Drawings.

B. Grout Installation:
1. Sand cement grout:
   a. Fill keyways between precast concrete hollow core slabs with sand cement grout.
   b. Consolidate grout by rodding or by other means to assure complete filling of keyways.
   c. Cure grout by one of methods specified.
2. Non-shrink non-metallic grout:
   a. Clean concrete surface to receive grout.
   b. Saturate concrete with water for 24 HRS prior to grouting.
   c. Mix in a mechanical mixer.
   d. Use no more water than necessary to produce flowable grout.
   e. Place in accordance with manufacturer's instructions.
   f. Provide under beam, column, and equipment base plates, in joints between precast concrete filter slabs, and in other locations indicated on the Drawings.
   g. Completely fill all spaces and cavities below the top of base plates.
   h. Provide forms where base plates and bed plates do not confine grout.
   i. Where exposed to view, finish grout edges smooth.
   j. Except where a slope is indicated on the Drawings, finish edges flush at the base plate, bed plate, member or piece of equipment.
   k. Coat exposed edges of grout with cure or seal compound recommended by the grout manufacturer.
   l. Protect against rapid moisture loss by covering with wet rags or polyethylene sheets. Wet cure grout for seven (7) days minimum.

3. Epoxy grout:
    a. Mix and place in accordance with manufacturer's instructions.
    b. Apply only to clean, dry, sound surface.
    c. Completely fill all cavities and spaces around dowels and anchors without voids.
    d. Grout base and bed plates as specified for non-shrinking, non-metallic grout.
    e. Obtain manufacturer's field technical assistance as required to assure proper placement.

3.7 CURING AND PROTECTION

A. Protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury immediately after placement, and maintain with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement, hardening, and compressive strength gain.
    1. Follow recommendations of ACI 308 except as modified herein.

B. Apply one of the following curing procedures immediately after completion of placement and finishing, for concrete surfaces not in contact with forms.
    1. Ponding or continuous sprinkling.
    2. Application of absorptive mats or fabric kept continuously wet.
    3. Application of sand kept continuously wet.
    4. Continuous application of steam (not exceeding 150 DegF) or mist spray.
    5. Application of waterproof sheet materials, conforming to ASTM C171.
    6. Application of other moisture retaining covering as approved.
    7. Application of a curing compound conforming to ASTM C309.
        a. Apply curing compound in accordance with manufacturer's recommendations immediately after any water sheen which may develop after finishing has disappeared from concrete surface.
        b. Do not use on any surface against which additional concrete or other material is to be bonded unless it is proven that curing compound will not prevent bond.
        c. Where a vertical surface is cured with a curing compound, the vertical surface shall be covered with a minimum of two (2) coats of the curing compound.
            1) Apply the first coat of curing compound to a vertical surface immediately after form removal.
            2) The vertical concrete surface at the time of receiving the first coat shall be damp with no free water on the surface.
            3) Allow the preceding coat to completely dry prior to applying the next coat.
            4) A vertical surface: Any surface steeper than 1 vertical to 4 horizontal.
        d. Curing compounds used in water treatment plant construction shall be non-toxic and taste and odor free.
            1) Curing compound to be NSF approved and have a moisture loss of not more than 0.62 kg/SQ meter per ASTM C156.
                a) Atlas Tech Products Atlas Quantum-Cure.
            2) Alternately, all tank surfaces shall be sand-blasted as required to remove non-NSF approved curing compound.

C. Curing Concrete In Contact with Forms:
   1. Minimize moisture loss from and temperature gain of concrete placed in forms exposed to heating by sun by keeping forms wet and cool until they can be safely removed.
   2. After form removal, cure concrete until end of time prescribed.
      a. Use one of methods listed above.
   3. Forms left in place shall not be used as a method of curing in hot weather.
   4. The term "hot weather," where used in these specifications, is defined in ACI 305R.
   5. In hot weather, remove forms from vertical surfaces as soon as concrete has gained sufficient strength so that the formwork is no longer required to support the concrete.

D. Continue curing for at least seven (7) days for all concrete except high early strength concrete for which period shall be at least three (3) days.
   1. If one of curing procedures indicated above is used initially, it may be replaced by one of other procedures indicated any time after concrete is one (1) day old, provided concrete is not permitted to become surface dry during transition.

E. Cold Weather:
   1. Follow recommendations of ACI 306R.
   2. Maintain temperature of concrete between 50 and 70 DegF for required curing period, when outdoor temperature is 40 DegF, or less.
   3. Use heating, covering, insulating, or housing of the concrete work to maintain required temperature without injury due to concentration of heat.
   4. Do not use combustion heaters unless precautions are taken to prevent exposure of concrete to exhaust gases which contain carbon dioxide.
   5. Interior slabs in areas intended to be heated shall be adequately protected so that frost does not develop in the supporting subgrade.

F. Hot Weather:
   1. Follow recommendations of ACI 305R.
   2. Make provision for cooling forms, reinforcement and concrete, windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material.
   3. Provide protective measures as quickly as concrete hardening and finishing operations will allow.

G. Rate of Temperature Change:
   1. Keep changes in temperature of air immediately adjacent to concrete as uniform as possible, during and immediately following curing period.
   2. Do not exceed a temperature change of 5 DegF in any 1 HR or 50 DegF in any 24 HR period.

H. Protection from Mechanical Injury:
   1. Protect concrete from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration.
   2. Protect finished concrete surfaces from damage by construction equipment, materials, or methods, and by rain or running water.
   3. Do not load self supporting structures in such a way as to overstress concrete.

3.8 FIELD QUALITY CONTROL

A. Tests in accordance with Specification Section 03 05 05.
   1. Perform a strength test on all concrete to which water or superplasticizer, above the amount stated in the approved concrete mix design, has been added.
      a. Perform sampling after water or superplasticizer has been added and additional mixing has been performed.

B. Field samples of fabricated waterstop fittings (crosses, tees, etc.) will be selected at random by the Engineer for testing by a laboratory at the Owner's expense.
   1. When tested, they shall have a tensile strength across the joints equal to at least 600 psi.

END OF SECTION

SECTION 03 35 00 - CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete finishing and repair of surface defects.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 03 11 13 - Formwork.
   4. Section 03 31 30 - Concrete, Materials and Proportioning.
   5. Section 03 31 31 - Concrete Mixing, Placing, Jointing and Curing.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 116R, Cement and Concrete Terminology.
   2. ASTM International (ASTM):
      a. C150, Standard Specification for Portland Cement.
      b. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
      c. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
      d. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
      e. D4259, Standard Practice for Abrading Concrete.
   3. The Society for Protective Coatings/NACE International (SSPC/NACE):
      a. SP 13/NACE No. 6, Surface Preparation of Concrete.

B. Qualifications:
   1. Applicator of surfacer/filler must be approved, in writing, by manufacturer.
   2. Manufacturer of surfacer/filler shall have minimum of five (5) years experience in manufacturing of same with documented performance history for similar installations.
   3. Installer/applicator of surfacer/filler shall have minimum of three (3) years experience installing similar coatings and shall be licensed or approved in writing by manufacturer to install/apply this product.
   4. Applicator of concrete sealer, hardener, densifier shall be factory trained and approved, in writing, by the manufacturer to apply the product.
      a. Applicator shall have a minimum of five (5) years experience successfully applying materials specified.

1.3 DEFINITIONS

A. Vertical Surface Defects:
   1. Any void in the face of the concrete deeper than 1/8 IN, such as:
      a. Tie holes.
      b. Air pockets (bug holes).
      c. Honeycombs.
      d. Rock holes.

2. Scabbing:
    a. Scabbing is defect in which parts of the form face, including release agent, adhere to concrete.
3. Foreign material embedded in face of concrete.
4. Fins 1/16 IN or more in height.

B. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

C. Other words and terms used in this Specification Section are defined in ACI 116R.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Division 1 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Manufacturer's installation instructions.
3. Certifications:
    a. Certification of aggregate gradation.
    b. Certification that products being used will not interfere with bonding of future floor or wall finishes.

B. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's recommendations and requirements for materials used.

1.6 WARRANTY

A. Provide warranty equal to specified manufacturer's standard warranty for all products used.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Chemical floor sealer (CS-1) (CS-3):
    a. L&M Construction Chemicals, Inc.
    b. Euclid Chemical Co.
    c. Dayton Superior.
2. Bonding agents:
    a. Euclid Chemical Co.
    b. BASF Admixtures, Inc.
    c. L&M Construction Chemicals, Inc.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Chemical Floor Sealer CS-1:
   1. Colorless low VOC water-based solution containing acrylic copolymers.
      a. ASTM C1315, Class B, minimum 30 percent solids.
      b. ASTM C309, Type 1.
      c. Non-yellowing UV resistant.
      d. Capable of being painted after cured.
   2. L&M Construction Chemicals, Inc. Dress and Seal WB 30.

B. Bonding Agent:
   1. For use only on concrete surfaces not receiving liquid water repellent coating:
      a. High solids acrylic latex base liquid for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars.
      b. Euclid Chemical Co. "Flex-Con."
      c. BASF Admixtures, Inc. "Acryl-Set."
      d. L&M Construction Chemicals, Inc. "Everbond."
      e. Thoro System Products "Acryl 60."
   2. For use only on concrete surface receiving liquid water repellent:
      a. Non-acrylic base liquid for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars.

C. Cement: ASTM C150, Type II Portland for all areas.

D. Aggregate:
   1. Sand: Maximum size #30 mesh sieve.
   2. For exposed aggregate finish surfaces: Same as surrounding wall.

E. Water: Potable.

F. Nonshrink Grout: See Specification Section 03 31 30 and Specification Section 03 31 31.

2.3 MIXES

A. Bonding Grout: One (1) part cement to one (1) part aggregate.

B. Patching Mortar:
   1. One (1) part cement to two and one-half (2-1/2) parts aggregate by damp loose volume.
      a. Substitute white Portland cement for a part of gray Portland cement to produce color matching surrounding concrete.

PART 3 - EXECUTION

3.1 PREPARATION

A. For methods of curing, see Specification Section 03 31 31.

B. Preparation of Bonding Grout Mixture:
   1. Mix cement and aggregate.
   2. Mix bonding agent and water together in separate container in accordance with manufacturer's instructions.
   3. Add bonding agent/water mixture to cement/aggregate mixture.
   4. Mix to consistency of thick cream.

5. Bonding agent itself may be used as bonding grout if approved by manufacturer and Engineer.

C. Preparation of Patching Mortar Mixture:
   1. Mix cement and aggregate.
   2. Mix bonding agent and water together in separate container in accordance with manufacturer's instructions.
   3. Add only enough bonding agent/water mixture to cement/aggregate mixture to allow handling and placing.
   4. Let stand with frequent manipulation with a trowel, until mix has reached stiffest consistency to allow placement.

D. Clean surfaces in accordance with ASTM D4258 to remove dust, dirt, form oil, grease, or other contaminants prior to abrasive blasting, chipping, grinding or wire brushing.
   1. Abrasive blast surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6 to completely open defects down to sound concrete and remove laitance.
      a. If additional chipping or wire brushing is necessary, make edges perpendicular to surface or slightly undercut.
      b. No featheredges will be permitted.
   2. Rinse surface with clean water and allow surface water to evaporate prior to repairing surface defects.

E. Repairing Surface Defects:
   1. This method of repairing surface defects is to be used only on vertical concrete surfaces, surfaces to receive liquid water repellent and exterior surfaces.
   2. Fill and repair using patching mortar mix specified in the MIXES Article in PART 2 of this Specification Section.
      a. Use nonshrink grout to fill tieholes as outlined in this Specification Section.
   3. If required by bonding agent manufacturer, etch surfaces with a muriatic acid solution followed by a thorough rinse with clean water.
      a. Test concrete to determine pH level and continue flushing with clean water until surface pH is within acceptable limits.
   4. Dampen area to be patched and an area at least 6 IN wide surrounding it prior to application of bonding grout.
   5. Brush bonding grout into the surface after the surface water has evaporated.
   6. Allow bonding grout to set for period of time required by bonding agent manufacturer before applying premixed patching mortar.
   7. Fill tie holes with nonshrink, nonmetallic grout.
      a. Where exposed to view and scheduled to receive concrete Finish #2 or #5, hold grout below surface of concrete and fill with patching mortar to match surrounding concrete.
   8. Fill all other defects with patching mortar.
      a. Match color of surrounding wall.
      b. Do not use acrylic bonding agent in patching mortar for filling defects in surfaces to be treated with liquid water repellent.
   9. Consolidate grout or mortar into place and strike off so as to leave patch slightly higher than surrounding surface.
   10. Leave undisturbed for at least 60 minutes before finishing level with surrounding surface.
      a. Do not use metal tools in finishing a patch in a formed wall which will be exposed or coated with other materials.

11. Keep areas damp in accordance with grout manufacturer or bonding agent manufacturer's directions.

F. Repairing Surface Defects - Interior Concrete Surfaces Only:
1. Does not include exterior concrete surfaces, surfaces exposed to water, or surfaces to receive liquid water repellent.
2. Clean surfaces in accordance with ASTM D4258 to remove dirt, dust, form oil, grease or other contaminants prior to abrasive blasting, chipping, grinding or wire brushing.
3. Abrasive blast concrete in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6 to completely open defects down to sound concrete and remove laitance.
4. If additional chipping or wire brushing is necessary, make edges perpendicular to surface or slightly undercut.
5. No feather edges will be permitted.
6. Rinse surface with clean water and allow surface water to evaporate prior to repairing surface defects.
7. Fill tie holes with nonshrink, nonmetallic grout.

G. Preparation - Surfacer/Filler:
1. Allow concrete to cure for minimum 28 days.
   a. Verify that surfaces have been cleaned in accordance with ASTM D4258 to remove dust, dirt, form oil, grease and other contaminants, and that surface has been abrasive blasted to completely open all defects down to sound concrete and remove all laitance.
   b. Bring surface within manufacturer's recommended moisture content.
      1) Test as recommended by surfacer/filler manufacturer.
2. Blend and mix individual components of prepackaged surfacer/filler system in strict accordance with manufacturer's instructions.
3. Provide primer when required by conditions and/or as recommended by manufacturer or as specified.
4. Apply by trowel or hydraulic pumping equipment.
   a. If applied by hydraulic pumping equipment, material shall be finished by hand troweling.
   b. Force material into all voids and surface irregularities.
   c. Provide a uniform, continuous, void free, smooth film surface.
5. Thickness:
   a. Minimum: 1/16 IN.
   b. Maximum: 1/8 IN.
   c. Uniform.
6. Remove all trowel marks and leave ready for topcoats of high performance industrial coatings.

3.2 INSTALLATION AND APPLICATION

A. Do not repair surface defects or apply wall or floor finishes when temperature is or is expected to be below 50 DegF.
1. If necessary, enclose and heat area to between 50 and 70 DegF during repair of surface defects and curing of patching material.
   a. Use only clean fuel, indirect fired heating apparatus.

B. Chemical Floor Sealer (CS-1)(CS-3) Application:
1. Apply to floor areas indicated on the Drawings in accordance with manufacturer's recommendations.

2. Apply at rate recommended by manufacturer.
3. After final coat of material is applied, remove surplus in accordance with manufacturer's recommendations.
4. Do not apply sealer to floors scheduled to receive epoxy floor finish.

C. Concrete Finishes for Vertical Wall Surfaces:
1. General: Give concrete surfaces finish as specified below after removal of formwork and repair of surface defects.
2. Finish #1 - As cast rough form finish:
   a. Selected forming materials are not required.
   b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section and repair the following surface defects:
      1) Tie holes.
      2) Honeycombs deeper than 1/4 IN.
      3) Air pockets deeper than 1/4 IN.
      4) Rock holes deeper than 1/4 IN.
   c. Chip or rub off fins exceeding 1/4 IN in height.
   d. Use at unexposed surfaces such as foundations and backfilled surfaces of walls not to be waterproofed.
3. Finish #2 - As cast form finish:
   a. Form facing material shall produce a smooth, hard, uniform texture.
      1) Use forms specified for surfaces exposed to view in accordance with Specification Section 03 11 13.
   b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section and repair the following surface defects:
      1) Tie holes.
      2) Honeycombs deeper than 1/4 IN or larger than 1/4 IN DIA.
      3) Air pockets deeper than 1/4 IN or larger than 1/4 IN DIA.
      4) Rock holes deeper than 1/4 IN or larger than 1/4 IN DIA.
      5) Scabbing.
   c. Chip or rub off fins exceeding 1/8 IN in height.
      1) Finish shall provide uniform color and texture.
   d. Provide this finish for:
      1) Walls being waterproofed or coated with some other material.
      2) Exposed surfaces not specified to receive another finish.

D. Related Unformed Surfaces (Except Slabs):
1. Strike smooth and level tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces after concrete is placed.
2. Float surface to a texture consistent with that of formed surfaces.
   a. If more than one (1) finish occurs immediately adjacent to unformed surface, provide surface with most stringent formed surface requirement.
3. Continue treatment uniformly across unformed surfaces.

E. Concrete Finishes for Horizontal Slab Surfaces:
1. General:
   a. Tamp concrete to force coarse aggregate down from surface.
   b. Screed with straightedge, eliminate high and low places, bring surface to required finish elevations; slope uniformly to drains.
   c. Dusting of surface with dry cement or sand during finishing processes not permitted.

2. Unspecified slab finish:
    a. When type of finish is not indicated, use following finishes as applicable:
        1) Surfaces intended to receive bonded applied cementitious applications: Scratched finish.
        2) Surfaces intended to receive roofing, or waterproofing membranes: Floated finish.
        3) Floors intended as walking surfaces or for reception of floor coverings: Troweled finish.
        4) Garage floors and ramps: Broom or belt finish.
        5) Exterior slabs, sidewalks, platforms, steps and landings, and ramps, not covered by other finish materials: Broom or belt finish.
        6) All slabs to receive a floated finish before final finishing.
3. Scratched slab finish: After concrete has been placed, consolidated, struck off, and leveled to a Class B tolerance, roughen surface with stiff brushes or rakes before final set.
4. Floated finish:
    a. After concrete has been placed, consolidated, struck off, and leveled, do no further work until ready for floating.
    b. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operations.
        1) Use wood or cork float.
    c. During or after first floating, check planeness of entire surface with a 10 FT straightedge applied at not less than two (2) different angles.
    d. Cut down all high spots and fill all low spots to produce a surface with Class B tolerance throughout.
    e. Refloat slab immediately to a uniform texture.
5. Troweled finish:
    a. Float finish surface to true, even plane.
    b. Power trowel, and finally hand trowel.
    c. First troweling after power troweling shall produce a smooth surface which is relatively free of defects, but which may still show some trowel marks.
    d. Perform additional trowelings by hand after surface has hardened sufficiently.
    e. Final trowel when a ringing sound is produced as trowel is moved over surface.
    f. Thoroughly consolidate surface by hand troweling.
    g. Leave finished surface essentially free of trowel marks, uniform in texture and appearance and plane to a Class A tolerance.
    h. On surfaces intended to support floor coverings, remove any defects that would show through floor covering by grinding.
6. Broom or belt finish: Immediately after concrete has received a float finish as specified, give it a transverse scored texture by drawing a broom or burlap belt across surface.
7. Underside of concrete slab finish:
    a. Match finish as specified for adjacent vertical surfaces.
    b. If more than one (1) finish occurs immediately adjacent to underside of slab surface, provide surface with most stringent formed surface requirement.

3.3 FIELD QUALITY CONTROL

A. Horizontal slab finishes will be accepted provided:
    1. Applicable specification requirements are satisfied.
    2. Water does not pond in areas sloped to drain.

3. Gap between a 10 FT straightedge placed anywhere and the finished surface does not exceed:
   a. Class A tolerance: 1/8 IN.
   b. Class B tolerance: 1/4 IN.
   c. Class C tolerance: 1/2 IN.
4. Accumulated deviation from intended true plane of finished surface does not exceed 1/2 IN.
5. Accuracy of floor finish does not adversely affect installation and operation of movable equipment, floor supported items, or items fitted to floor (doors, tracks, etc.).

B. Unacceptable finishes shall be replaced or, if approved in writing by Engineer, may be corrected provided strength and appearance are not adversely affected.
   1. High spots to be removed by grinding and/or low spots filled with a patching compound or other remedial measures to match adjacent surfaces.

3.4 PROTECTION

A. All horizontal slab surfaces receiving chemical floor sealer shall be kept free of traffic and loads for minimum of 72 HRS following installation of sealer.

END OF SECTION

SECTION 04 20 00 - UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units (CMU's).
2. Decorative concrete masonry units.
3. Steel reinforcing bars.
4. Embedded masonry flashing

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For reinforcing steel. Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

C. Samples: For each type and color of exposed masonry unit.

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product indicated. For masonry units include data on material properties.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.4 QUALITY ASSURANCE

A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

B. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects.

1. Build sample panels for typical exterior wall in sizes approximately 48 inches long by 36 inches high by full thickness.

1.5 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

C. National Concrete Masonry Construction, Technical Note 3-1C.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

1. Provide bullnose units for outside corners in building interior.

B. CMUs: ASTM C 90.

1. Density Classification: Normal weight unless otherwise indicated.

C. Decorative CMUs: ASTM C 90.

1. Density Classification: Normal weight.

2. Pattern and Texture: Standard pattern, ground-face finish, as selected by Architect from manufacturer's full range.

2.3 MASONRY LINTELS

A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout.

B. Loose Lintels: Specified in Section 05 50 10.

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction.

1. Color: Natural.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Aggregate for Mortar: ASTM C 144.

1. Color: Natural.

E. Aggregate for Grout: ASTM C 404.

F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

G. ASTM C 476 Standard Specification for Grout for Masonry.

H. ASTM C 143 Standard Test Method for Slump of Hydraulic Cement Concrete.

I. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement: ASTM A 951/A 951M.

1. Interior Walls: Mill-galvanized, carbon steel.
2. Exterior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Wire Size for Veneer Ties: 0.148-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Cavity Walls: Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.

2.6 TIES AND ANCHORS

A. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

B. Masonry Veneer Anchors: Metal Stud Back-Up.

1. Tape Seal:
   a. For use with strap anchors.

b. Peel-n-stick, self-healing where screws/prongs penetrate air retarder and sheathing.
c. Apply to substrate wall in continuous vertical strips prior to installation of strap anchors.
d. Base Product: X-Seal Tape by Hohmann & Barnard, Inc.

2. Offset Strap-Type Anchors
   a. Hot-dip galvanized steel.
   b. Thickness: 12 GA .
   c. Depth of prongs: As required for application.
   d. Base Product: X-Seal Anchor by Hohmann & Barnard, Inc.
   e. Base Product: DW-10X by Hohmann & Barnard, Inc.

3. Wire Ties:
   a. Hot-dip galvanized steel.
   b. Diameter: 1/4 IN .

4. Self-Drilling Fasteners:
   a. Material: No. 10 zinc-plated steel.
   b. 2. Length: As required for application.
   c. 3. Hex head, with washer flange.
   d. 4. Neoprene sealing washer.
   e. 5. Base Product: Standard Fastener by Hohmann & Barnard, Inc. Wire Ties:

2.7 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with Section 07 62 00 "Sheet Metal Flashing and Trim and as follows:
   1. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

B. Flexible Flashing: Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch.

   1. Products: Subject to compliance with requirements, provide one of the following:

      a. Carlisle Coatings & Waterproofing; CCW-705-TWF Thru-Wall Flashing.
      b. Dayton Superior Corporation, Dur-O-Wal Division; Dur-O-Barrier Thru-Wall Flashing.
      c. Grace Construction Products, W. R. Grace & Co. - Conn.; Perm-A-Barrier Wall Flashing.
      d. Heckmann Building Products Inc.; No. 82 Rubberized-Asphalt Thru-Wall Flashing.
      e. Hohmann & Barnard, Inc.; Textroflash.
      f. W. R. Meadows, Inc.; Air-Shield Thru-Wall Flashing.

   2. Termination Bars:

      a. Use to secure top edge of flexible membrane flashing to back-up wall.
      b. Extruded mill aluminum or stainless steel.
      c. 1/8 inch by 1 inch by 10 feet.
      d. Base product: TB-100 Series by Trufast, LLC.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07 62 00 "Sheet Metal Flashing and Trim."

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from neoprene or urethane.

B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

C. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard range.

1. Products:

a. Archovations, Inc.; CavClear Weep Vents
b. Mortar Net USA, Ltd.; Mortar Net Weep Vents
c. Approved substitute

D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products:

a. Advanced Building Products Inc.; Mortar Break II.
b. Archovations, Inc.; CavClear Masonry Mat.
c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
d. Mortar Net USA, Ltd.; Mortar Net.

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Dry mortar ingredients may be furnished in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification, except Property Specification may be used for Pre-blended, Dry Mortar Mix.. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type M.
2. For reinforced masonry, use Type S.

3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.
4. For interior non-load-bearing partitions, Type O may be used instead of Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.
3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

PART 3 - EXECUTION

3.1 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.2 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed exterior masonry in stack bond and exposed interior masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.3 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive direct-applied finishes (other than paint) unless otherwise indicated.

3.4 CAVITY WALLS

A. Bond wythes of cavity walls together using adjustable (two-piece) type masonry joint reinforcement installed in horizontal mortar joints.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Apply air barrier to face of backup wythe to comply with Section 07 27 26 "Fluid Applied Membrane Air Barriers."

D. Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards specified in Section 07 21 00 "Thermal Insulation." Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

E. Anchoring Masonry Veneers to Back-up:

1. Attach offset anchor straps to back-up wall.
   a. Use types suitable for condition.
   b. Apply flexible membrane flashing to walls prior to attachment of strap anchor.
   c. Where masonry walls bypass concrete or steel structural elements including shear walls, columns, and spandrel beams, anchor thereto with specialized anchors types indicated.

2. Select wire ties of length to span cavity and provide a minimum embedment of 2 inches in masonry facing.
   a. Where cavity width exceeds 4-1/2 inches , increase wire ties to 1/4 inch diameter.

3. Provide minimum of one anchor per 1.77 square feet of wall area with vertical and horizontal spacing not to exceed 16inches OC.
   a. Where stud spacing is less than 16 inches OC, stagger ties in alternating courses.

4. Where 2 inch thick masonry facing units are used as furring against columns or walls, anchor furring units to backing with adjustable metal ties designed for condition.

3.5 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.6 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.7 CONTROL JOINTS

A. Install control joint materials in unit masonry as masonry progresses. Do not allow materials to span control joints without provision to allow for in-plane wall or partition movement.

B. Where not indicated on Drawings, provide vertical control joints at a maximum spacing of 25 feet. Verify joint locations with Architect prior to wall construction.

C. Form control joints in concrete masonry as follows: Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.

D. Prime joint surfaces to receive sealant and install compressible backer rod in joints before applying sealant, except as otherwise indicated.

E. Prepare and apply sealant to comply with applicable requirements in Section 07 92 00 "Joint Sealants."

3.8 FLASHING, WEEPS AND VENTS

A. General: Install embedded flashing in masonry at lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

C. Through-Wall Flashing:

1. Install to provide positive drainage of cavity moisture.

2. Coordinate with built in items and brick ledges.

3. Drip Plate:
   a. Adhere to ledge angle or brick ledge with drip flange extending past face of masonry.

4. Flashing membrane:
   a. Extend bottom edge of flashing over top surface of drip plate.
      1) Terminate rubberized flashing membranes 1/2 inch from exterior face of wall.

2) Bond flashing to drip plate.
3) Lap and bond flashing ends minimum 6 inches.

b. Extend top edge of flashing membrane up face of wall minimum 8 inches.

c. Termination of top edge:

1) Metal stud/gypsum sheathing:

a) Bond flashing membrane to directly face of sheathing.
b) Mechanically secure its top edge with termination bar.
c) Lap air retarder 6 IN over flashing membrane.

d. Provide end dams.

5. Seal gap below ledge angles with backer and sealant.

6. Seal gap below relieving angles with compressible filler.

7. Seal items penetrating through-wall flashing system.

D. End Dams:

1. Configuration:

a. Extend ends of flashing beyond openings.
b. Return flashing up into head joints.
c. Bond to face of masonry units.
d. Install sill after end dam is in place.
e. Minimum height at sides: 4 inches.
f. Comply with BIA Tech Note 21B and 7.

2. Provide end dams at following locations:

a. Jamb edges of sills for doors, windows, louvers and similar openings.
b. Jamb edges of lintels for doors, windows, louvers and similar openings.
c. Step-flashing, where flashing follows grade.
d. At terminal ends of masonry veneer walls.

E. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.

F. Install weeps in head joints in exterior wythes of first course of masonry immediately above embedded flashing:

1. Use specified weep/vent products to form weeps.
2. Space weep holes 32 inches o.c.

G. Place cavity drainage material in cavities to comply with manufacturer's recommendations.

H. Install vents in head joints at tops of wall cavities in exterior wythes at 32 inches o.c.. Use specified weep/vent products to form vents.

3.9 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

C. Cleaning indicates acceptance of surfaces and responsibility for performance.

3.10 MASONRY WASTE DISPOSAL

A. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 20 00

SECTION 05 12 00 - STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Structural steel, including the fabrication and erection of support and bracing members, including connections.
   2. Connection detail design as required.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 09 91 00 - Painting and Protective Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Institute of Steel Construction (AISC):
      a. 303, Code of Standard Practice for Steel Buildings and Bridges.
      b. 360, Specifications for Structural Steel Buildings.
      c. Quality Certification Program for Fabricators.
   2. American Society of Civil Engineers (ASCE).
   3. American Society of Mechanical Engineers (ASME):
      a. B18.21.1, Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series).
   4. ASTM International (ASTM):
      a. A2, Standard Specification for Carbon Steel Girder Rails of Plain, Grooved, and Guard Types.
      b. A6/A6M, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
      c. A36/A36M, Standard Specification for Carbon Structural Steel.
      d. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      e. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
      f. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
      g. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
      h. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
      i. A325, Standard Specification of Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
      j. A490, Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
      k. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
      l. A563, Standard Specification for Carbon and Alloy Steel Nuts.
      m. A992/A992M, Standard Specification for Structural Steel Shapes.

n. A1064/A1064M, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
o. F436, Standard Specification for Hardened Steel Washers.
p. F593, Standard Specification for Stainless Steel Bolts, Hex Caps Screws, and Studs.
q. F959, Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
r. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
s. F1852, Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.

5. American Welding Society (AWS):
   a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
   b. A5.5/A5.5M, Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding.
   c. A5.17/A5.17M, Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
   d. A5.18/A5.18M, Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding.
   e. A5.20/A5.20M, Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
   f. A5.23/A5.23M, Specification for Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding.
   g. A5.28/A5.28M, Specification for Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding.
   h. A5.29/A5.29M, Specification for Low-Alloy Steel Electrodes for Flux Cored Arc Welding.
   i. D1.1/D1.1M, Structural Welding Code - Steel.
      1) Steel stud connectors and their installation to comply with requirements of AWS D1.1/D1.1M.
6. National Institute of Steel Detailing (NISD).
7. Research Council on Structural Connections (RCSC):
   a. Specification for Structural Joints Using High-Strength Bolts.
8. Building code:
   a. International Code Council (ICC):
      1) International Building Code and associated standards, 2009 Edition including all amendments, referred to herein as Building Code.

B. Qualifications:
   1. Steel fabricator:
      a. Minimum of 15 years experience in fabrication of structural steel and participate in the AISC Certification program and is designated an AISC Certified Plant, Category STD at time of bid.
      b. Fabricator plant quality control and inspection program: Meet requirements of the Building Code and/or be approved by the project's governing authority to self perform the Building Code required Special Inspections.
      c. Use a professional engineer on fabrication staff.

2. Steel erector:
    a. Minimum of 15 years of experience in erection of structural steel similar in the scope of this project and certified as CSE under the AISC Quality Certification Program.
    b. With an active and enforced quality assurance program in place, as described in the applicable Codes.
3. Qualify welding procedures and welding operators in accordance with AWS.
4. Structural steel connections design: Professional engineer registered in the State of Wisconsin.

1.3 DEFINITIONS

A. Owner: May mean the Owner's Designated Representative for Construction as defined by the AISC 303.

B. Galvanizing: Hot-dipped galvanizing per ASTM A153/A153M and/or ASTM A123/A123M with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by aforementioned standards.

1.4 SUBMITTALS

A. Shop Drawings:
1. See Division 1 for requirements for the mechanics and administration of the submittal process.
2. Product technical data including:
    a. Acknowledgement that products submitted meet requirements of standards referenced.
    b. Manufacturer's installation instructions.
    c. Detailed supplemental specification relating to load indicator washers or high-strength bolts.
        1) Alternate design for Engineer approval (submitted at Contractor's option if desired by Contractor for use).
    d. Source and certification of quality for high-strength bolts, nuts and washers.
3. Fabrication and/or layout drawings:
    a. Prepare Shop Drawings under NISD Quality Procedures Program certification.
    b. Complete Shop Drawings for all of the work showing clearly all pieces, sizes, dimensions, details, connections materials and shop coatings.
        1) All Shop Drawings must be checked and signed "approved" before submittal.
        2) Show all cuts, copes, and holes.
        3) Indicate all shop and field bolts.
        4) Indicate all shop and field welds using AWS symbols.
        5) Be reviewed and sealed by a Professional Engineer retained by Contractor to verify conformance with design criteria stipulated in the Contract Documents.
    c. Prepare complete erection drawings showing the location and marks of all pieces.
        1) Copies of up-to-date erection drawings shall accompany the Shop Drawings.
        2) Use match marks on the erection drawings to indicate the sheet number on which each particular member is detailed.
    d. Correct any incorrect or unacceptable material or fabrication due to incorrect detailing, shop work, or erection, without additional charge.

4. Certifications:
    a. Certificates of compliance with standards specified for all major components and fasteners incorporated into work.
    b. Copies of current welding certificates for each welder assigned to perform welding indicating compliance with testing specified by AWS.
    c. Welder qualification data and prequalified procedures.
    d. Special Inspections reports.
5. Test reports:
    a. Certified copies of mill tests.
    b. Manufacturer's load test and temperature sensitivity data for post-installed anchor bolts.
    c. Test reports for all structural steel work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Handle and store steel members above ground on skids or other supports.
    1. Keep free of dirt and other foreign material and protect against corrosion.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
    1. High-strength bolts:
        a. Portland Bolt and Manufacturing Company.
        b. Lewis Bolt & Nut Company.
        c. Nucor Fasteners.
        d. St. Louis Screw and Bolt Company.
    2. Load indicator washers for high-strength bolts:
        a. Portland Bolt and Manufacturing Company.
        b. Mid-South Bolt and Screw Co., Inc.
        c. J and M Turner, Inc.
    3. Alternate design high-strength bolts:
        a. T. C. Bolt Corporation.
        b. Construction Fastener Systems Division of Bristol Machine Company.
        c. LeJuene Bolt Co.
    4. Headed studs and deformed bar anchors:
        a. Nelson Stud Welding Division, TRW, Inc.
        b. Stud Welding Products, Inc.
    5. Expansion anchor bolts:
        a. Kwik Bolts by Hilti, Inc.
        b. Trubolt by ITW Ramset/Red Head.
        c. Powerbolt by Powers Rawl.
    6. Adhesive anchors bolts:
        a. HVA Adhesive Anchor System by Hilti.
        b. HIT HY 200 Adhesive Anchor by Hilti.
        c. HSE 2411 Epoxy Adhesive Anchor by Hilti.
        d. EPCON Ceramic 6 Epoxy by ITW Ramset/Red Head.
        e. Power Fast by Powers Rawl.
        f. Needle Capsule Anchor Systems by Powers Rawl.

7. Anchor bolt sleeves:
    a. Sinco/Wilson.

B. Submit request for substitution in accordance with Division 1.

2.2 MATERIALS

A. Steel, Structural Shapes and Plate (unless noted otherwise on Drawings):
    1. All W-shapes and WT-shapes: ASTM A992/A992M.
    2. All other plates, bars and rolled shapes: ASTM A36/A36M.

B. Pipe: ASTM A53/A53M, Grade B (Type E or S) (Fy=35).

C. Hollow Structural Sections (HSS):
    1. Round: ASTM A500/A500M, Grade B (Fy=42).
    2. Square or rectangular: ASTM A500/A500M, Grade B (Fy=46).

D. High-Strength Bolts, Nuts and Washers:
    1. ASTM A325 with ASTM A563 nuts:
    2. High-strength bolts:
        a. Provide two (2) ASTM F436 washers for all bolts.
        b. Provide beveled washers at connections of sloped/tapered sections.
    3. High-strength bolts with load indicating devices, ASTM F959, Type 325.
        a. Provide at Contractor's option and subject to approval of Engineer.
    4. Alternate high-strength design: Provide at Contractor's option and subject to approval of Engineer.

E. Bolts and Nuts, Non-high Strength: ASTM A307, Grade A or ASTM F1554, Grade 36.

F. Washers, Plain (for Non-high Strength Bolts): ASME B18.21.1, Type B.

G. Welding Electrodes:
    1. Shielded metal arc: AWS A5.1/A5.1M or AWS A5.5/A5.5M, E70XX or E801X-X.
    2. Submerged arc: AWS A5.17/A5.17M or AWS A5.23/A5.23M, F7XX-EXXX or F8XX-EXXX-XX.
    3. Gas metal arc: AWS A5.18/A5.18M, E70S-X or E70U-1 or AWS A5.28/A5.28M, ER80S-XX, E80C-XXX.
    4. Flux cored arc: AWS A5.20/A5.20M, E7XT-X (except 2, 3, 10, GS), AWS A5.29/A5.29M, E7XT-X or E8XTX-X, E8XTX-XM.

H. Anchor Rods and Bolts:
    1. ASTM F1554, Grade 55 with weldability supplement S1 for threaded rods.
    2. ASTM A307, Grade A for headed bolts.
    3. ASTM F593, Type 304 or 316 stainless steel with matching nut and washer.

I. Headed Studs and Deformed Bar Anchors:
    1. Headed studs:
        a. ASTM A108, complying with AWS D1.1/D1.1M, Section 7, Type B; minimum yield strength 50,000 psi, minimum tensile strength 60,000 psi.
        b. Uniform diameter.
        c. Heads: Concentric and normal to shaft.
        d. Weld end: Chamfered and solid flux.
    2. Deformed bar anchor:
        a. ASTM A1064/A1064M, complying with AWS D1.1/D1.1M, Section 7, Type C.
        b. Minimum yield strength: 70,000 psi.

c. Minimum tensile strength: 80,000 psi.
d. Straight, unless indicated otherwise.
e. Solid flux.

3. After welding, remove ceramic ferrules and maintain free from any substance which would interfere with function, or prevent bonding to concrete.

J. Nonshrink Grout: See Specification Section 03 31 30.

K. Crane Rails:
1. Controlled-cooled, open-hearth carbon steel ASCE rails per ASTM A2, Class A, #1 rails, unless noted otherwise, of size and weight indicated.
   a. Furnish rails with milled tight end joints suitable for crane service, with standard drilling, removable end stops and all related accessories required, including:
      1) Joint bars: Match rail section and properties, drilled to match rail drilling.
      2) Joint bar bolts and nuts: High strength.
      3) Hardened washer: ASTM F436 for bar bolts.
      4) Except as indicated otherwise, two-bolt type fixed or floating rail clamps to suit the conditions, of forged or pressed steel, complete with ASTM A325 bolts, reversible fillers, and self-locking nut or nut and lock washer.

L. Expansion Anchor Bolts and Adhesive Anchor Bolts for Fastening to Concrete:
1. Use of expansion bolts requires approval by Engineer.
2. Stainless steel, Type 304 or Type 316.
3. Provide minimum edge distance cover as recommended by manufacturer or as indicated on Drawings.
4. Submit manufacturer's data to verify at least the load test capacities and anchor bolt capacities at the following embedment depths:

ANCHOR BOLT DIAMETER (IN)	EMBEDMENT (IN)	MINIMUM ULTIMATE TENSION CAPACITY (KIP)*, **
3/8	4	4.8
½	6	8.1
5/8	7	11.4
¾	8	15.4
7/8	10	20.0
1	12	24.7
1-1/4	15	34.3

* Data must be based on actual tests preformed in unreinforced mass concrete of not more than 4000 psi compressive strength.

** Capacity must be at a concrete temperature of at least 130 DegF.

2.3 FABRICATION

A. Comply with requirements of applicable Building Code and AISC 360 with modifications and additional requirements specified herein.
1. Identify high-strength steel material in fabricated members in accordance with ASTM A6/A6M.

B. Minimize the amount of field welding.
1. Shop assemble components into largest size possible commensurate with transportation and handling limitations.

2. Shop connections: Bolted with high-strength bolts or welded.

C. Connection Details:
1. Connections not fully detailed on Drawings shall be designed by a Professional Engineer registered in the State of Wisconsin, retained by Contractor, based on requirements of Contract Documents.
2. Where beam reactions are shown on Drawings, design beam connection to support specified loads.
3. Where no reactions are shown, design each beam connection to support one-half of total uniform load capacity tabulated in AISC tables for "Uniform Load Constants for Beams" for the given shape, span and steel grade specified.
4. Where indicated on the Drawings, design beam connections for the axial load or transfer forces indicated in addition to the shear value indicated above.
5. Design bracing connections for loads indicated on the Drawings.
6. Where no reactions are shown, design bracing connections for 100% of the tension and compression capacity of the given shape.
7. Design girt connections for required lateral wind and/or seismic horizontal load acting either inward or outward in addition to vertical load due to panel and girt weight.
8. Provide as a minimum, two (2) 3/4 IN DIA, high-strength bolts for all bolted connections unless otherwise specified.

D. Provide bearing type connections for all bolted connections, unless specified otherwise or required to be slip-critical by the RCSC Specification for Structural Joints Using High-Strength Bolts.

E. One-sided or other types of eccentric connections not indicated will not be permitted without prior approval.

F. Field Connections:
1. Provide bolts for all field connections except where shown otherwise on the Drawings.
2. Use high-strength bolts unless shown or specified otherwise.
3. Use of high-strength bolts: Conform to RCSC Specification for Structural Joints Using High-Strength Bolts.
4. Unfinished bolts may be used for attaching stair treads to stringers.
5. If structural steel details (field welds versus shop welds, etc.) shown on design Drawings are not compatible with selected erection procedures, submit proposed modifications for review.
6. Connections to structural steel provided by others: Provide all connectors and coordinate location of bolt holes to match connection holes in steel provided by others.

G. Accurately mill column end bearing surfaces to true plane.

H. Fabricate and erect beams with non-specified camber in accordance with AISC 360, Chapter L1.

I. Cut, drill, or punch holes at right angles to surface of metal.
1. Do not make or enlarge holes by burning.
2. Make holes clean cut, without torn or ragged edges.
3. Remove outside burrs resulting from drilling or reaming operations with tool making 1/16 IN bevel.

4. Provide holes in members to permit connection of work of other trades or contractors.

J. Make allowance for draw in all cross bracing to provide small amount of initial tension in members.

K. Make splices only where indicated or where approved.

L. Wall Girts:
   1. Extend past columns and miter ends unless noted otherwise.
   2. Connect girts to each other at corners unless noted otherwise.

M. Cope at 45 degrees, corners of stiffener plates at junction of member flanges with webs.

N. Flame cut bevels for welds, provided such cutting is done automatically.
   1. Leave free of burrs and slag by grinding or planing the cut edges.

O. Grind smooth all rough welds and sharp steel edges shall be ground to approximately 1/8 IN radius.

P. Tolerances (unless noted otherwise on Drawings):
   1. When material received from the mill does not satisfy ASTM A6/A6M tolerances for camber, profile, flatness or sweep, Contractor is permitted to perform corrective work by the use of controlled heating, and mechanical straightening, subject to the limitations of the AISC 360.
   2. Fabrication tolerance:
      a. Member length:
         1) Both ends finished for contact bearing: 1/32 IN.
         2) Framed members: 30 FT or less: 1/16 IN. Over 30 FT: 1/8 IN.
      b. Member straightness:
         1) Compression members: 1/1000 of axial length between points laterally supported.
         2) Non-compression members: ASTM A6/A6M tolerance for wide flange shapes.
      c. Specified member camber (except compression members):
         1) 50 FT or less: -0/+1/2 IN.
         2) Over 50 FT: -0/+1/2 IN (plus 1/8 IN per 10 FT over 50 FT).
         3) Members received from mill with 75 percent of specified camber require no further cambering.
         4) Fabricate beams/trusses without specified camber so after erection, camber is upward.
         5) Measure camber in fabrication shop in unstressed condition.
      d. Use filler plates at bolted splices to take up depth deviation.
         1) At welded joints, adjust weld profile to conform to variation in depth.
         2) Slope weld surface per AWS requirements.
      e. Free finished members from twists, bends and open joints.
         1) Sharp kinks, bends and deviation from the above tolerances are cause for rejection of material.

2.4 WELDING

A. Comply with AWS D1.1/D1.1M, and other requirements indicated herein, for all welding, techniques of welding employed, appearance and quality of welds, and methods used to correct defective work.

1. Qualify joint welding procedures or test in accordance with AWS qualification procedures.

B. Test and qualify welders, welding operators and tackers in compliance with AWS D1.1/D1.1M for position and type of welding to which they will be assigned.
   1. Conduct tests in presence of approved testing agency.
   2. Certification within previous 12 months will be acceptable, provided samples of the welder's work are satisfactory.

C. Before Starting Welding:
   1. Carefully plumb and align members in compliance with specified requirements.
   2. Fully tighten all bolts.
   3. Comply with AWS D1.1/D1.1M, Section 5 for assembly and surface preparation.
   4. Preheat base metal to temperature stated in AWS D1.1/D1.1M.
      a. When no preheat temperature is given in AWS D1.1/D1.1M and base metal is below 50 DegF, preheat base metal to at least 70 DegF.
      b. Maintain temperature during welding.
      c. Preheat surface of all base metal within distance from point of welding equal to thickness of thicker part being welded or 3 IN, whichever is greater, to specified preheat temperature.
      d. Maintain this temperature during welding.
   5. Mark welds with an identifying mark unique to each welder.

D. Make flange welds before making web welds.

E. Where groove welds have back-up plates, make first three (3) passes with 1/8 IN round electrodes.
   1. Use backup plates in accordance with AWS D1.1/D1.1M, extending minimum of 1 IN either side of joint.

F. Flame cut edges of stiffener plates at shop or field butt weld.
   1. Do not shear.

G. Grind flush web fillets at webs notched to receive backup plates for flange groove welds.

H. Low Hydrogen Electrodes: Dry and store electrodes in compliance with AWS D1.1/D1.1M.

I. Do not perform welding when ambient temperature is lower than 0 DegF or where surfaces are wet or exposed to rain, snow, or high wind, or when welders are exposed to inclement conditions.

J. Headed Studs and Deformed Bar Anchors:
   1. Automatically end welded in accordance with the AWS D1.1/D1.1M and manufacturer's recommendations.
   2. Fillet welding of headed studs and deformed bar anchors is not allowed unless approved by Engineer.

K. Test in-place studs in accordance with requirements of AWS D1.1/D1.1M to ensure satisfactory welding of studs to members.
   1. Replace studs failing this test.

L. When headed stud-type shear connectors are to be applied, clean top surface of members to receive studs in shop to remove oil, scale, rust, dirt, and other materials injurious to satisfactory welding.
   1. Do not shop paint or galvanize metal surfaces to receive field applied studs.

2.5 SHOP COATING

A. Refer to Specification Section 09 91 00 and coordinate shop primer, surface preparation and coating with field applied primers and coatings where specified.

B. Provide suitable methods of handling and transporting painted steel to avoid damage to coating.

C. Do not coat following surfaces:
   1. Machined surfaces, surfaces adjacent to field welds, and surfaces fully embedded in concrete.
   2. All other members for which no coating is specified.
   3. Contact surfaces at bolted slip-critical connections, unless surface condition conforms to the RCSC Specification for Structural Joints Using High-Strength Bolts, Part 3.2.2.

D. Clean thoroughly all surfaces not coated before shipping.
   1. Remove loose mill scale, rust, dirt, oil and grease.
   2. Protect machined surfaces.

2.6 SOURCE QUALITY CONTROL

A. OWNER pays for inspection and testing:
   1. Testing:
      a. Owner will employ and pay for services of an independent testing agency to inspect and test structural steel shop and field work for compliance with Specifications.
      b. Contractor responsible for testing to qualify shop and field welders and as needed for Contractor's own quality control to ensure compliance with Contract Documents.
      c. Contractor provides sufficient notification and access so inspection and testing can be accomplished.
      d. Contractor pays for retesting of failed tests and for additional testing required when defects are discovered.

B. Testing Agency Responsibilities:
   1. Inspect shop and field welding in accordance with AWS D1.1/D1.1M, Section 6 including the following non-destructive testing:
      a. Visually inspect all welds.
      b. In addition to visual inspection, test 50 percent of full penetration welds and 20 percent of fillet welds with liquid dye penetrant.
      c. Test 20 percent of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.
   2. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
      a. Verify proper pretension for slip-critical bolted connection.
      b. Verify direct tension indicator gaps.
   3. Inspect structural steel which has been erected.
   4. Inspect stud welding in accordance with AWS D1.1/D1.1M, Section 7.8.
   5. Prepare and submit inspection and test reports to Engineer.
      a. Assist Engineer to determine corrective measures necessary for defective work.

PART 3 - EXECUTION

3.1 GENERAL

A. Contractor is solely responsible for safety.
   1. Construction means and methods and sequencing of work is the prerogative of the Contractor.
   2. Take into consideration that full structural capacity of many structural members is not realized until structural assembly is complete; e.g., until slabs, decks, bracing or rigid connections are installed.
   3. Partially complete structural members shall not be loaded without an investigation by the Contractor.
   4. Until all elements of the permanent structure and lateral bracing system are complete, provide temporary bracing designed, furnished, and installed by the Contractor for the partially complete structure.

B. Adequate temporary bracing to provide safety, stability and to resist all loads to which the partially complete structure may be subjected, including wind, construction activities, and operation of equipment, is the responsibility of the Contractor.
   1. Use temporary guys, braces, shoring, connections, etc., necessary to maintain the structural framing plumb and in proper alignment until permanent connections are made, the succeeding work is in place, and temporary work is no longer necessary.
   2. Use temporary guys, bracing, shoring, and other work to prevent injury or damage to adjacent work or construction from stresses due to erection procedures and operation of erection equipment, construction loads, and wind.
   3. Design of the temporary bracing system and consideration of the sequence and schedule of placement of such elements and effects of loads imposed on the structural steel members by partially or completely installed work, including work of all other trades, is the Contractor's responsibility.
      a. If not obvious from experience or from the Drawings, the Contractor shall confer with the Engineer to identify those structural steel elements that must be complete before the temporary bracing system is removed.
   4. Remove and dispose of all temporary work and facilities off-site.

C. Examine work-in-place on which specified work is in any way dependent to ensure that conditions are satisfactory for the installation of the work.
   1. Report defects in work-in-place which may influence satisfactory completion of the work.
   2. Absence of such notification will be construed as acceptance of work-in-place.

D. Field Measurement:
   1. Take field measurements as necessary to verify or supplement dimensions indicated on the Drawings.
   2. Contractor is responsible for the accurate fit of the work.

E. Check the elevations of all finished footings or foundations and the location and alignment of all anchor bolts before starting erection.
   1. Notify Engineer of any errors or deviations found by such checking.

3.2 ERECTION

A. Framing member location tolerances after erection shall not exceed the frame tolerances listed in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.

B. Erect plumb and level; introduce temporary bracing required to support erection loads.
   1. Provide temporary shoring to support composite slab construction.
   2. Do not remove temporary shoring supporting composite slab construction until concrete has reached specified strength.

C. Use light drifting necessary to draw holes together.
   1. Drifting to match unfair holes is not allowed.

D. Welding:
   1. Conform to AWS D1.1/D1/1M and requirements of this Specification Section.
   2. Join two (2) sections of steel of different ASTM designations using welding techniques in accordance with a qualified AWS D1.1/D1.1M procedure.

E. Shore existing members when unbolting of common connections is required.
   1. Use new bolts for rebolting connections.

F. Clean stored material of all foreign matter accumulated during erection period.

G. Clean bearing and contact surfaces before assembly.

H. Set beam and column base and bearing plates accurately, as indicated, on nonshrink grout.
   1. Set and anchor each base plate to proper line and elevation.
   2. Use metal wedges, shims or setting nuts as required and tighten anchor bolts.
      a. Use same metal as base plate.
      b. Cut off protrusions of wedges and shims flush with edge of base plate.
   3. Fill sleeves around anchor bolts with nonshrink grout.
   4. Pack grout solidly between bottom of plate and bearing surface.
   5. Refer to Specification Section 03 31 30 for nonshrink grout requirements.

I. Anchor Bolts:
   1. Anchor bolt location tolerance per AISC 303, Section 7.5.
   2. Tie anchor bolts in position to embedded reinforcing steel using wire.
   3. Welding or tack welding is prohibited.
   4. Provide steel templates for locating anchor bolts.
   5. Coat bolt threads and nuts with heavy coat of clean grease.

J. Install high strength bolts with hardened washers.
   1. Install and tighten in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 8.
   2. Coordinate installation with inspection.
      a. Do not start installation until coordination with Testing Agency is complete.
   3. Bearing-type connections: High-strength bolts shall be tightened to snug-tight condition.
   4. Slip-critical connections:
      a. Perform calibration testing for all methods of installation of high-strength bolts in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts, Section 8.2.
      b. Turn-of-nut tightening:
         1) Inspector shall observe the pre-installation verification testing.
         2) Subsequently, ensure by routine observation that the bolting crew properly rotates the turned element relative to the unturned element by the amount specified.

3) Alternatively, when fastener assemblies are match-marked after the initial fitup of the joint but prior to pretensioning, visual inspection after pretensioning is permitted in lieu of routine observation.

c. Calibrated wrench tightening: Calibrate on a daily basis.

d. Direct tension indicator tightening: If previously approved by Engineer.

e. Installation of alternate design bolts: If previously approved by Engineer.

5. In the event any bolt in a connection is found to be defective, check and retighten all bolts in the connection.

K. Do not use gas cutting to correct fabrication errors.

1. In case members do not fit or holes do not match, ream out the holes and insert the next larger size bolt.

a. Drill new holes if the connections require new holes.

b. Make no such corrections without prior approval of the Engineer.

2. Burning of holes is not permitted.

L. Prior to making field connections to existing structural steel, remove completely all paint from existing steel which will be in contact with new steel and new welds.

M. Tighten and leave in place erection bolts used in welded construction.

N. Provide beveled washers to give full bearing to bolt head or nut where bolts are to be used on surfaces having slopes greater than 1 in 20 with a plane normal to bolt axis.

O. After bolts are tightened, upset threads of non-high strength bolts and anchor bolts to prevent nuts from backing off.

P. Crane Runways:

1. Erect crane runways complete with columns, beams, girders, bracing, crane rails, crane stops, and other required components as indicated.

2. Stagger crane rail joints with respect to each other on opposite sides of the runway and do not coincide with crane girder joints.

3. Center crane rails on top of crane girders and secure to girders with tight clamps and/or floating clamps as appropriate; provide clamps in pairs spaced not over 3 FT OC along rail length, with each clamp secured with two (2) high-strength bolts and self-locking nuts (or nuts and lock washers), with reversible fillers used at each clamp to allow for alignment.

a. Do not use hook bolt type clamps.

4. Tolerances:

a. Center-to-center of crane rails: Not exceed plus or minus 1/4 IN from indicated dimension.

b. Crane rail horizontal misalignment: Not exceed 1/4 IN per 50 FT of runway with a maximum of 1/2 IN total deviation.

c. Vertical misalignment between crane rails and along a crane rail measured at centerlines of columns: Not to exceed 1/4 IN per 50 FT of runway with a maximum of 1/2 IN total deviation.

5. Tight-fitting joints between rail sections and install so top of crane rails are flush at all joints.

6. Secure the joints with joint bars on each side of rail, bolted together through rail with high-strength bolts, nuts and spring washers.

Q. After Erection:

1. Grind smooth all sharp surface irregularities resulting from field cutting or welding.

2. Power tool clean welds, bolts, washers and abrasions to shop coat removing all rust and foreign matter.

R. Expansion Anchor Bolts and Adhesive Anchor Bolts:
1. Minimum embedment as recommended by manufacturer or specified herein, whichever is larger.
2. Notify Engineer if required depth of embedment cannot be achieved at a particular bolt location.
3. Follow manufacturer's recommendations for installation and torque.

3.3 FIELD QUALITY CONTROL

A. Testing Agency responsibilities are described in the SOURCE QUALITY CONTROL Article in PART 2 of this Specification Section.

B. Erected Frame Tolerance, unless noted otherwise on the Drawings:
1. Do not exceed cumulative effect of rolling, fabrication and erection tolerance for overall finished dimensions.
2. Erection tolerances are defined relative to member working points and working lines as follows:
   a. Actual centerline of top flange or surface at each end for horizontal members.
   b. Actual center of member at each end for all other members.
   c. Other points may be used, providing they are based on these definitions.
   d. Working line is straight line connecting member working points.
3. Tolerances on position and alignment are as specified in the Code, unless otherwise modified.
   a. Provide "adjustable items" such as lintels, wall supports, curb angles, window mullions and similar members with adjustable connections to supporting structural frame.
4. Certification by steel erector:
   a. Certify the location of erected structural steel is acceptable for plumbness, level and aligned within tolerances specified.
   b. Provide certification upon completion of any part of work.
   c. Provide certification prior to start of work by other trades that may be supported; attach to structural steel work.

3.4 CLEANING AND REPAIR OF SHOP PRIMER PAINT

A. After erection, clean all steel of mud or other foreign materials, and repair any damage.
1. Touchup coatings to comply with Specification Section 09 91 00.

END OF SECTION

SECTION 05 21 00 - STEEL JOISTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manufactured open-web steel joists and joist accessories.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 05 12 00 - Structural Steel.
   4. Section 09 91 00 - Painting and Protective Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Institute of Steel Construction (AISC):
      a. 360, Specifications for Structural Steel Buildings (referred to herein as AISC Specification).
   2. ASTM International (ASTM):
      a. A36, Standard Specification for Carbon Structural Steel.
      b. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
      c. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
      d. A490, Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
   3. American Welding Society (AWS):
      a. D1.1, Structural Welding Code - Steel.
   4. Corps of Engineers (COE):
      a. CRD-C621, Standard Specification for Packaged, Dry, Hydraulic-Cement Grout (Nonshrink).
   5. Steel Joist Institute (SJI):
      a. Recommended Code of Standard Practice for Steel Joists and Joist Girders.
      b. Standard Specification for Open Web Steel Joists, K-Series (ANSI SJI-K-1.1).
      c. Standard Specification for Longspan Steel Joists LH-Series and Deep Longspan Steel Joists DLH-Series (ANSI SJI-LH-DLH-1.1).
      d. Standard Specification for Joist Girders (ANSI SJI-JG-1.1).
      e. Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders:
         1) Standard Load Table Open Web Steel Joists, K-Series.
         2) Standard Load Table Longspan Steel Joists, LH-Series.
         3) Standard Load Table Deep Longspan Steel Joists, DLH-Series.

B. Qualifications:
   1. Manufacturer: Member of SJI.
      a. Structural design calculations and details of manufactured joists shall be prepared by a qualified professional engineer retained by the manufacturer.

2. Qualification of welding work:
    a. Qualify welding processes, operations, and operators in accordance with requirements of AWS D1.1.
    b. Welding operators to have been qualified during the 12-month period prior to commencement of welding.

1.3 SUBMITTALS

A. Shop Drawings:
1. See Division 1 for requirements for the mechanics and administration of the submittal process.
2. Fabrication and/or layout drawings:
    a. Detailed Shop Drawings showing size and layout of each joist unit, bridging, connections, and accessories. Include mark, number, type, location, and spacing of joists and bridging.
    b. Show joining splice and connection to other work details.
    c. Provide templates or location drawings for installation of anchor bolts.
    d. Provide details of bridging, method of attachment to joists, and joist end anchorage and other details required for joist installation. Indicate beveled end plates for joist roof pitch where required.
    e. Show shop-applied coatings.
    f. Shop Drawings shall not be reproductions of the Contract Drawings.
3. Product technical data including:
    a. Joist manufacturer's load tables, Standard Specifications and installation instructions for each type of joist and its accessories. Include product data describing materials, shop coating, bridging, and accessories.
4. Certifications:
    a. Manufacturer’s certification that steel joists and accessories comply with specified requirements.
    b. Manufacturer member of SJI.
    c. Joist material, shop welding and testing, manufacturing and shop inspection and testing are in accordance with SJI requirements.
    d. Capability of joists per Paragraph 2.3A and D.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store and handle steel joists as recommended by SJI.
1. Exercise care to avoid damage to joists.

B. Store joists clear of earth on platforms, skids or other supports.
1. Protect joists after delivery to prevent rust and deterioration.

C. Provide anchor bolts and other items to be embedded in concrete or masonry, with templates as required, in time for incorporation into the work.

PART 2 - PRODUCTS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Nucor Corporation Vulcraft Divisions.
2. CANAM Steel Corporation.
3. Socar Incorporated.

2.2 MATERIALS

A. Steel: Comply with SJI and AISC Specifications for joist series indicated.

B. High-Strength Bolts, Nuts and Washers: ASTM A325 or ASTM A490 as required, heavy hexagon structural bolts with nuts and hardened washers.

C. Bolts and Nuts, Unfinished: ASTM A307, Grade A, regular hexagon type, low carbon steel, with carbon steel washers.

2.3 STEEL JOISTS

A. Design of steel joists to be supplied to have been checked by the SJI and found to conform to the standard specifications and load tables.

B. Fabricate Joists and Accessories in accordance with SJI Specifications and as follows:
   1. Make shop connections and splices using either arc or resistance welding.
      a. Do not shop bolt connections.
   2. Design and fabricate for maximum deflection of 1/360 of clear span under design live load.
   3. Shop holes, field holes, and enlargement of holes will not be permitted unless approved by Engineer.
   4. Fabricate bearing ends to provide following minimum bearing unless a longer bearing length is indicated on the Contract Documents.

	K SERIES	LH AND DLH SERIES	JOIST GIRDERS
On masonry or concrete:	4 IN min	6 IN min	6 IN min
On steel:	2-1/2 IN min	4 IN min	4 IN min

   5. With steel angle tops and bottom short members

C. Special or Concentrated Loads:
   1. Submit written certification that the joist(s) listed below (or joists for special loads indicated on Drawings) have been designed, fabricated, and are capable of supporting the indicated design loadings for the span(s) shown on the Drawings.
      a. Written certification to be signed and sealed by a registered Wisconsin Professional Structural Engineer.
      b. Submit certification along with the Shop Drawings for the joist(s).

JOIST SIZE	LOCATION	DESIGN UNIFORM LOAD	DESIGN CONCENTRATED LOAD
18KCS4	High Roof	See Drawings	NA
24KCS4	High Roof	See Drawings	NA
24KCS5	Above Monorail	See Drawings	5,500 lbs

D. Provide extended bottom chords where indicated.
   1. Comply with SJI and AISC requirements and load tables.

E. Provide extended top chords where indicated.
   1. Comply with SJI and AISC requirements and load tables.

F. Provide ceiling extensions in areas having ceilings attached directly to joist bottom chord.
   1. Provide either an extended bottom chord or a separate unit of sufficient strength to support ceiling construction.
   2. Extend ends to within 1/2 IN of wall surface.

G. Provide nailers bolted to top chord where indicated.

H. Prepare and paint steel joists and accessories in compliance with Section 09 91 00.

I. Comply with SJI Specifications:
   1. Joist designations indicated on the Drawing are minimum requirements; increase as required to comply with design requirements specified.
   2. Wherever possible increased joists shall have the same depth as joist indicated on Drawings.
   3. Where necessary to increase joist depths to meet design requirements, coordinate all project changes required due to the increased depth.
   4. Make all required joist revisions at no additional cost to Owner.

2.4 SOURCE QUALITY CONTROL

A. Engineer reserves right to inspect joists or manufacturer's shop during joist fabrication.

B. Identify each joist type, size and manufacturer.
   1. Provide tagging or other suitable (permanent) means.
   2. Maintain identification continuously.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine areas and conditions under which steel joists are to be installed for conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

C. Do not start placement of steel joists until supporting work is in place and secured.

D. Joists will be subject to rejection if:
   1. Joists do not comply with requirements of SJI and AISC Specifications and requirements herein.
   2. Joists are improperly manufactured, welded, painted or installed.
   3. Joists are damaged so that strength is impaired.
   4. Joists are not installed as indicated on Drawings.
   5. Chords are not installed straight within a tolerance of plus or minus 0.0028 times the length of the joist or the distance between points of lateral support.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
   1. Where not specifically indicated otherwise, place and secure steel joists in accordance with SJI and AISC Specifications and as herein specified.

B. Splice joists delivered to the site in more than one piece.

C. Do not overload joists.
   1. Note: Joists may not be stable or able to carry design loads until bridging and deck is fully installed.

2. Contractor is solely responsible for safety, construction methods and sequencing of the Work.
3. Do not install joists damaged so that strength is impaired.

D. Place joists on supporting work, adjust and align in accurate location and spacing before permanently fastening.
1. Provide end bearing and anchorages to secure all joists to supporting members or walls in accordance with SJI Specifications, unless otherwise indicated.
2. When joists do not bear flush on supporting member or wall, take corrective measures to ensure full bearing.
a. Provide steel shims as required for uniform flush bearing.

E. Field weld joists to supporting steel framework in accordance with SJI, AISC and AWS Specifications for type of joists used.
1. Coordinate welding sequence and procedure with placing of joists.

F. Bolt joists to supporting steel framework in accordance with SJI and AISC Specifications for type of joists.
1. Use ASTM A325 high-strength bolts.

G. Bearing on Masonry or Concrete Bearing Surfaces:
1. Secure joists resting on masonry or concrete bearing surfaces by bedding in mortar and anchoring to masonry or concrete construction as specified in SJI Specifications for type of steel joist used.
a. Masonry or concrete required to support joists to have reach required 28-day compressive strength prior to placing joists thereon.
b. Area under joist bearing shall be solidly fill with grout.
2. Furnish anchor bolts or steel bearing plates to be built into concrete and masonry construction.
a. Furnish templates as may be necessary for accurate location of anchors. Steel bearing plates to conform to ASTM A36.
3. Bedding mortar:
a. Sand cement grout:
1) Approximately 3 parts sand, 1 part Portland cement, 6 plus/minus 1 percent entrained air and water to produce a slump which allows grout to completely fill required areas and surround adjacent reinforcing.
2) Minimum 28-day compressive strength: 3000 psi.
b. Nonshrink grout complying with COE CRD-C621.

H. Provide type, size, spacing, and attachment of bridging in accord with SJI and AISC Specifications, where not specifically indicated otherwise, except as modified herein.
1. Provide diagonal type bridging as indicated.
2. Provide additional diagonal type bridging at each line of horizontal bridging between exterior and first interior joist and then at every 12th joist space.
3. Do not use sag rods as substitute for bridging.

I. Install bridging completely, immediately after erection, and before any loads are applied.
1. Anchor ends of bridging lines at top and bottom chords of each joist and where terminating at walls or beams.
2. Provide bridging connections at top and bottom chords capable of safely resisting a force specified by SJI Specifications for open web, long span, deep long span joists, and joist girders respectively.

3. Where five rows of bridging are required in spans over 40 FT, laterally brace each joist before erecting next joist or applying loads.
4. Do not release hoisting cables before installing center row of diagonal bridging and anchoring bridging line to prevent lateral movement.
5. During construction period, Contractor is responsible for any loads placed on joists.
    a. Contractor's attention is directed the fact that joists may be unstable and cannot carry their design load until steel deck and bridging are completely installed.

J. Remove or repair damaged joists or other work, to satisfaction of Engineer at no additional expense to Owner.

K. After installation, touch up paint or field paint as specified in Section 09 91 00.

3.3 FIELD QUALITY CONTROL

A. OWNER pays for inspection and testing:
1. Testing:
    a. Owner will employ and pay for services of an independent testing agency to inspect and test work for compliance with Specifications.
    b. Contractor responsible for testing to qualify shop and field welders and as needed for Contractor's own quality control to ensure compliance with Contract Documents.
    c. Contractor provides sufficient notification and access so inspection and testing can be accomplished.
    d. Contractor pays for retesting of failed tests and for additional testing required when defects are discovered.

B. Responsibilities of Testing Agency:
1. Visually inspect joists, anchorages, and connections which have been erected.
2. Prepare and submit inspection and test reports to Engineer.
    a. Assist Engineer to determine corrective measures necessary for defective work.
3. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
    a. Verify direct tension indicator gaps.

END OF SECTION

SECTION 05 30 00 - METAL DECK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manufactured metal roof deck.
   2. Manufactured metal composite deck.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 09 91 00 - Painting and Protective Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Iron and Steel Institute (AISI):
      a. S100, Specification for the Design of Cold-Formed Steel Structural Members.
   2. ASTM International (ASTM):
      a. A36/A36M, Standard Specification for Carbon Structural Steel.
      b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
      c. A780/A780M, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
      d. A1008/A1008M, 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.
      e. D746, Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
      f. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
   3. American Welding Society (AWS):
      a. D1.1/D1.1M, Structural Welding Code - Steel.
      b. D1.3/D1.3M, Structural Welding Code - Sheet Steel.
   4. Steel Deck Institute (SDI):
      a. 31, Design Manual for Composite Decks, Form Decks and Roof Decks.
   5. Underwriters Laboratories, Inc. (UL):
      a. Fire Resistance Directory.

B. Qualifications:
   1. Manufacturer:
      a. Member of SDI.
      b. Structural design of manufactured deck shall be prepared by a qualified professional engineer retained by the manufacturer.
   2. Welding work:
      a. Qualify welding processes, operations, and operators in accordance with requirements of AWS D1.1 and AWS D1.3.
      b. Welding operators to have been qualified during the 12 month period prior to commencement of welding, and be experienced in welding light gage metal.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Division 1 for requirements for the mechanics and administration of the submittal process.
   2. Fabrication and/or layout drawings:
      a. Detailed Shop Drawings showing the following:
         1) Complete framing and erection layouts.
         2) Location, length, type, cross section, thickness, and markings of metal deck units.
            a) Size and location of openings.
            b) Accessories and reinforcing.
         3) Sequence and procedure to be followed for erecting, fastening, and securing the deck units.
         4) Shop applied coatings.
         5) Location of required shoring for {composite} {and} form decks.
         6) Details and gages of accessories and miscellaneous items showing sump pans, cant strips, ridge and valley plates, closure and filler strips and insulation supports.
         7) Welding procedures for installation including size, number, type and location of all welds required to install deck units.
         8) Recommended welding rod size, type, burn off rate and welder setting for deck thickness to be joined.
            a) Define welds by use of standard AWS welding symbols.
         9) Correct fitting of members and accessories.
         10) Size and location of all openings in deck and all conditions requiring closure panels and supplementary framing.
         11) Shop Drawings shall not be reproductions of the Contract Drawings.
   3. Product technical data including:
      a. Metal deck manufacturer's specifications and installation instructions.
      b. Manufacturer's specifications and installation instructions for:
         1) Welds and welding procedure.
         2) Galvanizing repair paint.
         3) Screws.
         4) Joint sealing compound.
      c. Manufacturer's load tables for deck to be furnished on this project, including:
         1) Allowable gravity load for metal roof deck.
         2) Allowable diaphragm shear values for metal roof deck.
         3) Allowable superimposed load for metal deck.
         4) Allowable unshored span lengths for composite and form deck.
   4. Manufacturers certification that metal deck complies with specified requirements:
      a. Manufacturer member of SDI.
      b. Deck material, manufacturing, and shop testing and inspection are in accordance with SDI requirements.
      c. Welder qualifications.
   5. Test reports.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle metal deck as recommended by SDI.
   1. Exercise care to avoid damage to deck.

B. Protect materials from rusting, denting or crushing.
   1. Store metal deck on project site off the ground with one end elevated to provide drainage and protected from the elements with a waterproof covering, ventilated to avoid condensation.
   2. Prevent rust, deterioration and accumulation of foreign material.

1.5 PROJECT CONDITIONS

A. Do not overload supporting members.
   1. Until the entire assembly is complete, the structural elements may not be stable or capable of supporting code or stated design loads.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. 1-1/2 IN and 3 IN deep metal roof deck:
      a. Vulcraft.
      b. Verco Decking, Inc.
      c. New Millennium Building Systems.
      d. Consolidated Systems, Inc.
      e. DACS, Inc.
   2. 1-1/2 IN deep composite floor deck:
      a. Vulcraft, Type 1.5 VL.
      b. Verco Decking, Inc., PLB FORMLOK.
      c. New Millennium Building Systems, 1.5 CD.
      d. Consolidated Systems, Inc. CFD 1.5.
      e. DACS, Inc., 1-1/2 IN Composite Deck.
   3. 3 IN deep composite floor deck:
      a. Vulcraft, Type 3 VL.
      b. Verco Decking, Inc., PLW3.
      c. New Millennium Building Systems, 3.0 CD.
      d. Consolidated Systems, Inc., CFD3.
      e. DACS, Inc., 3 IN Composite Deck.

B. Submit request for substitution in accordance with Division 1.

2.2 METAL ROOF DECK

A. Design of the metal deck to be supplied to have been checked by SDI and found to conform to the standard specifications and load tables.
   1. The allowable superimposed live uniform loading per square foot for metal roof deck supplied for the spans indicated shall equal or exceed the allowable superimposed live uniform load per square foot for the same spans as indicated in the SDI latest tables.
   2. Maximum deflection: Less than 1/240 of span under live load.

B. Use deck configurations complying with SDI 31and as indicated.
   1. Painted deck: ASTM A1008.
   2. Galvanized deck: ASTM A653 G60 zinc coating.

C. Metal Roof Deck, 1-1/2 IN Deep:
   1. Minimum depth and gage as indicated on the Drawings.

2.3 COMPOSITE FLOOR DECK

A. Composite Floor Deck:
   1. Minimum depth and gage as indicated on the Drawings.
   2. Minimum superimposed load capacity:
      a. As indicated on the Drawings.
      b. Design in accordance with SDI 31.
   3. Fabricate deck from steel conforming to AISI S100, Section A3.
   4. Finish: Galvanized coating conforming to ASTM A653 G60 zinc coating.
   5. Metal closures and pour-stops:
      a. Manufacturers standard, 20 GA minimum, and as indicated on the Drawings.
      b. Finish: Galvanizing conforming to ASTM A653 G60, minimum.
      c. Form to configuration required to provide mortar-tight closures.

B. Provide composite deck to act as bottom form for cast-in-place concrete slabs and which will become positive slab reinforcement through mechanical anchorage after concrete hardens.

C. Maximum Deflection:
   1. Deck as a form: Less than 1/180 of span or 3/4 IN, whichever is smaller, under the weight of wet concrete and steel deck.
   2. Composite slab with deck: Less that 1/360 under superimposed loads.

2.4 FABRICATION

A. Standard Deck Profiles:

DEPTH	TYPE	RIB SPACING	TOP SURFACE MAXIMUM RIB OPENING	MINIMUM BOTTOM OF RIB WIDTH
1-1/2 IN	Roof Deck - Narrow Rib ('A')	6 IN	1 IN	3/8 IN
1-1/2 IN	Roof Deck - Intermediate Rib ('F')	6 IN	1-3/4 IN	1/2 IN
1-1/2 IN	Roof Deck - Wide Rib ('B')	6 IN	2-1/2IN	1-3/4 IN
3 IN	Roof Deck ('N')	8 IN	2-3/4 IN	1-1/2 IN
1-1/2 IN	Form Deck ('C')	6 IN	1-3/4 IN	2-1/2 IN (max)
1-1/2 IN	Composite Floor Deck	6 IN	2-1/2 IN	1-3/4 IN
2 IN	Composite Floor Deck	12 IN	7 IN	5 IN
3 IN	Composite Floor Deck	12 IN	7-1/4 IN	4-3/4 IN
3 IN	Composite Floor Deck	8 IN	2-3/4 IN	1-3/4 IN

B. Minimum Deck Thickness:
   1. Where gage of metal is indicated, provide the minimum uncoated thickness as specified by SDI.
      a. Delivered thickness of the uncoated steel: No less than 95 percent of the design thickness.
   2. Use steel with a minimum yield stress as indicated on the Drawings.

C. Fabrication:
   1. Fabricate deck units in lengths to span three or more support spacings with flush, telescoped or nested 2 IN end laps.
      a. End laps shall occur on supporting members.
      b. Provide deck units having overlapping male and female type side laps or joints to provide positive vertical and lateral alignment of adjacent deck units.

2.5 ACCESSORIES

A. Metal Closures:
   1. Form to configuration required to provide tight-fitting closures at open ends and sides of deck.
   2. Minimum thickness before galvanizing: 0.0358 IN (20 GA).

B. Ridge and Valley Plates:
   1. Minimum width: 4-1/2 IN.
   2. Bend to provide tight-fitting closure with deck units.
   3. Provide plates in 10 FT length where possible.
   4. Minimum thickness before galvanizing: 0.0747 IN (14 GA).

C. Welding Washers:
   1. 16 GA bent steel plate with 3/8 IN center hole.
   2. Use at all deck units thinner than 20 GA.

D. Filler Sheet: Flat or formed 20 GA galvanized steel.

E. Roof Sump Pans:
   1. Fabricate from a single piece of galvanized sheet steel with level bottoms and sloping sides to direct water flow to drain.
   2. Provide sump pans of adequate size to receive roof drains with bearing flanges minimum 3 IN wide.
   3. Recess pans not less than 1-1/2 IN below roof deck surface, unless otherwise indicated or required by deck configuration.
   4. Minimum thickness before galvanizing: 0.0747 IN (14 GA).

F. Cant Strips:
   1. Bend cant strips to form 45 degree slope not less than 5 IN wide, with top and bottom flanges not less than 3 IN wide.
   2. Minimum thickness before galvanizing: 0.0358 IN (20 GA).

G. Insulation supports.

H. Venting: Slotted openings in bottom flutes in accordance with manufacturer's standards.

I. Metal Pour Stops: Form to configuration required to provide mortar-tight closures at open sides and ends of deck.

J. Primer Paint: Deck manufacturer's baked on, rust-inhibitive paint applied at plant to chemically cleaned and phosphate chemically treated metal surfaces.

K. Galvanized coating for metal deck accessories: Conform to ASTM A653 G60 zinc coating.

L. Galvanized Repair Paint: Comply with Specification Section 09 91 00 and ASTM A780 for repair of damaged galvanized surfaces.

M. Screws:
   1. Self-drilling, self-tapping, #12 size minimum hex washer head sheet metal screws.
   2. Carbon steel by Hilti.
      a. Organic zinc chromate coated, Hilti Kwik-cote.

N. Miscellaneous Steel Shapes: Comply with ASTM A36.

O. Sheet Metal Accessories: Same material and finish as deck members.

P. Flexible Closure Strips for Deck:
   1. Vulcanized, closed cell expanded chloroprene elastomer, complying with ASTM D1056, Grade SCE 41.
   2. Brittleness temperature: -40 DegF, ASTM D746.
   3. Flammability resistance: Self-extinguishing.
   4. Install with adhesive in accordance with manufacturer's instructions.
      a. Ensure complete closure.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine areas and conditions under which metal deck is to be installed for conditions detrimental to proper and timely completion of work.

B. Do not proceed with work until unsatisfactory conditions have been corrected.

C. Do not start placement of metal deck until supporting work is in place and secured.

D. Deck will be subject to rejection if metal deck:
   1. Units do not comply with requirements of SDI specifications and requirements herein.
   2. Is improperly manufactured, painted or installed.
   3. Is damaged so that strength is impaired.
   4. Is not installed as specified.

3.2 INSTALLATION

A. Install roof deck units and accessories as indicated, in accordance with SDI 31, manufacturer's recommendations, final approved Shop Drawings and as specified herein.
   1. Furnish manufacturer's standard accessories as needed to complete the deck installation.

B. Locate deck bundles to prevent overloading of structure.

C. Do not overload metal deck or supporting members:
   1. Contractor is solely responsible for safety, construction means, methods and sequencing of the Work.
   2. Until the entire assembly is complete, the structural elements may not be stable or capable of supporting code or stated design loads.
   3. Use care to assure deck construction loads are less than the recommendation of SDI 31, except where temporary shoring is installed.

D. Place each deck unit on supporting structural frame, adjust to final position and accurately align with ends bearing on supporting members.
   1. Lap roof deck units at ends no less than 2 IN.
   2. Interlock units at sides without stretching, contracting, or deforming.

3. Place deck units flat and square and secure to framing without warp or excessive deflection.
4. Place units in accurate and close alignment for entire length of run and with close registration of flutes of one unit with those of abutting unit.

E. Plug weld sizes specified are effective fusion diameter of welds.
1. Weld metal shall penetrate all layers of deck material and have good fusion to supporting members.
2. Do not burn through deck.

F. Prevent overtorquing of screw fasteners by using a tool with a depth limiting nosepiece and a clutch.

G. Fastening of 1-1/2 IN Deep Metal Roof Deck:
1. Secure deck units to supporting frame and side laps as follows:
   a. Fasten edge ribs of panels at each support.
   b. At all interior supports and at ends of deck use:
      1) For 24 IN wide deck: Three (3) 5/8 IN round plug welds per deck unit.
      2) For 30 and 36 IN wide deck: Four (4) 5/8 IN round plug welds per deck unit.
      3) Install 22 GA deck with welding washers at weld locations.
   c. At perimeter supports, use 5/8 IN round plug welds at 12 IN OC.
   d. At side laps, use 5/8 IN round puddle weld or 3/8 x 1-1/2 IN arc seam weld at 18 IN OC.

H. Fastening of Composite and Form Deck:
1. Secure deck units to supporting frame and side laps as follows:
   a. Fasten edge ribs of panels at each support.
   b. At each end of each unit and at intermediate supports: 5/8 IN puddle welds at 12 IN OC with not less than two welds per support.
   c. At perimeter parallel to deck: 5/8 IN puddle welds or 3/8 x 1-1/4 IN seam welds at 18 IN OC.
   d. At side laps: Puddle welds spaced not more than 2 FT OC.
   e. At sheet metal closures used at ends or sides: Self-drilling sheet metal screws or tack welds at 2 FT OC.

I. Shoring for Composite and Form Deck:
1. Design and install temporary shoring for composite form deck for span conditions and lengths where required in SDI 31.
2. Shoring to support form deck for the construction loads listed in SDI 31 or for the actual loads applied during construction, whichever is greater.
   a. Indicate shoring on installation Shop Drawings.
3. Locate shoring so as not to overstress supporting construction.
4. Do not remove shores until concrete has reached at least 75 percent of its specified compressive strength.

J. Remove and replace deck which is structurally weak or unsound or which has burn holes due to improper welding or damage which Engineer declares defective.

K. Cut and fit deck units and accessories around other work projecting through or adjacent to decking.
1. Make cutting and fitting neat, square and trim.
   a. Cut deck by mechanical means, not by burning.

2. Neatly and accurately install reinforcing at all openings except:
    a. Circular openings less than 6 IN DIA.
    b. Rectangular openings having no side dimension greater than 6 IN.
3. Reinforce openings that have not been framed between 6 and 12 IN with 20 GA flat steel sheet 12 IN greater in each dimension than opening.
    a. Place sheet around opening and fusion weld to top surface of deck at each corner and midway along each side.

L. Install insulation supports for support of roof insulation.
1. Provide where top surface of roof deck does not occur adjacent to edge and openings as required to completely support roof insulation.
2. Weld into position.

M. Install metal closure strips at all open uncovered ends and edges of roof deck, and in voids between deck and other construction.
1. Weld into position to provide a complete decking installation.
2. Provide flexible closure strips instead of metal closures, at Contractor's option and when approved by Engineer wherever their use will ensure complete closure.
    a. Install with elastomeric type adhesive in accordance with written directions and recommendations of manufacturers of closure strips and adhesives.

N. Ridge and Valley Plates:
1. Weld ridge and valley plates to top surface of roof deck.
2. Lap end joints not less than 3 IN with laps in direction of water flow.

O. Roof Sump Pans:
1. Place over openings in roof deck.
2. Weld to top deck surface.
    a. Space welds maximum 12 IN OC with at least one weld at each corner and each side midway between each corner.
3. Cut opening in bottom of roof sump to accommodate drain size indicated.

P. Cant Strips:
1. Weld cant strips to top surface of roof deck at 12 IN OC.
2. Lap end joints not less than 3 IN.

Q. Install metal accessories to close all openings and gaps between deck and other construction, at objects projecting through deck, at locations where deck changes direction, and at open ends of deck units where deck units terminate.
1. Weld into position to provide a complete installation.

R. Install pour stops continuous around the perimeter:
1. Locate so that the slab terminates beyond the perimeter support centerline a distance as indicated on the Contract Drawings.
2. Weld into position adequately to resist forces due to placement and finishing of concrete and in accordance with manufacturer's recommendations.

S. Clean and Touch Up:
1. Remove all surplus materials and debris from surface of deck after installation.
2. Repair damaged galvanized surfaces in accordance with Specification Section 09 91 00.

3.3 FIELD QUALITY CONTROL

A. Remove and replace defective or damaged deck units.

B. Testing:
   1. Make the following test in the presence of the Testing Agency employed on the project on the first deck panel to be installed.
   2. Place one (1) end of panel over a perimeter support and attach it only to that support with two (2) welds as specified 6 IN apart.
   3. Move the opposite end of the panel in plane parallel to the span of the panel until shear distress is noted in the weld.
   4. Make the welds of sufficient quality to cause local distortions in the panel around the welds and show good perimeter contact between the welds and the panel.
   5. When the results of this test are satisfactory and approved by the {Engineer} {Testing Agency}, install the remainder of the deck using the same weld rod size and type, amperage setting, and procedures used in the tested deck.
   6. Visually inspect the remainder of the welds.
      a. When, in the opinion of the Testing Agency, any weld is of poor quality, provide an additional weld adjacent to the rejected weld.
      b. Place the new weld on sound, unburned deck a sufficient distance away from the rejected weld.

END OF SECTION

SECTION 05 50 00 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Custom fabricated metal items and certain manufactured units not otherwise indicated to be supplied under work of other Specification Sections.
   2. Design of all temporary bracing not indicated on Drawings.
   3. Design of systems and components, including but not limited to:
      a. Stairs.
      b. Landings.
      c. Ladders.
      d. Modular framing system.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 03 31 30 - Concrete, Materials and Proportioning.
   4. Section 05 12 00 - Structural Steel.
   5. Section 05 52 13 - Pipe and Tube Railings.
   6. Section 09 91 00 - Painting and Protective Coatings.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. Aluminum Association (AA):
      a. ADM 1, Aluminum Design Manual.
   2. American Association of State Highway and Transportation Officials (AASHTO):
      a. HB, Standard Specifications for Highway Bridges.
   3. American Institute of Steel Construction (AISC):
      a. 325, Manual of Steel Construction - Allowable Stress Design (ASD).
      b. 360, Specifications for Structural Steel Buildings (referred to herein as AISC Specification).
   4. American National Standards Institute (ANSI):
      a. A14.3, Ladders - Fixed - Safety Requirements.
   5. American Society of Civil Engineers (ASCE):
      a. 7, Minimum Design Loads for Buildings and Other Structures.
   6. ASTM International (ASTM):
      a. A6, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
      b. A36, Standard Specification for Carbon Structural Steel.
      c. A47, Standard Specification for Ferritic Malleable Iron Castings.
      d. A48, Standard Specification for Gray Iron Castings.
      e. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
      f. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.
      g. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
i. A197, Standard Specification for Cupola Malleable Iron.
j. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
k. A276, Standard Specification for Stainless Steel Bars and Shapes.
l. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
m. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
n. A325, Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
o. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
p. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
q. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
r. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
s. A536, Standard Specification for Ductile Iron Castings.
t. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
u. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
v. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
w. A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
x. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
y. A786, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
z. A992, Standard Specification for Steel for Structural Shapes.
aa. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
bb. B26, Standard Specification for Aluminum-Alloy Sand Castings.
cc. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
dd. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
ee. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
ff. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
gg. B632, Standard Specification for Aluminum-Alloy Rolled Tread Plate.
hh. F467, Standard Specification for Nonferrous Nuts for General Use.
ii. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
jj. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

kk. F835, Standard Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws.
ll. F879, Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws.
mm. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
nn. F1789, Standard Terminology for F16 Mechanical Fasteners.

7. American Welding Society (AWS):
   a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
   b. D1.1, Structural Welding Code - Steel.
   c. D1.2, Structural Welding Code - Aluminum.
   d. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
8. National Association of Architectural Metal Manufacturers (NAAMM):
   a. AMP 510, Metal Stairs Manual.
   b. AMP 555, Code of Standard Practice for the Architectural Metal Industry (Including Miscellaneous Iron).
   c. MBG 531, Metal Bar Grating Manual.
9. NACE International (NACE).
10. Nickel Development Institute (NiDI):
    a. Publication 11 007, Guidelines for the welded fabrication of nickel-containing stainless steels for corrosion resistant services.
11. Occupational Safety and Health Administration (OSHA):
    a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
12. Building code:
    a. International Code Council (ICC):
       1) International Building Code and associated standards, 2009 Edition including all amendments, referred to herein as Building Code.

B. Qualifications:
   1. Qualify welding procedures and welding operators in accordance with AWS.
   2. Fabricator shall have minimum of 10 years experience in fabrication of metal items specified.
   3. Engineer for contractor-designed systems and components: Professional structural engineer licensed in the State of Wisconsin.
   4. NACE certified inspector shall have minimum of two (2) years experience performing inspections as indicated.
      a. Have a current Level III coating inspector certification.

1.3 DEFINITIONS

A. Fasteners: As defined in ASTM F1789.

B. Galvanizing: Hot-dip galvanizing per ASTM A123/A123M or ASTM A153/A153M with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.

C. Hardware: As defined in ASTM A153/A153M.

D. Installer or Applicator:
   1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
   2. Installer and applicator are synonymous.

1.4 SUBMITTALS

A. Shop Drawings:
   1. See Division 1 for requirements for the mechanics and administration of the submittal process.
   2. Fabrication and/or layout drawings and details:
      a. Submit drawings for all fabrications and assemblies.
         1) Include erection drawings, plans, sections, details and connection details.
      b. Identify materials of construction, shop coatings and third party accessories.
   3. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
      c. Provide manufacturer's standard allowable load tables for the following:
         1) Grating and checkered plate.
         2) Expansion anchor bolts.
         3) Adhesive anchor bolts.
         4) Castings, trench covers and accessories.
         5) Modular framing systems.
   4. Contractor designed systems and components, including but not limited to, stairs, landings and ladders:
      a. Certification that manufactured units meet all design loads specified.
      b. Shop Drawings and engineering design calculations:
         1) Indicate design live loads.
         2) Sealed by a professional structural engineer.
         3) Engineer will review for general compliance with Contract Documents.

B. Informational Submittals:
   1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
   2. Certification of welders and welding processes.
      a. Indicate compliance with AWS.
   3. NACE inspector qualifications.
   4. NACE certification of surface preparation.
   5. NACE certification of paint application.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and handle fabrications to avoid damage.

B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer registered in the State of Wisconsin to design ladders.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

2.2 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Abrasive stair nosings (embedded in concrete stairs):
      a. American Safety Tread.
      b. Balco.
   2. Headed studs and deformed bar anchors:
      a. Nelson Stud Welding Div., TRW Inc.
      b. Stud Welding Products, Inc.
   3. Expansion anchor bolts:
      a. Hilti Inc.
      b. ITW Ramset/Red Head.
      c. Simpson Strong-Tie.
   4. Epoxy adhesive anchor bolts:
      a. Hilti Inc.
      b. ITW Ramset/Red Head.
      c. Simpson Strong-Tie.
   5. Self-tapping concrete anchors:
      a. ITW Buildex.
      b. Powers Fasteners.
   6. Castings, trench covers and accessories:
      a. Neenah Foundry Co.
      b. Deeter Foundry Co.
      c. Barry Craft Construction Casting Co.
      d. McKinley Iron Works.
   7. Aluminum ladders:
      a. Any manufacturer capable of meeting the requirements of this Specification Section.
   8. Galvanizing repair paint:
      a. Clearco Products Co., Inc.
      b. ZRC Products.
   9. Modular framing system:
      a. Unistrut Building Systems.
      b. B-Line Systems.
      c. Kindorf.
      d. Superstrut.
   10. Ladder safety extension post:
      a. Bilco.

B. No like, equivalent or "or-equal" item or substitution is permitted.

C. Submit request for substitution in accordance with Specification Section 01 25 13.

2.3 MATERIALS

A. Steel:
   1. Structural:
      a. W-shapes and WT-shapes: ASTM A992, Grade 50.
      b. All other plates and rolled sections: ASTM A36.
   2. Pipe: ASTM A53, Types E or S, Grade B or ASTM A501.
   3. Structural tubing:
      a. ASTM A500, Grade B (46 ksi minimum yield).

4. Bolts, nuts and washers, high strength:
    a. ASTM A325.
    b. Provide two (2) washers with all bolts.
5. Bolts and nuts:
    a. ASTM A307, Grade A.
6. Welding electrodes: AWS D1.1, E70 Series.
7. Steel forgings: ASTM A668.

B. Iron:
1. Ductile iron: ASTM A536.
2. Gray cast iron: ASTM A48 (minimum 30,000 psi tensile strength).
3. Malleable iron: ASTM A47, ASTM A197.

C. Washers: Same material and alloy as found in accompanying bolts and nuts.

D. Embedded Anchor Bolts:
1. Building anchor bolts: See Specification Section 05 12 00.

E. Expansion Anchor Bolts and Adhesive Anchor Bolts:
1. Stainless steel, Type 304, 314 or 316.
2. Provide minimum edge distance cover and spacing as recommended by manufacturer, or as indicated on Drawings whichever is larger.
    a. Minimum embedment as recommended by manufacturer or eight (8) diameters of bolt, whichever is larger.
    b. Notify Engineer if required depth of embedment cannot be achieved at a particular anchor bolt location.
    c. Follow manufacturer's recommendations for installation and torque.

F. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 psi and a minimum tensile strength of 60,000 psi.

G. Deformed Bar Anchors: ASTM A496 or ASTM A1064 with a minimum yield strength of 70,000 psi and a minimum tensile strength of 80,000 psi.

H. Iron and Steel Hardware: Galvanized in accordance with ASTM A153/A153M when required to be galvanized.

I. Galvanizing Repair Paint:
1. High zinc dust content paint for regalvanizing welds and abrasions.
2. ASTM A780.
3. Zinc content: Minimum 92 percent in dry film.
4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."

J. Dissimilar Materials Protection: See Specification Section 09 91 00.

2.4 MANUFACTURED UNITS

A. Ladders:
1. General:
    a. Fully welded type.
        1) All welds to be full penetration welds.
    b. All ladders of a particular material shall have consistent construction and material shapes and sizes unless detailed otherwise on the Drawings.
    c. Design ladder in accordance with OSHA Standards, ANSI A14.3, ASCE 7 and applicable Building Codes.

d. Ladders shall be designed to support a minimum concentrated live load of 300 LBS at any point to produce the maximum stress in the member being designed.
    1) Apply additional 300 LB loads for each section of ladder exceeding 10 FT.
e. Maximum allowable stresses per AA ADM 1.
f. Maximum lateral deflection: Side rail span/240 when lateral load of 100 LBS is applied at any location.

2. Material:
    a. Galvanized steel.
    b. Finish:
        1) Steel: Galvanized after fabrication.
3. Rails:
    a. Round pipe or rectangular tubing:
        1) Round pipe:
            a) 1-1/2 IN nominal diameter.
            b) Schedule 80.
        2) Rectangular tubing:
            a) Cross-section: 3 by 2 IN maximum.
            b) Thickness: 0.125 IN minimum.
    b. Spacing:
        1) Minimum clear distance between rails to be 18 IN.
        2) Step-through ladder extensions: 24 IN, centerline to centerline.
    c. Provide cap at exposed top and bottom of side rails.
        1) Provide weep holes as necessary to prevent the accumulation of moisture within hollow members.
    d. Extend side rails of step-through ladders a minimum of 42 IN above the landing.
4. Rungs:
    a. Minimum 1 IN DIA or 1 IN square solid bar.
        1) Integral non-slip finish on all sides.
            a) Non-slip finish: Coarse knurling or extruded serrations.
            b) Shop or field-applied grit tape and cap type non-slip finish is not acceptable.
    b. Rungs shall penetrate inside wall of side rails.
        1) Do not extend rungs beyond the outside face of the side rail.
        2) Provide full-penetration weld all around rung.
    c. Rung spacing:
        1) Uniform, 12 IN.
        2) Top rung shall be level with landing or platform.
            a) Where top of ladder terminates at grating cover, floor access door, roof hatch or similar condition; locate top rung as close as practicable to, but not more than 6 IN below, adjacent walking surface.
        3) Spacing of bottom rung from grade or platform may vary but shall not exceed 14 IN.
5. Brackets:
    a. Angle or bent plate brackets welded to side rails:
        1) 3/8 IN by 2-1/2 IN by length required.
        2) Provide punched holes for 3/4 IN bolts or anchors.
        3) Minimum distance from centerline of rung to wall or any obstruction: 7 IN.
        4) Maximum spacing: 4 FT OC.

b. For floor supported ladders, provide 3/8 by 2-1/2 by 4 IN rectangular bracket or 3/8 by 6 by 6 IN square plate welded to rails with punched holes for 3/4 IN bolts.
    1) Provide wall brackets on floor supported units if vertical run is over 4 FT.

6. Provide ladder cage where shown on the Drawings.
    a. Cage construction shall meet all requirements of OSHA Standards and this Specification Section:
        1) Hoops: Minimum 1/4 by 2 IN bar at 48 IN OC spacing.
        2) Vertical bars: Minimum 1/4 by 1-1/2 IN bar.
        3) Weld all connections.
        4) Construct cage of same materials as the ladder on which it is mounted.
        5) Mount cage on ladder by welding.
7. Landings:
    a. Construct landing, railing and all supports of same material as the ladder.
    b. Design landing platform and supporting structure for not less than 100 psf plus a concentrated load of 300 LBS with a maximum deflection of 1/300 of span under a superimposed live load of 100 psi.
    c. Grating:
        1) Minimum 1-1/2 IN non-slip grating per this Specification Section.
        2) Attach grating using stainless steel clips and bolts at 24 IN OC maximum spacing.
    d. Structural support: Channel or tubular sections with bracing, plates, angles, etc., to support guardrail and grating and to support landing off the side of the building wall.
        1) Weld or bolt all connections using stainless steel bolts, nuts and washers.
    e. Guardrails:
        1) Match ladder side rails.
            a) Space intermediate rails equally between top rail and top of kickplate.
        2) Provide 4 IN high x 3/8 IN thick toeboard each side of landing.
8. Gates:
    a. Constructed of same material and sizes as the ladder system.
    b. Hinges:
        1) Stainless steel.
        2) Heavy-duty, self-closing.
    c. Gate stop:
        1) Galvanized steel.
        2) Positive self-latching.
9. Ladder safety extension post:
    a. Telescoping tubular galvanized steel section that automatically locks into place when fully extended.
    b. Non-ferrous corrosion-resistant spring and hardware.
    c. Factory assembled with all hardware necessary for mounting to ladder.
    d. Bilco "LadderUp" safety post.

B. Metal Ships' Ladders
1. Provide metal ships' ladders where indicated. Fabricate of open-type construction with channel or plate stringers and pipe and tube railings unless otherwise indicated. Provide brackets and fittings for installation.
    a. Treads shall be not less than 5 inches exclusive of nosing or less than 8-1/2 inches including the nosing, and riser height shall be not more than 9-1/2 inches.
    b. Fabricate ships' ladders, including railings, from steel.

c. Fabricate treads from welded or pressure-locked steel bar grating. Limit openings in gratings to no more than ½ inch in least dimension.
d. Comply with applicable railing requirements in Section 05 52 13.

C. Bollards:
1. 8 IN DIA extra strength steel pipe, ASTM A53.
a. Galvanized.
b. See Specification Section 09 91 00 for painting requirements.

D. Abrasive Stair Nosings:
1. Two (2) component consisting of an embedded subchannel, installed with the concrete pour, and an abrasive tread plate to be installed later.
2. 6063-T5 extruded aluminum, mill finished and heat treated.
3. Complete with concrete anchors and tread plate securing screws.
4. Tread plate:
a. Extruded aluminum.
b. Solid epoxy abrasive filler.
1) Color: Safety yellow.
5. Balco "DXH-330."
6. Length:
a. Concrete stairs:
1) 4 IN less than overall stair width.
2) Where tread mounted railing post occurs, hold nosing back 4 IN clear from railing centerline.
b. Concrete landings at metal stairs: 4 IN less than clear width between stringers.

E. Metal Stairs:
1. Fabricated as indicated.
2. Treads: Grating as specified.
a. Provide integral corrugated non-slip nosing.
3. Risers:
a. Grating treads: Solid plate attached to trailing edge of tread as shown on Drawings.
b. Landings: Grating as specified.
c. Provide integral corrugated non-slip nosing at edge acting as stair tread/nosing.
d. Nosing at concrete landing:
1) Abrasive stair nosing.
4. Fabricate and design stair, platforms and landings, and all connections to support a 100 psf uniform live load or a concentrated load of 1000 LBS, whichever requires the stronger component.
5. Design, fabricate, and install in compliance with NAAMM and applicable codes.
a. NAAMM AMP 510:
1) Exterior at site structures and equipment: Industrial Class.
2) Interior or exterior at buildings: Service Class.
6. Material:
a. Steel: ASTM A36, galvanized after fabrication.

F. Steel Checkered Plate:
1. Conform to ASTM A786.
a. Diamond pattern: No.3 (large) or No.4 (medium).
b. Use one (1) pattern throughout Project.
c. Material: 36 ksi minimum yield strength.
2. Design live load:

a. 100 psf, uniform load.
b. 300 LBS concentrated load on 4 IN square area.
c. All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
d. Maximum deflection: 1/300 of span under a superimposed live load of 50 psf.

3. Reinforce as necessary with steel angles.
4. Plate sections:
   a. Maximum 3 FT wide.
   b. Minimum 1/4 IN thick.
   c. Maximum 100 LBS per section if required to be removable.
5. Provide joints at center of all openings unless shown otherwise.
   a. Reinforce joints and openings with additional angles to provide required load carrying capacity.
6. Unless shown otherwise, frame for opening with steel checkered plate cover:
   a. Steel support angles:
      1) 3 by 2 by 1/4 IN minimum size with long leg vertical.
      2) 5/8 IN DIA adhesive anchor bolts spaced at maximum of 24 IN OC along each side with not less than two (2) anchor bolts per side.
   b. Steel concrete insert seats:
      1) 2 by 2 by 1/4 IN minimum size.
      2) Auto-welded studs or strap anchors, ASTM A108 at 18 IN OC with not less than two (2) studs or anchors per side.
   c. Drill and tap frame to receive 3/8 IN DIA fasteners at not more than 24 IN OC with not less than two (2) fasteners per side.
      1) Fasteners: Flat countersunk cap screws, ASTM F835.
         a) Galvanized, ASTM A153/A153M.
7. Provide galvanized checkered plate and edge supports.

G. Steel Grating:
1. NAAMM MBG 531.
2. Bearing bars:
   a. Platforms and Walkways:
      1) Rectangular 1-1/2 by 3/16 IN unless shown otherwise on Drawings.
      2) Maximum 1-3/16 IN OC spacing.
   b. Over Truck Wash Pit (15-W-4):
      1) Rectangular 4 by ¼ IN
      2) Maximum 15/16 IN OC spacing.
3. Cross bars:
   a. Welded, swagged or pressure locked to bearing bars.
   b. Maximum 4 IN OC spacing.
4. Top edges of bars: Serrated.
5. Removable grating sections: Not wider than 3 FT and not more than 50 LBS.
6. Finish:
   a. Galvanized.
   b. Clips and bolts: Galvanized.
   c. Seat angles: Galvanized steel.
7. Ends and perimeter edges: Banded.
8. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 IN high toe plate.
9. Provide joints at openings between individual grating sections.

H. Heavy-Duty Castings, Trench Covers, and Accessories:

1. Prefabricated, cast iron ASTM A48 or ductile iron ASTM A536.
2. Design load: AASHTO HS-20 wheel loading for indicated span.
3. Machine horizontal mating surfaces.

I. Access Cover:
1. Tank type manhole frame and solid lid: ASTM A48 or ASTM A536, cast iron.
2. Unless shown otherwise, design of cover shall be such that top of frame extends several inches above slab to prevent surface water from entering tank.
3. Equip lid with four (4) stainless steel screws to secure lid to frame.

J. Loose Lintels:
1. Steel, ASTM A36 or ASTM A572 Grade 50, sizes as indicated on Drawings.
2. Hot-dip galvanized per ASTM A123/A123M.

K. Modular Framing System:
1. Materials:
   a. Steel: ASTM A1011, stainless steel, Grade 33.
      1) Hot-dipped galvanized, ASTM A123 or ASTM A153.
   b. Aluminum: ASTM B221 or ASTM B209.
   c. Stainless steel: ASTM A666.
   d. Fiberglass: See Specification Section 06 82 00.
2. Channels and inserts:
   a. Steel or stainless steel: Minimum 12 GA.
   b. Aluminum: Minimum 0.080 IN.
   c. Channels to have one (1) side with a continuous slot with in-turned lips.
      1) Width: 1-5/8 IN.
      2) Depth and configuration as necessary for loading conditions.
3. Fittings: Same material as system major components.
4. Fasteners:
   a. Nuts: Toothed groves in top of nuts to engage the in-turned lips of channel.
   b. Bolts: Hex-head cap screws.
   c. Same material as system major components.
5. End caps:
   a. At each exposed end of each piece mounted on walls, or guardrails, or suspended from framing 7 FT or less above the floor or platform.
      a) Plastic for all exposed ends 7 FT or more above floor or platform.
      b) Plastic or metallic for all other exposed ends.
6. Schedule:
   a. All areas: Hot-dipped galvanized steel.
7. Provide dissimilar materials protection in accordance with Specification Section 09 91 00.
8. Repair all cut ends or otherwise damaged areas of galvanized steel in accordance with ASTM A780.

2.5 FABRICATION

A. Verify field conditions and dimensions prior to fabrication.

B. Form materials to shapes indicated with straight lines, true angles, and smooth curves.
1. Grind smooth all rough welds and sharp edges.
   a. Round all corners to approximately 1/16 IN nominal radius.

C. Provide drilled or punched holes with smooth edges.
1. Punch or drill for field connections and for attachment of work by other trades.

D. Weld Permanent Shop Connections:
   1. Welds to be continuous fillet type unless indicated otherwise.
   2. Full penetration butt weld at bends in stair stringers and ladder side rails.
   3. Weld structural steel in accordance with AWS D1.1 using Series E70 electrodes conforming to AWS A5.1/A5.1M.
   4. Weld aluminum in accordance with AWS D1.2.
   5. Weld stainless steel in accordance with AWS D1.6.
      a. Treat all welded areas in accordance with ASTM A380.
   6. Weld stainless steel in accordance with AWS D1.6 and NiDI 11 007.
   7. All headed studs to be welded using automatically timed stud welding equipment.
   8. Grind smooth welds that will be exposed.

E. Conceal fastenings where practicable.

F. Fabricate work in shop in as large assemblies as is practicable.

G. Tolerances:
   1. Rolling:
      a. ASTM A6.
      b. When material received from the mill does not satisfy ASTM A6 tolerances for camber, profile, flatness, or sweep, the Contractor is permitted to perform corrective work by the use of controlled heating and mechanical straightening, subject to the limitations of the AISC Specification.
   2. Fabrication tolerance:
      a. Member length:
         1) Both ends finished for contact bearing: 1/32 IN.
         2) Framed members:
            a) 30 FT or less: 1/16 IN.
            b) Over 30 FT: 1/8 IN.
      b. Member straightness:
         1) Compression members: 1/1000 of axial length between points laterally supported.
         2) Non-compression members: ASTM A6 tolerance for wide flange shapes.
      c. Specified member camber (except compression members):
         1) 50 FT or less: Minus 0/plus 1/2 IN.
         2) Over 50 FT: Minus 0/plus 1/2 IN (plus 1/8 IN per 10 FT over 50 FT).
         3) Members received from mill with 75 percent of specified camber require no further cambering.
         4) Beams/trusses without specified camber shall be fabricated so after erection, camber is upward.
         5) Camber shall be measured in fabrication shop in unstressed condition.
      d. At bolted splices, depth deviation shall be taken up by filler plates.
         1) At welded joints, adjust weld profile to conform to variation in depth.
         2) Slope weld surface per AWS requirements.
      e. Finished members shall be free from twists, bends and open joints.
         1) Sharp kinks, bends and deviation from above tolerances are cause for rejection of material.

H. Fabricate grating, checkered plate, stairs, ladders and accessories using galvanized steel unless shown otherwise on Drawings.
   1. Finish:
      a. Mill, unless noted otherwise.
      b. Coat surfaces in contact with dissimilar materials.

1) See Specification Section 09 91 00.

I. Fabricate grating in accordance with NAAMM MBG 531.
   1. Maximum tolerance for difference in depth between grating depth and seat or support angle depth: 1/8 IN.
   2. Distance between edge of grating and face of embedded seat angle or face of wall or other structural member: 1/4 IN.
      a. Tolerance: NAAMM MBG 531.
   3. Removable sections: Not wider than 3 FT and not more than 50 LBS.
   4. Ends and perimeter edges: Banded.
      a. Provide full depth banding unless noted otherwise.
      b. Banding at trenches and sumps to be 1/4 IN less than grating depth to allow for drainage.
   5. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 IN high toe plate.
   6. Provide joints at openings between individual grating sections.
   7. Fabricate grating so that bearing bars and cross bars in adjacent sections are aligned.

J. Fabricate checkered plate and miscellaneous metals in accordance with NAAMM AMP 555.
   1. Workmanship: Class 2 unless noted otherwise.

K. See Specification Section 09 91 00 for preparation and painting of ferrous metals and other surfaces.

2.6 SOURCE QUALITY CONTROL

A. Surface Preparation:
   1. Refer to Specification Section 09 91 00 for surface preparation requirements.
   2. All miscellaneous metal fabrication item surfaces shall be inspected and approved by NACE certified coatings inspector prior to application of shop-applied paint coating.
      a. Inspection shall be performed to determine depth of blast profile and cleanliness of surface.
      b. Fabricator shall reblast and or re-clean surfaces as required until acceptable.

B. Shop Applied Paint Coating Application:
   1. Refer to Specification Section 09 91 00 for painting requirements.
   2. After surface has been accepted in writing by NACE certified coatings inspector, fabricator may proceed with application of paint coatings.
   3. Application of paint coatings shall be observed and certified by NACE certified coatings inspector.

C. OWNER Pays for Field Inspection and Testing:
   1. Owner will employ and pay for services of an independent testing agency to inspect and test structural steel shop and field work for compliance with this Specification Section.
   2. Contractor responsible for testing to qualify shop and field welders and as needed for Contractor's own quality control to ensure compliance with Contract Documents.
   3. Contractor provides sufficient notification and access so inspection and testing can be accomplished.

4. Contractor pays for retesting of failed tests and for additional testing required when defects are discovered.

D. Responsibilities of Testing Agency:
1. Inspect shop and field welding in accordance with AWS Code including the following non-destructive testing:
   a. Visually inspect all welds.
   b. In addition to visual inspection, test 50 percent of full penetration welds and 20 percent of fillet welds with liquid dye penetrant.
   c. Test 20 percent of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.
2. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
   a. Verify direct tension indicator gaps.
3. Inspect structural steel which has been erected.
4. Inspect stud welding in accordance with AWS Code.
5. Prepare and submit inspection and test reports to Engineer.
   a. Assist Engineer to determine corrective measures necessary for defective work.

PART 3 - EXECUTION

3.1 PREPARATION

A. Provide items to be built into other construction in time to allow their installation.
1. If such items are not provided in time for installation, cut in and install.

B. Prior to installation, inspect and verify condition of substrate.

C. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.
1. Field welding aluminum is not permitted unless approved in writing by Engineer.

3.2 INSTALLATION

A. Set metal work level, true to line, plumb.
1. Shim and grout as necessary.

B. Contractor is solely responsible for safety.
1. Construction means and methods and sequencing of work is the prerogative of the Contractor.
2. Take into consideration that full structural capacity of many structural members is not realized until structural assembly is complete; e.g., until slabs, decks, and diagonal bracing or rigid connections are installed.
3. Partially complete structural members shall not be loaded without an investigation by the Contractor.
4. Until all elements of the permanent structure and lateral bracing system are complete, temporary bracing for the partially complete structure will be required.

C. Adequate temporary bracing to provide safety, stability and to resist all loads to which the partially complete structure may be subjected, including construction activities and operation of equipment is the responsibility of the Contractor.
1. Plumb, align, and set structural steel members to specified tolerances.
2. Use temporary guys, braces, shoring, connections, etc., necessary to maintain the structural framing plumb and in proper alignment until permanent connections are made, the succeeding work is in place, and temporary work is no longer necessary.

3. Use temporary guys, bracing, shoring, and other work to prevent injury or damage to adjacent work or construction from stresses due to erection procedures and operation of erection equipment, construction loads, and wind.
4. Contractor shall be responsible for the design of the temporary bracing system and must consider the sequence and schedule of placement of such elements and effects of loads imposed on the structural steel members by partially or completely installed work, including work of all other trades.
    a. If not obvious from experience or from the Drawings, the Contractor shall confer with the Engineer to identify those structural steel elements that must be complete before the temporary bracing system is removed.
5. Remove and dispose of all temporary work and facilities off-site.

D. Examine work-in-place on which specified work is in any way dependent to ensure that conditions are satisfactory for the installation of the work.
    1. Report defects in work-in-place which may influence satisfactory completion of the work.
    2. Absence of such notification will be construed as acceptance of work-in-place.

E. Field Measurement:
    1. Take field measurements as necessary to verify or supplement dimensions indicated on the Drawings.
    2. Contractor responsible for the accurate fit of the work.

F. Check the elevations of all finished footings or foundations and the location and alignment of all anchor bolts before starting erection.
    1. Use surveyor's level.
    2. Notify Engineer of any errors or deviations found by such checking.

G. Framing member location tolerances after erection shall not exceed the frame tolerances listed in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.

H. Erect plumb and level; introduce temporary bracing required to support erection loads.

I. Use light drifting necessary to draw holes together.
    1. Drifting to match unfair holes is not allowed.

J. Welding:
    1. Conform to AWS D1.1 and requirements of the FABRICATION Article in PART 2 of this Specification Section.
    2. When joining two (2) sections of steel of different ASTM designations, welding techniques shall be in accordance with a qualified AWS D1.1 procedure.

K. Shore existing members when unbolting of common connections is required.
    1. Use new bolts for rebolting connections.

L. Clean stored material of all foreign matter accumulated during erection period.

M. Bolt Field Connections: Where practicable, conceal fastenings.

N. Field Welding:
    1. Follow AWS procedures.
    2. Grind welds smooth where field welding is required.

O. Field cutting grating or checkered plate to correct fabrication errors is not acceptable.
    1. Replace entire section.

P. Remove all burrs and radius all sharp edges and corners of miscellaneous plates, angles, framing system elements, etc.

Q. Unless noted or specified otherwise:
   1. Connect steel members to steel members with 3/4 IN DIA ASTM A325 high strength bolts.
   2. Connect aluminum to aluminum with 3/4 IN DIA aluminum bolts.
   3. Connect aluminum to structural steel using 3/4 IN DIA stainless steel bolts.
      a. Provide dissimilar metals protection.
   4. Connect aluminum and steel members to concrete and masonry using stainless steel expansion anchor bolts or adhesive anchor bolts unless shown otherwise.
      a. Provide dissimilar materials protection.
   5. Provide washers for all bolted connections.
   6. Where exposed, bolts shall extend a maximum of 3/4 IN and a minimum of 1/2 IN above the top nut.
      a. If bolts are cut off to required maximum height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nuts.

R. Install and tighten ASTM A325 high-strength bolts in accordance with the AISC 325, Allowable Stress Design (ASD).
   1. Provide hardened washers for all ASTM A325 bolts.
      a. Provide the hardened washer under the element (nut or bolt head) turned in tightening.

S. After bolts are tightened, upset threads of ASTM A307 unfinished bolts or anchor bolts to prevent nuts from backing off.

T. Secure metal to wood with lag screws of adequate size with appropriate washers.

U. Do not field splice fabricated items unless said items exceed standard shipping length or change of direction requires splicing.
   1. Provide full penetration welded splices where continuity is required.

V. Provide each fabricated item complete with attachment devices as indicated or required to install.

W. Anchor such that work will not be distorted nor fasteners overstressed from expansion and contraction.

X. Set beam and column base plates accurately on nonshrink grout as indicated on Drawings.
   1. See Division 03 Specification Sections for non-shrink grout.
   2. Set and anchor each base plate to proper line and elevation.
      a. Use metal wedges, shims, or setting nuts for leveling and plumbing columns and beams.
         1) Wedges, shims and setting nuts to be of same metal as base plate they support.
         2) Tighten nuts on anchor bolts.
      b. Fill space between bearing surface and bottom of base plate with nonshrink grout.
         1) Fill space until voids are completely filled and base plates are fully bedded on wedges, shims, and grout.
      c. Do not remove wedges or shims.
         1) Where they protrude, cut off flush with edge of base plate.
      d. Fill sleeves around anchor bolts solid with non-shrink grout.

Y. Tie anchor bolts in position to embedded reinforcing steel using wire.
   1. Tack welding prohibited.
      a. Coat bolt threads and nuts with heavy coat of clean grease.
   2. Anchor bolt location tolerance:
      a. 1/16 IN.
      b. Provide steel templates for all column anchor bolts.

Z. Install bollards in concrete as detailed.
   1. 48 IN projection above ground.
   2. 48 IN embedment in concrete, unless detailed otherwise on Drawings.
   3. Fill pipe with concrete and round off at top.

AA. Provide abrasive stair nosings in each tread and landing of all concrete stairs and at each concrete stair landing having metal stair structure attaching to the concrete landing.
   1. Center stair nosings in stair width.
   2. Coordinate nosings with railing vertical posts.
      a. Maintain 2 IN clear between end of nosing and edge of railing base plate.

BB. Accurately locate and place frames for openings before casting into floor slab so top of plate is flush with surface of finished floor.
   1. Keep screw holes clean and ready to receive screws.

CC. Attach grating to end and intermediate supports with grating saddle clips and bolts.
   1. Maximum spacing: 2 FT OC with minimum of two (2) per side.
   2. Attach individual units of aluminum grating together with clips at 2 FT OC maximum with a minimum of two (2) clips per side.

DD. Repair damaged galvanized surfaces in accordance with ASTM A780.
   1. Prepare damaged surfaces by abrasive blasting or power sanding.
   2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions.

EE. Anchor ladder to concrete structure with minimum 3/4 IN stainless steel anchor bolts with minimum 6 IN embedment.

FF. Anchor ladder to masonry structure with minimum 3/4 IN stainless steel anchor bolts with minimum 6 IN embedment.
   1. When anchoring into masonry, fill masonry cores with grout at anchor locations and each masonry core within 8 IN of anchor
   2. When anchoring into cavity wall construction, provide minimum 6 IN embedment into concrete or masonry back-up wall.
      a. At each anchor location, provide sleeve between back face of veneer and cavity face of concrete or masonry back-up wall.
      b. Cut cavity insulation as required and seal around sleeve.
         1) Sleeve to be 1 IN DIA schedule 40 stainless steel tubing, TP-304L, ASTM A269.
            a) Minimum wall thickness to be .065 IN.
         2) Continuously weld 4 by 4 by 1/4 IN Type 304 stainless steel, ASTM A666 flange onto each end of pipe.
            a) Drill 1 IN hole in flange to match pipe.
            b) Attach sleeve to concrete or masonry back-up with 1/4 IN self-tapping concrete anchors.
         3) Grout solid, area around bolt where bolt penetrates veneer.

4) Accurately locate sleeves to align with bolt locations on ladder.

GG. Anchor ladder to metal stud walls using minimum 1/2 IN stainless steel bolts, nuts and washers.
1. Verify that stud wall has been provided with adequate backing to accept ladder anchors.

HH. Install ladder safety extension post in accordance with manufacturer's instructions.
1. Mount device opposite the climbing side.
2. Provide ladder safety extension device for all ladders unless noted otherwise.

II. Mount ladder fall protection system with rail offset from ladder side rail approximately 3 IN.

JJ. Install factory pre-fabricated stairs in location indicated in the Contract Documents.

3.3 FIELD QUALITY CONTROL

A. Tolerances shall meet structural requirements of Specification Section 05 12 00 for erecting items of structural nature.

B. Tolerances (unless otherwise noted on the Drawings):
1. Frame placement, after assembly and before welding or tightening.
a. Deviation from plumb, level and alignment: 1 in 500, maximum.
b. Displacement of centerlines of columns: 1/2 IN maximum, each side of centerline location shown on Drawings.

3.4 CLEANING

A. After fabrication, erection, installation or application, clean all miscellaneous metal fabrication surfaces of all dirt, weld slag and other foreign matter.

B. All stainless steel products in addition to Paragraph A. above:
1. Remove all heat tint, rusting, discoloration by passivation, ASTM A380, or other acceptable means as listed in NiDI 11 007 as approved by the Engineer.

C. Provide surface acceptable to receive field applied paint coatings specified in Specification Section 09 91 00.

END OF SECTION

SECTION 05 51 00 - METAL STAIRS

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 industrial-type, straight-run stairs with concrete-filled metal-pan treads .

B. Related Requirements:

1. Section 05 52 13 "Pipe and Tube Railings" for railings attached to metal stairs

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

B. Delegated-Design Submittal: For stairs, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design stairs.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft..
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in..
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.

B. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.

1. Provide mechanically deposited or hot-dip, zinc-coated anchor bolts for stairs indicated to be galvanized.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.4 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.

B. Form exposed work with accurate angles and surfaces and straight edges.

C. Weld connections to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 4 welds: good quality, uniform undressed weld with minimal splatter.

2.5 STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," industrial class, unless more stringent requirements are indicated.

B. Stair Framing:

1. Fabricate stringers of steel channels

   a. Provide closures for exposed ends of channel stringers.

2. Construct platforms of steel plate or channel headers and miscellaneous framing members as needed to comply with performance requirements indicated.

3. Weld stringers to headers; weld framing members to stringers and headers.

C. Metal Pan Stairs: Form risers, subtread pans, and subplatforms to configurations shown from steel sheet of thickness needed to comply with performance requirements, but not less than 0.067 inch.

1. Steel Sheet: Uncoated hot-rolled steel sheet.
2. Attach risers and subtreads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
3. Shape metal pans to include nosing integral with riser.
4. At Contractor's option, provide stair assemblies with metal pan subtreads filled with reinforced concrete during fabrication.
5. Provide subplatforms of configuration indicated or, if not indicated, the same as subtreads. Weld subplatforms to platform framing.

2.6 FINISHES

A. Finish metal stairs after assembly.

B. Galvanizing: Hot-dip galvanize items metal stairs to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
2. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

3.2 ADJUSTING AND CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 51 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

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. Steel pipe and tube railings.

B. Related Requirements:

1. Section 07 72 00 "Roof Accessories" for roof edge railing system.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Railing brackets.
2. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

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."

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

2.2 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.3 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

E. Woven-Wire Mesh: Intermediate-crimp, square pattern, 2-inch woven-wire mesh, made from 0.134-inch- diameter wire complying with ASTM A 510.

2.4 FASTENERS

A. General: Provide the following:

1. Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
3. Provide Phillips flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.6 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form changes in direction by bending. Use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

J. Close exposed ends of railing members with prefabricated end fittings.

K. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

L. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

M. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

N. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

O. For removable railing posts, fabricate slip-fit sockets from steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

P. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL AND IRON FINISHES

A. Provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, galvanize anchors to be embedded in exterior concrete or masonry.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."

C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with universal shop primer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Cover anchorage joint with flange of same metal as post, attached to post with set screws.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. Weld flanges to post and bolt to metal supporting surfaces.

3.5 ATTACHING RAILINGS

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.

B. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.

3.6 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 52 13

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wood blocking and nailers.
2. Plywood panels.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NHLA: National Hardwood Lumber Association.
3. NLGA: National Lumber Grades Authority.
4. WCLIB: West Coast Lumber Inspection Bureau.
5. WWPA: Western Wood Products Association.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers beneath and between each bundle to provide air circulation. Protect lumber from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat all miscellaneous carpentry except blocking and nailers in interior partitions.

2.3 FIRE-RETARDANT TREATED LUMBER AND PLYWOOD (FRT):

A. Flame spread index: Less than 25.

B. Smoke developed index: Less than 450.

C. Free of halogens, sulfates, chlorides, arsenic, ammonium phosphate, formaldehyde, and urea formaldehyde.

D. Kiln dried after treatment, (KDAT).

E. FRT material for interior and above grade locations:

1. Base: Pyro-Guard by Hoover Treated Wood Products, Incorporated

2. Optional:
   a. Dricon FRT by Lonza Group Limited
   b. FirePro by Western Wood Preserving Company.
   c. Natural wood products treated to add fire-retardant qualities.

2.4 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
2. Northern species, No. 2 Common grade; NLGA.

D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.5 MISCELLANEOUS PLYWOOD PANELS

A. DOC PS 1, Exterior, C-C Plugged , in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Power-Driven Fasteners: NES NER-272.

C. Lag Bolts: ASME B18.2.1.

D. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry

assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

E. Nails, Brads, and Staples: ASTM F1667.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

D. Do not splice structural members between supports unless otherwise indicated.

E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

2. Wall Blocking: Provide in-wall fire-treated wood blocking reinforcement where following items are required to be wall-mounted to interior walls:

a. Architectural casework, millwork, cabinets, shelving, wardrobes, and bookcases.
b. Handrails at stairwells.
c. Between studs at height of door stop, behind stop.

F. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

H. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.

3. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.

3.2 INSTALLATION OF BLOCKING AND NAILERS FOR ROOFING AND PARAPETS

A. Install in accordance with ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used With Low Slope Roofing Systems.

B. Minimum Wood Member Size: 2 inches x 6 inches nominal.

C. Fasteners:

1. Corrosion resistant.
   a. Hot dip galvanized: Comply with ASTM A153 or ASTM A653, Class G185.
   b. Stainless steel: Types 304 or 316.

2. Countersink heads of fasteners.

3. Types required for substrate conditions.

4. Fasteners of diameter and spacing required to resist forces indicated.

5. Spacing:
   a. Threaded anchor bolts; 3/8 inch or larger:
      1) Provide 5/8 IN 16 mm OD washers or larger.
      2) Maximum spacing: 48inches OC.
      3) Stagger 1/3 nailer width.
   b. Other fastener types:
      1) Maximum Spacing:
         a) Typical: inches OC.
         b) Up to 16 inches OC where necessary to match spacing of structural members.
      2) Stagger 1/3 nailer width.
      3) Install 2 fasteners and within 6 inches of nailer ends.

D. Anchor nailers to resist minimum vertical force of 300 LBS/LF 446 kg/min any direction.

1. Locate fasteners approximately 4 inches from ends but not less than inches.

2. Use minimum of 3 anchors for each nailer.

3. Where members are wider than 6 inches, stagger fasteners from side to side to avoid splitting of the wood member.

4. Corner region enhancements:
   a. Double the above listed vertical force which must be resisted.
   b. Length and width of corners as prescribed by ANSI/SPRI RP-4:
      1) 40 percent of the building height, but not less than 8-1/2 feet.

E. Nailers used for perimeter securement of roofing membranes:

1. Install nailers where indicated and where required to secure perimeter of membrane roofing.

2. Match height of nailers to adjacent insulation.

3. Where multiple layers are required to match depth of insulation:
   a. Attach base layer as indicated in General Requirements above.
   b. Apply a bead of construction adhesive between laminations.
   c. Attach subsequent layers using fastener type which is appropriate for wood-to-wood securement.
   d. Size and locate fasteners as required to resist uplift loading indicated.

F. Install blocking as indicated for securement of sheet metal edge flashings, parapet copings, and similar items.

3.3 INSTALLATION OF FIRE RETARDANT TREATED WOOD

A. Fire retardant treated lumber and plywood used in structural applications shall be applied according to lumber and plywood strength tables provided by manufacturer.

B. Use only fasteners approved by the manufacturer of fire-retardant-treated or preservative treated wood.

C. Field Cuts:

1. Dimensional Lumber: Do not rip or mill fire retardant treated lumber.
   a. Cross cuts, joining cuts, and drilling holes are permitted.

2. Plywood: Fire retardant treated plywood may be cut in any direction.

3. Field treat cuts and holes in preservative and fire retardant treated material in accordance with AWPA M4.

3.4 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Composite nail base insulated sheathing.
3. Sheathing joint and penetration treatment.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for plywood backing panels.
2. Section 07 27 26 "Fluid-Applied Membrane Air Barriers" for water-resistive barrier applied over wall sheathing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PLYWOOD PANEL PRODUCTS

A. Oriented Strand Board: DOC PS 2.

B. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

C. Factory mark panels to indicate compliance with applicable standard.

2.2 WALL SHEATHING

A. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. CertainTeed Corporation; GlasRoc.
   b. G-P Gypsum Corporation; Dens-Glass Gold.
   c. National Gypsum Company; Gold Bond e(2)XP.
   d. Temple-Inland Inc.; GreenGlass
   e. United States Gypsum Co.; Securock.

2. Type and Thickness: Type X, 5/8 inch thick.

2.3 COMPOSITE NAIL BASE INSULATED SHEATHING

A. Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing: Rigid, cellular, polyisocyanurate thermal insulation with oriented strand board laminated to one face complying with ASTM C 1289, Type V.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Atlas Roofing Corporation.
   b. Cornell Corporation.
   c. Dow Chemical Company (The).
   d. Johns Manville; Berkshire Hathaway Inc.
   e. Rmax, Inc.

2. Polyisocyanurate-Foam Thickness: 2 inches.
3. Oriented-Strand-Board Nominal Thickness: 7/16 inch.

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. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

C. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached, with organic-polymer

or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

1. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C 954.

2.5 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."

D. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.
2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent boards without forcing. Abut ends of boards over centers of studs, and stagger end joints of adjacent boards not less than one stud spacing. Attach boards at perimeter and within field of board to each steel stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

D. Vertical Installation: Install board vertical edges centered over studs. Abut ends and edges of each board with those of adjacent boards. Attach boards at perimeter and within field of board to each stud.

1. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of boards.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 06 16 00

SECTION 06 41 16 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Plastic-laminate countertops.

B. Related Requirements:

1. Section 06 10 00 "Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.

2. Section 12 36 65 "Solid Surfacing Countertops."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products, high-pressure decorative laminate, adhesive for bonding plastic laminate and cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
2. Show locations and sizes of cutouts and holes for plumbing fixtures and fittings, and other items installed in architectural plastic-laminate cabinets.

C. Samples for Verification:

1. Plastic laminates, 8 by 10 inches, for each color, pattern, and surface finish, with one sample applied to core material and specified edge material applied to one edge.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: Custom.

C. Type of Construction: Frameless.

D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

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. Formica Corporation.

b. Nevamar
c. Wilsonart International; Div. of Premark International, Inc.

2. See Finish Legend on Sheet I001 for laminate types.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Vertical Surfaces: Grade VGS.

G. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade CLS.

a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade CLS.

2. Drawer Sides and Backs: Solid-hardwood lumber.

3. Drawer Bottoms: Hardwood plywood.

H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

2.2 Countertops:

1. Edge Treatment: Same as laminate cladding on horizontal surfaces.

2. Core Material: Particleboard or medium-density fiberboard.

3. Core Material at Sinks: Particleboard made with exterior glue.

4. Second option in "Core Thickness" Paragraph below is for heavy-duty applications and costs approximately 20 percent more than first option.

5. Core Thickness: 3/4 inch.

a. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.

6. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.

B. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. Match Architect's sample.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 8 to 13 4 to 9 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Veneer-Faced Panel Products (Hardwood Plywood): HPVA HP-1.

2.4 CABINET HARDWARE AND ACCESSORIES

A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.

B. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

C. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

D. Drawer Slides: BHMA A156.9.
1. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.

E. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

F. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.5 FABRICATION

A. Fabricate cabinets to dimensions, profiles, and details indicated.

B. Fabricate countertops with front and end overhang of 1 inch over base cabinets.

C. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

D. Shop-cut openings to maximum extent possible to receive plumbing fixtures and fittings, hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-

in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips or toggle bolts through metal backing or metal framing behind wall finish.

G. Countertops:

1. Provide cutouts for plumbing fixtures, electrical work, and similar items.

2. Seal edges of cutouts by saturating with varnish.

3. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

a. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

4. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

5. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

6. Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

   a. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
   b. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
   c. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semi-exposed surfaces.

END OF SECTION 06 41 16

SECTION 07 13 26 - SELF-ADHERING SHEET WATERPROOFING

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. Modified bituminous sheet waterproofing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.

B. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.

1. Do not apply waterproofing in snow, rain, fog, or mist.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer's standard materials-only warranty in which manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MODIFIED BITUMINOUS SHEET WATERPROOFING

A. Modified Bituminous Sheet: Minimum 60-mil nominal thickness, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated on one side to a 4-mil thick, polyethylene-film reinforcement, and with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Carlisle Coatings & Waterproofing Inc.; CCW MiraDRI 860/861.
b. Grace, W. R., & Co. - Conn.; Bituthene 3000/Low Temperature or Bituthene 4000.
c. Henry Company; Blueskin WP 100/200.
d. Meadows, W. R., Inc.; SealTight Mel-Rol.
e. Protecto Wrap Company; PW 100/60.

2. Physical Properties:

a. Tensile Strength, Membrane: 250 psi minimum; ASTM D 412, Die C, modified.
b. Ultimate Elongation: 300 percent minimum; ASTM D 412, Die C, modified.
c. Low-Temperature Flexibility: Pass at minus 20 deg F; ASTM D 1970.
d. Crack Cycling: Unaffected after 100 cycles of 1/8-inch movement; ASTM C 836.
e. Puncture Resistance: 40 lbf minimum; ASTM E 154.
f. Water Absorption: 0.2 percent weight-gain maximum after 48-hour immersion at 70 deg F; ASTM D 570.
g. Water Vapor Permeance: 0.05 perms maximum; ASTM E 96/E 96M, Water Method.
h. Hydrostatic-Head Resistance: 200 feet minimum; ASTM D 5385.

2.2 AUXILIARY MATERIALS

A. General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

1. Furnish liquid-type auxiliary materials that comply with VOC limits of authorities having jurisdiction.

B. Primer: Liquid primer recommended for substrate by sheet-waterproofing material manufacturer.

C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by sheet-waterproofing material manufacturer.

D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, of trowel grade or low viscosity.

E. Substrate Patching Membrane: Low-viscosity, two-component, modified asphalt coating.

F. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch thick, predrilled at 9-inch centers.

2.3 INSULATION

A. Insulation: Comply with Section 07 21 00 "Thermal Insulation."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the waterproofing.

1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Verify that compacted subgrade is dry, smooth, sound, and ready to receive waterproofing sheet.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D 4258.

F. Bridge and cover isolation joints and discontinuous deck-to-wall and deck-to-deck joints with overlapping sheet strips of widths according to manufacturer's written instructions.

1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.

G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.

1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:

    a. At footing-to-wall intersections, extend liquid membrane in each direction from corner or install membrane strip centered over corner.
    b. At plaza-deck-to-wall intersections, extend liquid membrane or sheet strips onto deck waterproofing and to finished height of sheet flashing.

H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

A. Install modified bituminous sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D 6135.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.

C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch- minimum lap widths and end laps. Overlap and seal seams, and stagger end laps to ensure watertight installation.

    1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, modified bituminous sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.

D. Horizontal Application: Apply sheets from low to high points of decks to ensure that laps shed water.

E. Apply continuous sheets over already-installed sheet strips, bridging substrate cracks, construction, and contraction joints.

F. Seal edges of sheet-waterproofing terminations with mastic.

G. Install sheet-waterproofing and auxiliary materials to tie into adjacent waterproofing.

H. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending 6 inches beyond repaired areas in all directions.

I. Immediately install protection course with butted joints over waterproofing membrane.

3.4 INSULATION INSTALLATION

A. Install one or more layers of board insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch of projections and penetrations.

B. On vertical surfaces, set insulation units in adhesive or tape applied according to manufacturer's written instructions.

C. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.5 PROTECTION, REPAIR, AND CLEANING

A. Do not permit foot or vehicular traffic on unprotected membrane.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed board insulation from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 07 13 26

SECTION 07 21 00 - THERMAL 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. Foam-plastic board insulation.
2. Spray polyurethane foam insulation.

B. Related Sections:

1. Section 04 20 00 "Unit Masonry" for installation of insulation in cavity walls.
2. Section 06 16 00 "Sheathing" for composite nail base insulated sheathing.
3. Section 07 53 23 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing" for insulation specified as part of roofing construction.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration due to moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect foam-plastic board insulation as follows:

1. Do not expose to sunlight except to necessary extent for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver foam-plastic board materials to Project site before installation time.
3. Quickly complete installation and concealment of foam-plastic board insulation in each area of construction.

PART 2 - PRODUCTS

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

B. Extruded Polystyrene Board, Type IV, ASTM C 578, Type IV, 25-psi minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

1. Water vapor permeance per ASTM E96: 1.50 perm maximum.

2. Water absorption per ASTM D2842: a. 0.3 percent, maximum.

3. Thermal resistance per ASTM C518: R-value of 5.0 per inch at 75 DegF mean temperature.

4. 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. DiversiFoam Products
b. Dow Chemical Company (The).
c. Owens Corning.

5. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.2 POLYISOCYANURATE BOARD INSULATION

A. Polyisocyanurate Board Insulation: Rigid, closed cell foam core bonded to heavy-duty glass fiber mat facers.

1. ASTM C1289 Type II, Class 1.
2. R-value: 5.6 per inch in accordance with ASTM C1303, CAN/ULC S770.
3. Compressive Strength: 20 PSI minimum per ASTM D1621, Grade 2.
4. Maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.

5. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Atlas Roofing Corporation.
b. Dow Chemical Company (The).
c. Rmax, Inc.

2.3 MINERAL FIBER SPANDREL INSULATION

A. Foil-faced, non-combustible, water repellant, semi-rigid mineral wool insulation board.
1. Tape seams with vapor retarder tape.

B. Nominal Density: 4 PCF 64 kg/m3.

C. Minimum Thermal Value: R-4 per inch.

2.4 ACCESSORIES

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

B. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

2.5 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II.

1. Minimum Density: 1.9 PSF.
2. Closed cell content: 90 percent.
3. Thermal Resistance, aged: R-6 per inch at 75 deg F.
4. Water Vapor Permeance: 2.2 Perm at 1 IN.
5. Flame Spread: Less than 25.
6. Smoke Developed: Less than 450.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Bayer Material Science.
b. Icynene, Inc.
c. Johns Manville.

C. Thermal Coating: Intumescent, UL listed or ICC tested for use with SPF.

1. Base Product: DC 315 by Icynene.

2. Optional Product: Bayseal IC by Bayer Material Science.

3. Provide thermal coating when a minimum of 1/2 inch GWB or sheathing board does not separate the sprayed polyurethane foam from interior occupied space.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of substances which are harmful to insulation or that interfere with insulation attachment.

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

E. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using sprayed polyurethane foam sealant: Apply according to manufacturer's written instructions.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. On vertical footing and foundation wall surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.

1. If not otherwise indicated, extend insulation a minimum of 48 inches below exterior grade line.

3.4 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Insulation and Insulated Drainage Panel in cavity walls:

1. Do not proceed with installation until subsequent work which conceals insulation is ready to be performed.
2. Extend insulation full thickness in one layer over entire area to be insulated.
3. Install insulation over 2 inches thick in multiple layers. Stagger joints.
4. Adhere insulation to masonry wall per insulation manufacturer’s recommendations.
5. Press courses of insulation between wall ties (horizontal reinforcing) with edges butted tightly both ways.
6. Seal unavoidable joints at penetrations and voids with polyurethane spray foam insulation to maintain R-value.
7. Tape joints.

D. Mineral Fiber spandrel insulation:

1. Install insulation at each spandrel location.
   a. Tightly fit boards between window framing members.
   b. FSK facing to be installed facing to inside of building.
   c. Leave a minimum of 1 inch air space between glass and insulation.

2. Secure insulation by use of mechanical fasteners, impaling clips or pins.
   a. Locate fasteners 6 IN 150 mm from edges and at 12 IN 300 mm OC each direction.

b. Install washers and clip prongs of fasteners.

3. Tape seams, washers, penetrations and edge terminations.
   a. Cover fastener with 6 inches square of vapor retarder tape.
   b. Tape edges of vapor retarder to window frame to form continuous vapor retarder.
   c. Tape butt edges of insulation to each other.
   d. Cover penetrations or connections that remain exposed after insulation is in place and sealed, with minimum 1 inch thick insulation.
   e. Seal penetrations for a minimum of 6 inches on each side.

3.5 PROTECTION

A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 21 00

SECTION 07 26 00 - UNDER SLAB VAPOR RETARDER

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Under slab vapor retarder.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. American Concrete Institute (ACI):
      a. 302.2R, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
   2. ASTM International (ASTM):
      a. D882, Standard Test Method for Tensile Properties of Thin Plastic Sheeting.
      b. D1709, Standard Test Methods for Impact Resistance of Plastic Film by the Free-Falling Dart Method.
      c. E96, Standard Test Methods for Water Vapor Transmission of Materials.
      d. E1643, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
      e. E1745, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Division 1 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Product data sheet on vapor retarder sheet and vapor retarder tape.
      c. All accessories proposed for use.
      d. Manufacturer's installation instructions.

B. Samples:
   1. Provide two (2) 6 IN x 6 IN samples of vapor retarder material taped together using the vapor retarder tape proposed.
   2. Provide two (2) samples of all accessories proposed for use.

C. Informational Submittals: Manufacturer's recommendation on vapor retarder tape.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
   1. Vapor retarder:
      a. Fortifiber Corporation.
      b. Layfield Group
      c. Raven Industries.
      d. Reef Industries.
      e. Stego Industries.
      f. WR Meadows, Inc.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 PERFORMANCE REQUIREMENTS

A. Vapor Retarder:
   1. ASTM E1745, Class A.
   2. Thickness: Minimum 15 mil.
   3. Water vapor permeance: 0.03 maximum per ASTM E96.
   4. Puncture resistance: ASTM D1709, Method B, 2200 grams.
   5. Minimum tensile strength: 45 LBS/IN, ASTM D882.

2.3 ACCESSORIES

A. Pipe Boots: Manufacturer's standard boot fabricated to maintain the integrity of the vapor retarder system.

B. Vapor Retarder Tape: As recommended by vapor retarder manufacturers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions, ASTM E1643 and ACI 302.2R.

B. Provide vapor retarder where indicated on the Drawings.
   1. Place continuous vapor retarder above granular fill subgrade material, unless noted otherwise.

C. Lap minimum 6 IN and seal in accordance with ASTM E1643 and manufacturer's recommendations.

D. Extend to extremities of area and seal to adjacent elements.

E. Seal all penetrations: Provide pipe boot for all pipes or conduit penetrating the floor slab.

3.2 FIELD QUALITY CONTROL

A. Ensure proper precautions are implemented to prevent damage to installed vapor retarder membrane prior to and during pouring of concrete floor slab.

B. Inspect vapor retarder immediately prior to placement of concrete.
   1. Patch all punctures, tears, holes, etc.
      a. Repair with additional layer of vapor retarder and seal entire patch with vapor retarder tape or as recommended by manufacturer.
      b. Lap all repairs minimum 6 IN.

END OF SECTION

SECTION 07 27 26 - FLUID-APPLIED MEMBRANE AIR BARRIERS

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 fluid-applied, vapor-retarding membrane air barriers.

1.3 DEFINITIONS

A. Air-Barrier Material: A primary element that provides a continuous barrier to the movement of air.

B. Air-Barrier Accessory: A transitional component of the air barrier that provides continuity.

C. Air-Barrier Assembly: The collection of air-barrier materials and accessory materials applied to an opaque wall, including joints and junctions to abutting construction, to control air movement through the wall.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review air-barrier requirements and installation, special details, mockups, air-leakage and bond testing, air-barrier protection, and work scheduling that covers air barriers.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written instructions for evaluating, preparing, and treating substrate; technical data; and tested physical and performance properties of products.

B. Shop Drawings: For air-barrier assemblies.

1. Show locations and extent of air barrier. Include details for substrate joints and cracks, counterflashing strips, penetrations, inside and outside corners, terminations, and tie-ins with adjoining construction.
2. Include details of interfaces with other materials that form part of air barrier.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1. Installer shall be licensed by ABAA according to ABAA's Quality Assurance Program and shall employ ABAA-certified installers and supervisors on Project.

2. Minimum five years of continued experience in successful installation of vapor and water resistive air barrier products on similar project applications.

B. ASTM International (ASTM):

1. ASTM C836 Standard Specification for High Solids, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
2. ASTM C920 Specifications for Elastomeric Joint Sealants.
3. ASTM C1193 Guide for Use of Joint Sealants.
4. ASTM D412 Standard Test Methods for Rubber Properties in Tension.
5. ASTM D903 Standard Test Method for Peel or Stripping Strength of Adhesive Bonds.
6. ASTM D3767 Standard Practice for Rubber - Measurements of Dimensions.
7. ASTM D4541 Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
8. ASTM E96 Test Methods for Water Vapor Transmission of Materials.
9. ASTM E283 Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across Specimen.
10. ASTM E2178 Standard Test Method for Air Permeance of Building Materials.
11. ASTM E2357 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Remove and replace liquid materials that cannot be applied within their stated shelf life.

B. Protect stored materials from direct sunlight.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Apply air barrier within the range of ambient and substrate temperatures recommended by air-barrier manufacturer.

1. Protect substrates from environmental conditions that affect air-barrier performance.
2. Do not apply air barrier to a damp or wet substrate or during snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Source Limitations: Obtain primary air-barrier materials and air-barrier accessories from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Air barrier shall be capable of performing as a continuous vapor-retarding air barrier and as a liquid-water drainage plane flashed to discharge to the exterior incidental condensation or water penetration. Air-barrier assemblies shall be capable of accommodating substrate movement and of sealing substrate expansion and control joints, construction material changes, penetrations, tie-ins to installed waterproofing, and transitions at perimeter conditions without deterioration and air leakage exceeding specified limits.

B. Air-Barrier Assembly Air Leakage: Maximum 0.04 cfm/sq. ft. of surface area at 1.57 lbf/sq. ft., when tested according to ASTM E 283, ASTM E 783 or ASTM E 2357.

2.3 VAPOR-RETARDING MEMBRANE AIR BARRIER

A. Fluid-Applied, Vapor-Retarding Membrane Air Barrier: Elastomeric, modified bituminous membrane.

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. Elastomeric, Modified Bituminous Membrane:

      1) Carlisle Coatings & Waterproofing Inc.; Barritech NP.
      2) Grace Perm-A-Barrier NP 20.
      3) Henry Company; Air-Bloc 32 MR.
      4) Hohmann & Barnard, Inc.; Textroflash Liquid.
      5) Meadows, W. R., Inc.; Air-Shield LM.
      6) Polyguard Poly Wall Airlok Flex with ProBan
      7) Tremco Incorporated, an RPM company; ExoAir 120SP/R.

2. Physical and Performance Properties:

   a. Air Permeance: Maximum 0.004 cfm/sq. ft. of surface area at 1.57-lbf/sq. ft. pressure difference; ASTM E 2178.
   b. Vapor Permeance: Maximum 0.1 perm; ASTM E 96/E 96M.
   c. Ultimate Elongation: Minimum 500 percent; ASTM D 412, Die C.

2.4 ACCESSORY MATERIALS

A. General: Accessory materials recommended by air-barrier manufacturer to produce a complete air-barrier assembly and compatible with primary air-barrier material.

B. Primer: Liquid waterborne primer recommended for substrate by air-barrier material manufacturer.

C. Butyl Strip: Vapor retarding, 30 to 40 mils thick, self-adhering; polyethylene-film-reinforced top surface laminated to layer of butyl adhesive with release liner backing.

D. Adhesive and Tape: Air-barrier manufacturer's standard adhesive and pressure-sensitive adhesive tape.

E. Sprayed Polyurethane Foam Sealant: One- or two-component, foamed-in-place, polyurethane foam sealant, 1.5- to 2.0-lb/cu. ft density; flame-spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.

F. Modified Bituminous Transition Strip: Vapor retarding, 40 mils thick, smooth surfaced, self-adhering; consisting of 36 mils of rubberized asphalt laminated to a 4-mil- thick polyethylene film with release liner backing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

1. Verify that substrates are sound and free of oil, grease, dirt, excess mortar, or other contaminants.
2. Verify that concrete has cured and aged for minimum time period recommended by air-barrier manufacturer.
3. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
4. Verify that masonry joints are flush and completely filled with mortar.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. Clean, prepare, treat, and seal substrate according to manufacturer's written instructions. Provide clean, dust-free, and dry substrate for air-barrier application.

B. Mask off adjoining surfaces not covered by air barrier to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

E. Remove excess mortar from masonry ties, shelf angles, and other obstructions.

F. At changes in substrate plane, apply sealant or termination mastic beads at sharp corners and edges to form a smooth transition from one plane to another.

G. Cover gaps in substrate plane and form a smooth transition from one substrate plane to another with stainless-steel sheet mechanically fastened to structural framing to provide continuous support for air barrier.

3.3 JOINT TREATMENT

A. Concrete and Masonry: Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1193 and air-barrier manufacturer's written instructions. Remove dust and dirt from joints and cracks complying with ASTM D 4258 before coating surfaces.

1. Prime substrate and apply a single thickness of air-barrier manufacturer's recommended preparation coat extending a minimum of 3 inches along each side of joints and cracks. Apply a

double thickness of fluid air-barrier material and embed a joint reinforcing strip in preparation coat.

B. Gypsum Sheathing: Fill joints greater than 1/4 inch with sealant according to ASTM C 1193 and air-barrier manufacturer's written instructions. Apply first layer of fluid air-barrier material at joints. Tape joints with joint reinforcing strip after first layer is dry. Apply a second layer of fluid air-barrier material over joint reinforcing strip.

3.4 TRANSITION STRIP INSTALLATION

A. General: Install strips, transition strips, and accessory materials according to air-barrier manufacturer's written instructions to form a seal with adjacent construction and maintain a continuous air barrier.

1. Coordinate the installation of air barrier with installation of roofing membrane and base flashing to ensure continuity of air barrier with roofing membrane.
2. Install butyl strip on roofing membrane or base flashing so that a minimum of 3 inches of coverage is achieved over each substrate.

B. Apply primer to substrates at required rate and allow it to dry. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.

1. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

C. Connect and seal exterior wall air-barrier material continuously to roofing-membrane air barrier, concrete below-grade structures, floor-to-floor construction, exterior glazing and window systems, glazed curtain-wall systems, storefront systems, exterior louvers, exterior door framing, and other construction used in exterior wall openings, using accessory materials.

D. At end of each working day, seal top edge of strips and transition strips to substrate with termination mastic.

E. Apply joint sealants forming part of air-barrier assembly within manufacturer's recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

F. Wall Openings: Prime concealed, perimeter frame surfaces of windows, curtain walls, storefronts, and doors. Apply modified bituminous transition strip so that a minimum of 3 inches of coverage is achieved over each substrate. Maintain 3 inches of full contact over firm bearing to perimeter frames with not less than 1 inch of full contact.

1. Modified Bituminous Transition Strip: Roll firmly to enhance adhesion.

G. Fill gaps in perimeter frame surfaces of windows, curtain walls, storefronts, and doors, and miscellaneous penetrations of air-barrier material with foam sealant.

H. Seal strips and transition strips around masonry reinforcing or ties and penetrations with termination mastic.

I. Seal exposed edges of strips at seams, cuts, penetrations, and terminations not concealed by metal counterflashings or ending in reglets with termination mastic.

J. Repair punctures, voids, and deficient lapped seams in strips and transition strips. Slit and flatten fishmouths and blisters. Patch with transition strips extending 6 inches beyond repaired areas in strip direction.

3.5 FLUID AIR-BARRIER MEMBRANE INSTALLATION

A. General: Apply fluid air-barrier material to form a seal with strips and transition strips and to achieve a continuous air barrier according to air-barrier manufacturer's written instructions. Apply fluid air-barrier material within manufacturer's recommended application temperature ranges.

1. Apply primer to substrates at required rate and allow it to dry.
2. Limit priming to areas that will be covered by fluid air-barrier material on same day. Reprime areas exposed for more than 24 hours.
3. Prime glass-fiber-surfaced gypsum sheathing with number of prime coats needed to achieve required bond, with adequate drying time between coats.

B. Membrane Air Barriers: Apply a continuous unbroken air-barrier membrane to substrates according to the following thickness. Apply air-barrier membrane in full contact around protrusions such as masonry ties.

1. Vapor-Retarding Membrane Air Barrier: Total dry film thickness as recommended in writing by manufacturer to meet performance requirements, but not less than 40-mil dry film thickness, applied in one or more equal coats.

C. Apply strip and transition strip a minimum of 1 inch onto cured air-barrier material or strip and transition strip over cured air-barrier material overlapping 3 inches onto each surface according to air-barrier manufacturer's written instructions.

D. Do not cover air barrier until it has been tested and inspected by Owner's testing agency.

E. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air-barrier components.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Inspections: Air-barrier materials, accessories, and installation are subject to inspection for compliance with requirements. Inspections may include the following:

1. Continuity of air-barrier system has been achieved throughout the building envelope with no gaps or holes.
2. Continuous structural support of air-barrier system has been provided.
3. Masonry and concrete surfaces are smooth, clean, and free of cavities, protrusions, and mortar droppings.
4. Site conditions for application temperature and dryness of substrates have been maintained.
5. Maximum exposure time of materials to UV deterioration has not been exceeded.
6. Surfaces have been primed, if applicable.
7. Laps in strips and transition strips have complied with minimum requirements and have been shingled in the correct direction (or mastic has been applied on exposed edges), with no fishmouths.
8. Termination mastic has been applied on cut edges.
9. Strips and transition strips have been firmly adhered to substrate.

10. Compatible materials have been used.
11. Transitions at changes in direction and structural support at gaps have been provided.
12. Connections between assemblies (air-barrier and sealants) have complied with requirements for cleanliness, surface preparation and priming, structural support, integrity, and continuity of seal.
13. All penetrations have been sealed.

C. Tests: As determined by Owner's testing agency from among the following tests:

1. Qualitative Air-Leakage Testing: Air-barrier assemblies will be tested for evidence of air leakage according to ASTM E 1186, smoke pencil with pressurization or depressurization.

D. Air barriers will be considered defective if they do not pass tests and inspections.

1. Apply additional air-barrier material, according to manufacturer's written instructions, where inspection results indicate insufficient thickness.
2. Remove and replace deficient air-barrier components for retesting as specified above.

E. Repair damage to air barriers caused by testing; follow manufacturer's written instructions.

3.7 CLEANING AND PROTECTION

A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

1. Protect air barrier from exposure to UV light and harmful weather exposure as required by manufacturer. If exposed to these conditions for more than 30days, remove and replace air barrier or install additional, full-thickness, air-barrier application after repairing and preparing the overexposed membrane according to air-barrier manufacturer's written instructions.
2. Protect air barrier from contact with incompatible materials and sealants not approved by air-barrier manufacturer.

B. Clean spills, stains, and soiling from construction that would be exposed in the completed work using cleaning agents and procedures recommended by manufacturer of affected construction.

C. Remove masking materials after installation.

END OF SECTION 07 27 26

SECTION 07 42 13 - METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes aluminum composite material (ACM) wall panels.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, metal composite material panel Installer, structural-support Installer, and installers whose work interfaces with or affects metal composite material panels, including installers of doors, windows, and louvers.
2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
3. Review methods and procedures related to metal composite material panel installation, including manufacturer's written instructions.
4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect metal composite material panels.
6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
7. Review temporary protection requirements for metal composite material panel assembly during and after installation.
8. Review procedures for repair of panels damaged after installation.
9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal composite material panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, and accessories; and special details.

2. Accessories: Include details of the flashing, trim and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.

1. Metal Composite Material Panels: 12 inches long by actual panel width. Include fasteners, closures, and other metal composite material panel accessories.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal composite material panels to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Five years experience in cladding fabrication.

B. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal composite material panels, and other manufactured items so as not to be damaged or deformed. Package metal composite material panels for protection during transportation and handling.

B. Unload, store, and erect metal composite material panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal composite material panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal composite material panels to ensure dryness, with positive slope for drainage of water. Do not store metal composite material panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal composite material panels during installation.

1.8 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal composite material panels to be performed according to manufacturers' written instructions and warranty requirements.

1.9 COORDINATION

A. Coordinate metal composite material panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal composite material panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 330:

1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.
3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

2.2 METAL COMPOSITE MATERIAL WALL PANELS

A. Metal Composite Material Wall Panel Systems: Provide factory-formed and -assembled, metal composite material wall panels fabricated from two metal facings that are bonded to a solid, extruded thermoplastic core; formed into profile for installation method indicated. Include attachment assembly components, panel stiffeners, and accessories required for weathertight system.

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. 3A Composites USA, Inc.; Alucobond.
b. Alcoa Inc.; Reynobond FR.
c. CENTRIA Architectural Systems; Formabond Wall System.
d. Firestone Metal Products, LLC; UNA-FAB Series 1000.

B. Aluminum-Faced Composite Wall Panels: Formed with 0.020-inch thick, coil-coated aluminum sheet facings.

1. Panel Thickness: 0.157 inch.
2. Core: Standard.
3. Exterior Finish: Two-coat fluoropolymer.

a. Color: As selected by Architect from manufacturer's full range.

C. Attachment Assembly Components: Formed from extruded aluminum.

D. Attachment Assembly: Manufacturer's standard.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class AZ50 aluminum-zinc-

alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal composite material panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal composite material panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal composite material panel as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps (copings), soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal composite material panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal composite material panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

2.4 FABRICATION

A. General: Fabricate and finish metal composite material panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. Fabricate metal composite material panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
4. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.

    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not

acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Aluminum Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal composite material panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal composite material wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal composite material wall panel manufacturer.

a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and assemblies penetrating metal composite material panels to verify actual locations of penetrations relative to seam locations of metal composite material panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal composite material panel manufacturer's written recommendations.

3.3 METAL COMPOSITE MATERIAL PANEL INSTALLATION

A. General: Install metal composite material panels according to manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor metal composite material panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving metal composite material panels.
2. Flash and seal metal composite material panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal composite material panels are installed.
3. Install screw fasteners in predrilled holes.

4. Locate and space fastenings in uniform vertical and horizontal alignment.
5. Install flashing and trim as metal composite material panel work proceeds.
6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
7. Align bottoms of metal composite material panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

B. Fasteners:

1. Aluminum Panels: Use aluminum or stainless-steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal composite material panel manufacturer.

D. Attachment Assembly, General: Install attachment assembly required to support metal composite material wall panels and to provide a complete weathertight wall system, including subgirts, perimeter extrusions, tracks, drainage channels, panel clips, and anchor channels.

1. Include attachment to supports, panel-to-panel joinery, panel-to-dissimilar-material joinery, and panel-system joint seals.

E. Rainscreen-Principle Installation: Install using manufacturer's standard assembly with vertical channel that provides support and secondary drainage assembly, draining at base of wall. Notch vertical channel to receive support pins. Install vertical channels supported by channel brackets or adjuster angles and at locations, spacings, and with fasteners recommended by manufacturer. Attach metal composite material wall panels by inserting horizontal support pins into notches in vertical channels and into flanges of panels. Leave horizontal and vertical joints with open reveal.

1. Install wall panels to allow individual panels to be installed and removed without disturbing adjacent panels.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal composite material panel assembly including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal composite material panel manufacturer; or, if not indicated, provide types recommended in writing by metal composite material panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently

waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align metal composite material wall panel units within installed tolerance of 1/4 inch in 20 feet, non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.5 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal composite material panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal composite material panel installation, clean finished surfaces as recommended by metal composite material panel manufacturer. Maintain in a clean condition during construction.

B. After metal composite material panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal composite material panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

3.6 TESTING

A. Test for water leakage: Test under differential pressure amounting to 20 percent of specified performance pressure required relative to complete module of metal panel system.

B. Test for Air Leakage: Not to exceed 0.09 CFM/FT when tested to ASTM E283 at a static pressure differential of 6.24 PSF.

END OF SECTION 07 42 13

SECTION 07 53 23 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

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. Adhered ethylene-propylene-diene-monomer (EPDM) roofing system.
2. Roof insulation.

B. Related Requirements:
1. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07 62 00 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
3. Section 22 05 14 "Plumbing Specialties" for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Architect, roofing installer, roofing system manufacturer's representative, deck installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
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 deck 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 affects roofing system.
7. Review temporary protection requirements for roofing system during and after installation.
8. Review roof observation and repair procedures after roofing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of roofing and fastening spacings and patterns for mechanically fastened roofing.

1.6 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing system to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

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 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.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. 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.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 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.

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, substrate board, roofing accessories, and other components of roofing system.

2. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain components including roof insulation and fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed 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. 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: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Roofing System Design: Tested by a qualified testing agency to resist the uplift pressures indicated on Drawings.

D. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.3 EPDM ROOFING

A. EPDM: ASTM D 4637, Type I, nonreinforced, uniform, flexible EPDM sheet.

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. Carlisle SynTec Incorporated.
b. Firestone Building Products.

2. Thickness: 60 mils, nominal.

3. Exposed Face Color: Black.

2.4 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

B. Sheet Flashing: 60-mil- thick EPDM, partially cured or cured, according to application.

C. Bonding Adhesive: Manufacturer's standard.

D. for compatibility and use with fabric-backed membrane roofing.

E. Seaming Material: Manufacturer's standard, synthetic-rubber polymer primer and 3-inch wide minimum, butyl splice tape with release film.

F. Lap Sealant: Manufacturer's standard, single-component sealant, colored to match membrane roofing.

G. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

H. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch thick; with anchors.

I. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.

J. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

1. Provide white flashing accessories for white EPDM membrane roofing.

2.5 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1396/C 1396M, Type X gypsum board, 5/8 inch thick.

B. Cover Board: Water resistant gypsum core with fiberglass facings.

1. Minimum Thickness: 1/4 inch.

2. Pre-primed.

3. Products:
   a. Base: As approved by roofing manufacturer.
   b. Optional: Dens-Deck Prime Roof Board by Georgia-Pacific

C. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate panel to roof deck.

2.6 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by EPDM roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 3, felt or glass-fiber mat facer on both major surfaces.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.7 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulationto substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Modified asphaltic, asbestos-free, cold-applied adhesive.
2. Full-spread spray-applied, low-rise, two-component urethane adhesive.

2.8 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, solid-rubber, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16 inch thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 31 00 "Steel Decking."

B. 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 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

B. 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.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Global's "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers' written instructions.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. 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.

1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. 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 of nailers, projections, and penetrations.

G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

3.6 ADHERED MEMBRANE ROOFING INSTALLATION

A. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

B. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

C. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer, and allow to partially dry before installing roofing. Do not apply to splice area of roofing.

D. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeters.

E. Apply roofing with side laps shingled with slope of roof deck where possible.

F. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing terminations.

G. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

H. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal membrane roofing in place with clamping ring.

3.7 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories, and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.8 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.9 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction does 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 membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane 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 07 53 23

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 General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Formed roof sheet metal fabrications.
2. Formed wall sheet metal fabrications.

B. Related Requirements:

1. Section 04 20 00 "Unit Masonry" for embedded masonry flashing
2. Section 06 10 00 "Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 07 42 13 "Metal Wall Panels for sheet metal flashing and trim integral with metal wall panels.
4. Section 07 72 00 "Roof Accessories" for roof hatches."

1.3 COORDINATION

A. Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.

B. Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
3. Review sheet metal flashing observation and repair procedures after flashing installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: For sheet metal flashing and trim.

1. Include plans, elevations, sections, and attachment details.
2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work.
3. Include identification of material, thickness, weight, and finish for each item and location in Project.
4. Include details for forming, including profiles, shapes, seams, and dimensions.
5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
6. Include details of termination points and assemblies.
7. Include details of roof-penetration flashing.
8. Include details of special conditions.
9. Include details of connections to adjoining work.
10. Detail formed flashing and trim at scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Verification: For each type of exposed finish.

1. Sheet Metal Flashing: 12 inches long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim and Miscellaneous Fabrications: 12 inches long and in required profile. Include fasteners and other exposed accessories.

1.6 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and trim installation.

1.10 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Aluminum Sheet: ASTM B 209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.

1. Exposed Coil-Coated Finish:

a. Two-Coat Fluoropolymer: AAMA 620. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2. Color: As selected by Architect from manufacturer's full range.
3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

C. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed; with smooth, flat surface.

1. Finish: 2D (dull, cold rolled).

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal, unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
3. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

C. Solder:

1. For Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

D. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

E. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt emulsion according to ASTM D 1187.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

H. Do not use graphite pencils to mark metal surfaces.

2.5 ROOF SHEET METAL FABRICATIONS

A. Roof Edge Flashing: Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long sections. Furnish with 6-inch- wide, joint cover plates. Shop fabricate interior and exterior corners.

1. Joint Style: Butted with expansion space and 6-inch- wide, concealed backup plate.

2. Fabricate from the Following Materials:

a. Aluminum: 0.050 inch thick.

B. Gutters: Fabricate to cross section indicated, complete with end pieces, outlet tubes, and other accessories as required. Fabricate in minimum 96 inch long sections. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal

standard but with thickness not less than twice the gutter thickness. Fabricate expansion joints, gutter bead reinforcing bars, and gutter accessories from same metal as gutters. Shop fabricate interior and exterior corners.

1. Expansion Joints: Lap type.
2. Fabricate from the following materials:
   a. Aluminum: 0.032 inch thick.

C. Downspouts: Fabricate rectangular downspouts to dimensions indicated, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors. Shop fabricate elbows.

1. Fabricate from the following materials:
   a. Aluminum: 0.024 inch thick.

D. Counterflashing and Flashing Receivers: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.

E. Roof-Penetration Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.019 inch thick.

F. Roof-Drain Flashing: Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

2.6 WALL SHEET METAL FABRICATIONS

A. Metal Drip Edge: Fabricate from the following materials:

1. Stainless Steel: 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact

surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

B. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

C. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

D. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

E. Seal joints as required for watertight construction.

1. Use sealant-filled joints unless otherwise indicated. Embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

F. Rivets: Rivet joints in aluminum where necessary for strength.

3.3 ROOF FLASHING INSTALLATION

A. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

A. Gutters: Join sections with joints sealed with sealant. Provide for thermal expansion. Attach gutters to firmly anchor them in position. Provide end closures and seal watertight with sealant. Slope to downspouts.

1. Fasten gutter spacers to front and back of gutter.
2. Anchor gutter with straps spaced not more than 24 inches apart to roof deck, unless otherwise indicated, and loosely lock to front gutter bead.
3. Install gutter with expansion joints at locations indicated, but not exceeding, 50 feet apart. Install expansion-joint caps.

B. Downspouts: Join sections with 1-1/2-inch telescoping joints.

1. Provide hangers with fasteners designed to hold downspouts securely to walls. Locate hangers at top and bottom and at approximately 60 inches o.c.
2. Provide elbows at base of downspout to direct water away from building.

C. Pipe Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

D. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches. Secure in waterproof manner by means of snap-in installation and sealant or lead wedges and sealant unless otherwise indicated.

E. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.4 ERECTION TOLERANCES

A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean off excess sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended by sheet metal flashing and trim manufacturer. Maintain sheet metal flashing and trim in clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

SECTION 07 72 00 - ROOF 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. Roof hatches.
2. Roof edge railing system.

1.3 ACTION SUBMITTALS

A. Product Data: For each product indicated.

B. Shop Drawings: For each product indicated.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

PART 2 - PRODUCTS

2.1 METAL MATERIALS

A. Aluminum Sheet: ASTM B 209, manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.

B. Aluminum Extrusions and Tubes: ASTM B 221, manufacturer's standard alloy and temper for type of use, finished to match assembly where used, otherwise mill finished.

C. Steel Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish per ASTM A 123/A 123M.

D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

1. Provide galvanized finish per ASTM A 153/A 153M.

2.2 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Fasteners: Roof accessory manufacturer's recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.

C. Sealants: As recommended by roof accessory manufacturer for installation indicated.

2.3 ROOF HATCHES

A. Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, and integrally formed deck-mounting flange at perimeter bottom.

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. Babcock-Davis.
    b. Bilco Company (The).
    c. J. L. Industries, Inc.
    d. Milcor Inc.; Commercial Products Group of Hart & Cooley, Inc.
    e. Naturalite Skylight Systems; Vistawall Group (The).
    f. Nystrom.
    g. O'Keeffe's Inc.

B. Type and Size: Single-leaf lid, 30 by 54 inches.

C. Loads: Minimum 40-lbf/sq. ft. external live load and 20-lbf/sq. ft. internal uplift load.

D. Hatch Material: Aluminum sheet, 0.090 inch thick.

1. Finish: Mill.

E. Construction:

1. Insulation: Polyisocyanurate board.
2. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.
3. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.
4. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
5. Fabricate curbs to minimum height of 12 inches unless otherwise indicated.

F. Hardware: Galvanized-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.

1. Provide two-point latch on lids larger than 84 inches.
2. Provide remote-control operation.

2.4 SAFETY RAILING SYSTEM

A. Freestanding counterweighted guardrail system with 42 inch nominal height.

B. Basis of Design: Subject to compliance with requirements, provide KeeGuard Roof Edge Fall Protection System; Kee Safety, Inc, or comparable product.

C. Codes and Regulations: Comply OSHA 1926.502 (b)-(e) Fall Protection Systems Criteria and Practices.

D. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Top Rails: Concentrated load of 200 lbf applied at any point in any direction.

E. Components:
1. Posts and Rails: 1-1/2 inch diameter steel pipe.
2. Fittings: Galvanized cast iron, Provide elbows, crossovers, wall flanges, tees, couplings, as required for application.
3. Mounting Bases: Galvanized steel with a rubber pads on underside.
4. Counterweights: Steel, with a rubber pad on underside, or recycled PVC.
5. Fasteners: Type 304 or 305 stainless steel.

F. Fabrication:
1. Fit and shop-assemble components in largest practical sizes for delivery to site.
2. Upright tops shall be plugged with weather and light resistant material.
3. Assemble components with joints tightly fitted and secured with set screws tightened to 29 foot pounds of torque.

PART 3 - EXECUTION

3.1 ROOF HATCH INSTALLATION

A. General: Verify dimensions of roof openings for roof hatches. Install roof hatches according to manufacturer's written instructions.

1. Install roof hatches level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.
2. Anchor roof hatches securely in place so they are capable of resisting indicated loads.
3. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.
4. Install roof hatches to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum roof hatches with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing roof hatches directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene sheet.

C. Seal joints with sealant as required by roof hatch manufacturer.

3.2 SAFETY RAILING INSTALLATION

A. Comply with manufacturer's printed installation instructions.

B. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack. Use mechanical joints for connecting railing components.

C. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

D. Align rails so variations from level for horizontal members do not exceed 1/4 inch in 12 feet.

3.3 REPAIR AND CLEANING

A. Replace components that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 72 00

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Foam Joint Seals

B. Related Sections:

1. Section 04 20 00 "Unit Masonry" for masonry control and expansion joint fillers and gaskets.
2. Section 08 80 00 "Glazing" for glazing sealants.
3. Section 09 29 00 "Gypsum Board" for sealing perimeter joints.
4. Section 09 30 00 "Tiling" for sealing tile joints.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.

B. Field-Adhesion Test Reports: For each sealant application tested.

C. Warranties: Sample of special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.

C. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Omniseal 50.
b. Dow Corning Corporation; 756 SMS.
c. GE Advanced Materials - Silicones; SilGlaze II SCS2800.
d. Pecora Corporation; 864.
e. Sika Corporation, Construction Products Division; SikaSil-C995.
f. Tremco Incorporated; Spectrem 2 or Spectrem 3.

B. Single-Component, Pourable, Traffic-Grade, Neutral-Curing or Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade P, Class 100/50, for Use T.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 890-SL.
b. Pecora Corporation; 300 SL.
c. Tremco Incorporated; Spectrem 900 SL.

C. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing or Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Dow Corning Corporation; 786 Mildew Resistant.
b. GE Advanced Materials - Silicones; Sanitary SCS1700.
c. Pecora Corporation; 898.
d. Tremco Incorporated; Tremsil 200 Sanitary

2.3 URETHANE JOINT SEALANTS

A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 50, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pacific Polymers International, Inc.; Elasto-Thane 230 LM Type II.
b. Polymeric Systems, Inc.; PSI-901.

B. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use NT.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Sonolastic NP 2.
b. Bostik, Inc.; Chem-Calk 500.
c. Pecora Corporation; Dynatred.
d. Tremco Incorporated; Vulkem 227.

2.4 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. BASF Building Systems; Sonolac.
b. Bostik, Inc.; Chem-Calk 600.
c. Pecora Corporation; AC-20+.
d. Tremco Incorporated; Tremflex 834.

2.5 FOAM JOINT SEALS

A. Preformed, Foam Joint Seals: Manufacturer's standard joint seal manufactured from urethane or EVA (ethylene vinyl acetate) foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths based on design criteria indicated, with factory- or field-applied adhesive for bonding to substrates.

1. Design Criteria:

a. Nominal Joint Width: As indicated on Drawings.
b. Movement Capability: -25 percent/+25 percent.

2. Joint Seal Color: As selected by Architect from full range of industry colors.

3. Products: Subject to compliance with requirements, available manufacturers whose products may be incorporated into the Work include, but are not limited to, the following:

a. EMSEAL Joint Systems, Ltd.
b. MM Systems Corporation
c. Nystrom Inc.

2.6 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.7 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

   a. Metal.
   b. Glass.
   c. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

4. Provide flush joint profile where indicated per Figure 8B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 8C in ASTM C 1193.

G. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 INSTALLATION OF FOAM JOINT SEALS

A. Install each length of seal immediately after removing protective wrapping.

B. Firmly secure compressed joint seals to joint gap side to obtain full bond using exposed pressure-sensitive adhesive or field-applied adhesive as recommended by manufacturer.

C. Do not pull or stretch material. Produce seal continuity at splices, ends, turns, and intersections of joints.

D. For applications at low ambient temperatures, heat foam joint seal material in compliance with manufacturer's written instructions.

3.5 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed and cured sealant joints as follows:

   a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
   b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.

2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:

   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that

fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.6 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.7 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.8 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surface.

1. Joint Locations:
   a. Joints between metal panels.
   b. Perimeter joints of aluminum frames of doors, windows and louvers.

2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 50**.**

B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surface.

1. Joint Locations: Cast in place concrete, concrete masonry, HM Door perimeters

2. Joint Sealant: Multicomponent, Nonsag, Urethane Joint Sealant:

C. Joint-Sealant Application: Interior joints in horizontal traffic surface.

1. Joint Locations:

   a. Isolation joints in cast-in-place concrete slabs.

2. Silicone Joint Sealant: Single component, pourable, traffic grade, neutral curing.

D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces

1. Joint Locations:

   a. Perimeter joints of exterior openings where indicated.
   b. Tile control and expansion joints.
   c. Vertical joints on exposed surfaces of interior unit masonry.
   d. Perimeter joints between interior wall surfaces and frames of interior doors and windows.

2. Joint Sealant: Latex.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Sealant Location:

a. Joints between plumbing fixtures and adjoining walls, floors, and counters.

2. Joint Sealant: Mildew-Resistant Silicone

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes hollow-metal work.

B. Related Requirements:

1. Section 08 71 00 "Door Hardware" for door hardware for hollow-metal doors.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.4 COORDINATION

A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, fire-resistance ratings, and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door type.
2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.7 QUALITY ASSURANCE

A. A. Hollow Door and Frame Standards:

1. ANSI A250.4 Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors
2. ANSI A250.8 / SDI 100 Recommended Specifications for Standard Steel Doors and Frames
3. ANSI A250.11 Recommended Erection Instructions for Steel Frames

B. B. Fire Rated Doors and Frames:
1. Label and list for ratings indicated by ITS – Warnock Hersey, UL or other testing and inspection agency acceptable to authorities having jurisdiction.
2. Affix physical label or approved marking to fire door or fire door frame at an authorized facility as evidence of compliance with procedures of labeling agency.
3. Where pairs of doors require fire rating (90 minute maximum), doors shall have passed appropriate test without the use of astragals.
4. Positive Pressure: Comply with Positive Pressure Requirements UL 10C, Category A or NFPA 252.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Ceco Door Products; an Assa Abloy Group company.
2. Curries Company; an Assa Abloy Group company.
3. Karpen Steel Custom Doors & Frames.
4. LaForce, Inc.
5. Mesker Door Inc.
6. Steelcraft; an Ingersoll-Rand company.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra Heavy-Duty Doors and Frames: SDI A250.8, Level 3.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:

    a. Type: As indicated in the Door and Frame Schedule.
    b. Thickness: 1-3/4 inches.
    c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
    d. Edge Construction: Model 2, Seamless.
    e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

3. Frames:

    a. Materials: Uncoated steel sheet, minimum thickness of 0.053 inch.
    b. Construction: Full profile welded.

4. Lites:
    a. Provide light kits which are labeled for intended opening.
    b. Fixed Stop:
        1) Locate at exterior face.
        2) Integral to door/frame.
        3) Removable Stop:
        4) Locate on interior face.
    c. Snap-in stops or stops secured with countersunk Phillips head machine screws.

5. Exposed Finish: Prime.

2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3.

1. Physical Performance: Level A according to SDI A250.4.
2. Doors:

a. Type: As indicated in the Door and Frame Schedule.
b. Thickness: 1-3/4 inches
c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
d. Edge Construction: Model 2, Seamless.
e. Core: Polyurethane.

3. Frames: Thermally Broken HM Frames:

a. Provide thermally broken hollow metal frames at exterior openings..
b. Construct as specified for conventional frames with two steel sections mechanically joined together, separated by continuous, low-conductivity, thermal break material.
c. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
d. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

G. Glazing: Comply with requirements in Section 08 80 00 "Glazing."

H. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Vertical Edges for Single-Acting Doors: Bevel edges 1/8 inch in 2 inches.
2. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors of same material as face sheets.
3. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
4. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

1. Sidelight Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames installed in masonry.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

   a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:

      1) Three anchors per jamb from 60 to 90 inches high.
      2) Four anchors per jamb from 90 to 120 inches high.
      3) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

   b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

      1) Four anchors per jamb from 60 to 90 inches high.

6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.

   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
2. Provide loose stops and moldings on inside of hollow-metal work.
3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

    a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    b. Install frames with removable stops located on secure side of opening.
    c. Install door silencers in frames before grouting.
    d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

    a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.

4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

    a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:

    a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.

b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 11 13

SECTION 08 14 16 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 08 80 00 "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; and the following:

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Requirements for veneer matching.
6. Doors to be factory finished and finish requirements.
7. Fire-protection ratings for fire-rated doors.

C. Samples: For door faces, 8 inches square.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Algoma Hardwoods, Inc.
2. Eggers Industries.
3. Graham Wood Doors; an Assa Abloy Group company.
4. Marshfield Door Systems, Inc.

5. Oshkosh Door Company.

2.2 WOOD VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

A. WDMA I.S.1-A Performance Grade: Heavy Duty.Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.

B. Veneer Grade: A.

C. Species: Select white maple.

D. Cut: Plain sliced.

E. Match between Veneer Leaves: Book match.

F. Assembly of Veneer Leaves on Door Faces: Running match.

A. Core: Particleboard: ANSI A208.1, Grade LD-1 or Grade LD-2.

1. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.

B. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering. Faces are bonded to core using a hot press.

2.3 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.

1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.

C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 08 80 00 "Glazing."

2.4 FACTORY FINISHING

A. Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Finish: WDMA TR-4 conversion varnish or WDMA TR-6 catalyzed polyurethane.

C. Staining: As selected by Architect from manufacturer's full range.

D. Effect: Semi-filled finish, produced by applying an additional finish coat to partially fill the wood pores.

E. Sheen: Satin.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hardware for Installation: See Section 08 71 00 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.

1. Install fire-rated doors according to NFPA 80.

C. Align in frames for uniform clearance at each edge.

D. Restore finish before installation if fitting or machining is required at Project site.

END OF SECTION 08 14 16

SECTION 08 31 13 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Access doors and frames for use in conjunction with Mechanical and Electrical equipment concealed in walls and ceilings.

a. Provide stainless steel access doors in restrooms and other spaces subject to moisture. Provide steel doors elsewhere.

2. Sizes and quantities shall be determined by applicable trade contractors in accordance with system requirements.

B. Related Requirements:

1. Section 07 72 00 "Roof Accessories" for roof hatches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, materials, individual components and profiles, and finishes.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

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. Babcock-Davis.
2. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
3. Karp Associates, Inc.
4. Larsen's Manufacturing Company.
5. Milcor Inc.
6. Nystrom, Inc.

B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

C. Size:
   1. As required to allow access, inspection, service, and removal of items served.
   2. Minimum 18 by 18 inches.

D. Flush Access Doors with Exposed Flanges:

   1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.

   2. Uncoated Steel Sheet for Door: Nominal 0.060 inch thick (16 gage).

      a. Finish: Factory prime.

   3. Stainless-Steel Sheet for Door: Nominal 0.062 inch (16 gage).

   4. Frame Material: Same material, thickness, and finish as door.

   5. Hinges: Manufacturer's standard.

   6. Hardware: Cam latch operated by screwdriver.

2.2 MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.

C. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304. Remove tool and die marks and stretch lines, or blend into finish.

D. Frame Anchors: Same type as door face.

E. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.3 FABRICATION

A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.

B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.

C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.

   1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.

   2. Provide mounting holes in frame for attachment of masonry anchors.

D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.

2.4 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

A. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

1. Provide primed, field finished to match ceiling, in office area.

B. Stainless-Steel Finish:

1. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

2. Polished Finish: No. 4 finish. Grind and polish surfaces to produce uniform finish, free of cross scratches.

a. Run grain of directional finishes with long dimension of each piece.
b. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.3 ADJUSTING

A. Adjust doors and hardware, after installation, for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 08 31 13

SECTION 083313 - COILING COUNTER DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fire-rated counter doors.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

A. Product Data: For coiling counter door and accessories.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.
3. Include description of automatic closing device and testing and resetting instructions.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. Show locations of controls, locking devices, and other accessories.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For coiling counter doors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at as close to neutral pressure as possible according to NFPA 252 or UL 10B.

1. Smoke Control: Provide doors that are listed and labeled with the letter "S" on the fire-rating label by a qualified testing agency for smoke- and draft-control based on testing according to UL 1784; with maximum air-leakage rate of 3.0 cfm/sq. ft. of door opening at 0.10-inch wg for both ambient and elevated temperature tests.

PART 2 - PRODUCTS

2.1 COUNTER DOOR ASSEMBLY

A. Overhead fire-rated coiling door formed with curtain of interlocking metal slats.

B. Fire Rating: 1-1/2 hours.

C. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. C.H.I. Overhead Doors
2. Cookson Company.
3. Cornell Iron Works Inc.
4. Overhead Door Corp.
5. Raynor.
6. Wayne-Dalton Corp.

D. Operation Cycles: Door components and operators capable of operating for not less than 10,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

E. Door Curtain Material: Galvanized steel.

F. Door Curtain Slats: Flat profile slats of 1-1/4-inch center-to-center height.

G. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated hot-dip galvanized steel and finished to match door.

H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

I. Integral Frame, Hood, and Fascia: Galvanized steel.

1. Mounting: As shown on Drawings.

J. Sill Configuration: Integral metal sill.

K. Manual Door Operator: Push-up operation.

L. Curtain Accessories: Equip door with smoke seals push/pull handles and automatic closing device.

M. Door Finish: Baked-enamel or powder-coated finish, color as indicated by manufacturer's designations.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate coiling counter-door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.3 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Galvanized Steel: Nominal 0.028-inch-thick, hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.
2. Include automatic drop baffle to guard against passage of smoke or flame.

B. Integral Frame, Hood, and Fascia: Welded sheet metal assembly of the following sheet metal(s):

1. Galvanized Steel: Hot-dip galvanized steel sheet with G90 zinc coating, complying with ASTM A 653/A 653M.

2.4 CURTAIN ACCESSORIES

A. Smoke Seals: Equip each fire-rated door with replaceable smoke-seal perimeter gaskets or brushes for smoke and draft control as required for door listing and labeling by a qualified testing agency.

B. Push/Pull Handles: Equip each door with lifting handles on each side of door, finished to match door.

C. Automatic-Closing Device: Equip each fire-rated door with an automatic-closing device or holder-release mechanism and governor unit complying with NFPA 80 and an easily tested and reset release mechanism. Testing for manually operated doors shall allow resetting by opening the door without retensioning the counterbalancing mechanism. Automatic-closing device shall be designed for activation by the following:

1. Building fire-detection, smoke-detection, and -alarm systems.

2.5 COUNTER DOOR ACCESSORIES

A. Integral Metal Sill: Fabricate sills as integral part of frame assembly of Type 304 stainless steel in manufacturer's standard thickness with No. 4 finish.

2.6 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

1. Equip with auxiliary counterbalance spring and prevent tension release from main counterbalance spring when automatic closing device operates.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.7 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf.

2.8 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.9 STEEL AND GALVANIZED-STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

2.10 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.

1. Run grain of directional finishes with long dimension of each piece.
2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
3. Directional Satin Finish: No. 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install according to NFPA 80.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.
3. Test door closing when activated by detector or alarm-connected fire-release system. Reset door-closing mechanism after successful test.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 08 33 13

SECTION 08 33 23 - OVERHEAD COILING DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Insulated service doors.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling door and accessory.

1. Include construction details, material descriptions, dimensions of individual components, profiles for slats, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished accessories.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies, and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
4. For exterior components, include details of provisions for assembly expansion and contraction and for excluding and draining moisture to the exterior.
5. Include diagrams for power, signal, and control wiring.

C. Samples for Verification: For each type of exposed finish on the following components, in manufacturer's standard sizes:

1. Curtain slats.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For overhead coiling doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain overhead coiling doors from single source from single manufacturer.

1. Obtain operators and controls from overhead coiling door manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance, Exterior Doors: Capable of withstanding the design wind loads.

1. Design Wind Load: As indicated on Drawings.
2. Testing: According to ASTM E 330 or DASMA 108 for garage doors and meeting the acceptance criteria of DASMA 108.
3. Deflection Limits: Design overhead coiling doors to withstand design wind load without evidencing permanent deformation or disengagement of door components.
4. Operability under Wind Load: Design overhead coiling doors to remain operable under design wind load, acting inward and outward.

2.3 DOOR ASSEMBLY

A. Insulated Service Door: Overhead coiling door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. C.H.I. Overhead Doors.
b. Clopay Building Products.
c. Cookson Company.
d. Cornell Iron Works, Inc.
e. Overhead Door Corporation.
f. Raynor.
g. Wayne-Dalton Corp.

B. Operation Cycles: Door components and operators capable of operating for not less than 100,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

1. Include tamperproof cycle counter.

C. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. at 15 and 25 mph when tested according to ASTM E 283 or DASMA 105.

D. Curtain R-Value: 4.5 deg F x h x sq. ft./Btu.

E. Door Curtain Material: Galvanized steel.

F. Door Curtain Slats: Flat profile slats of 1-7/8-inch center-to-center height.

1. Insulated-Slat Interior Facing: Metal.
2. Gasket Seal. Manufacturer's standard continuous gaskets between slats.

G. Bottom Bar: Two angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch thick; fabricated from hot-dip galvanized steel and finished to match door.

H. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats.

I. Hood: Match curtain material and finish.

1. Shape: Round.
2. Mounting: Face of wall.

J. Locking Devices: Equip door with locking device assembly.

1. Locking Device Assembly: Single-jamb side locking bars, operable from inside with thumb turn.

K. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Operator Location: Top of hood.
3. Safety: Listed according to UL 325 by a qualified testing agency for commercial or industrial use; moving parts of operator enclosed or guarded if exposed and mounted at 8 feet or lower.
4. Motor Exposure: Exterior, wet, and humid.
5. Emergency Manual Operation: Chain type.
6. Obstruction-Detection Device: Automatic photoelectric sensor.
7. Control Station(s): Interior mounted.
8. Other Equipment: Portable radio-control system.

L. Curtain Accessories: Equip door with weatherseals.

M. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color as selected by Architect from manufacturer's full range.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.4 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate overhead coiling-door curtain of interlocking metal slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Double wall slats injected with polyurethane foam.
   a. Thickness: 15/16 inch
   b. Thermal Value: R-6.25 minimum.
2. Exterior Curtain-Slat Facing: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 zinc coating; nominal sheet thickness (coated) of 0.028 inch; and as required.
3. Insulation: Fill slats for insulated doors with manufacturer's standard thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84 or UL 723. Enclose insulation completely within slat faces.
4. Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face, with minimum steel thickness of 0.010 inch.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.6 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Exterior-Mounted Doors: Fabricate hood to act as weather protection and with a perimeter sealant-joint-bead profile for applying joint sealant.

2.7 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.8 CURTAIN ACCESSORIES

A. Weatherseals for Exterior Doors: Equip each exterior door with weather-stripping gaskets fitted to entire exterior perimeter of door for a weather-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch- thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch thick seals of flexible vinyl, rubber, or neoprene.

2.9 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless or welded carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.10 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

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. Chamberlain Group, Inc. (The).

2. Comply with NFPA 70.

3. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Door Operator Location(s): Operator location indicated for each door.

1. Top-of-Hood Mounted: Operator is mounted to the right or left door head plate with the operator on top of the door-hood assembly and connected to the door drive shaft with drive chain and sprockets. Headroom is required for this type of mounting.

D. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated.

1. Electrical Characteristics:

    a. Phase: Single phase.
    b. Volts: 115 V.
    c. Hertz: 60.

2. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
3. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.
4. Coordinate wiring requirements and electrical characteristics of motors and other electrical devices with building electrical system and each location where installed.

E. Limit Switches: Equip each motorized door with adjustable switches interlocked with motor controls and set to automatically stop door at fully opened and fully closed positions.

F. Obstruction Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. Activation of device immediately stops and reverses downward door travel.

1. Photoelectric Sensor: Manufacturer's standard system designed to detect an obstruction in door opening without contact between door and obstruction.

G. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Interior-Mounted Units: Full-guarded, standard-duty, surface-mounted, weatherproof type, NEMA ICS 6, Type 4 enclosure, key operated.

H. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

I. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

J. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

K. Portable Radio-Control System: Consisting of three of the following per door operator:

1. Three-channel universal coaxial receiver to open, close, and stop door.
2. Portable control device to open and stop door may be momentary-contact type; control to close door shall be sustained- or constant-pressure type.
3. Remote-antenna mounting kit.

2.11 FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry film thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates areas and conditions, with Installer present, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

B. Examine locations of electrical connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install overhead coiling doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install overhead coiling doors, hoods, controls, and operators at the mounting locations indicated for each door.

C. Accessibility: Install overhead coiling doors, switches, and controls along accessible routes in compliance with regulatory requirements for accessibility.

D. Smoke-Control Doors: Install according to NFPA 80 and NFPA 105.

E. Power-Operated Doors: Install automatic garage doors openers according to UL 325.

3.3 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Perform installation and startup checks according to manufacturer's written instructions.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

   1. Adjust exterior doors and components to be weather-resistant.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

C. Adjust seals to provide tight fit around entire perimeter.

3.5 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of coiling-door Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for door operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

   1. Perform maintenance, including emergency callback service, during normal working hours.
   2. Include 24-hour-per-day, seven-day-per-week, emergency callback service.

END OF SECTION 08 33 23

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

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. Storefront framing for ribbon walls.
2. Exterior and interior manual-swing entrance doors and door-frame units

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.

2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

C. Structural Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

2. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.

3. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inch for spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.

E. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.

2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.

3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:

a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..

2. Entrance Doors:
a. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft..

G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

H. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg F as determined according to NFRC 100.

2. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 25 as determined according to NFRC 500.

I. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2. Thermal Cycling: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F.
b. Low Exterior Ambient-Air Temperature: -10 deg F.
c. Interior Ambient-Air Temperature: 75 deg F.

2.2 MANUFACTURERS

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. EFCO Corporation.
2. Kawneer North America.
3. Oldcastle BuildingEnvelope.
4. TRACO.
5. United States Aluminum.
6. YKK AP America Inc.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Center
4. Finish: High-performance organic finish.
5. Fabrication Method: Field-fabricated stick system.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B 209.
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.

2.4 GLAZING

A. Glazing: Comply with Section 08 80 00 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

2.5 ACCESSORIES

A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system, fabricated from 300 series stainless steel.

B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Storefront Framing: Fabricate components for assembly using screw-spline system head-and-sill-receptor system with shear blocks at intermediate horizontal members.

F. Entrance Door Frames: Thermally broken. Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

G. Entrance Doors: Thermally broken. Reinforce doors as required for installing entrance door hardware. Provide 10 inch bottom rail.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF or FEVE resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare surfaces that are in contact with structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.

3.3 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 088000 "Glazing."

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
3. Alignment:

    a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.

1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

    a. Perform a minimum of three tests in areas as directed by Architect.
    b. Perform tests in each test area as directed by Architect. Perform at least three tests, prior to 10, 35, and 70 percent completion.

C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 08 41 13

SECTION 08 45 23 - FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

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. Translucent fiberglass-sandwich-panel wall systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of translucent fiberglass-sandwich-panel panel wall system shown.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for translucent panel wall systems.

B. Shop Drawings: For translucent fiberglass-sandwich-panel wall systems.

1. Include plans, elevations, sections, details, and connections to supporting structure and other adjoining work.
2. Multiple Units: Methods of connection and structural support for multiple units clustered together.

C. Delegated-Design Submittal: For translucent fiberglass-sandwich-panel wall systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Aluminum Finish Samples: For exposed finish required, on a representative section of panel framing in manufacturer's standard size.

E. Glazing Samples: For glazing indicated, 12 inches square and of same thickness indicated for the final Work.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified installer and manufacturer.

B. Product Test Reports: For each type and size of translucent panel wall system, for tests performed within the last four years by a qualified testing agency. Test results based on testing of smaller translucent wall panels than indicated will not be accepted.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For translucent fiberglass-sandwich-panel wall systems, to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer capable of fabricating translucent wall panel systems that meet or exceed performance requirements indicated and of documenting this performance by inclusion in lists and by labels, test reports, and calculations and be capable of providing field service representation during installation..

B. Installer Qualifications: An installer acceptable to translucent wall panel systems manufacturer for installation of units required for this Project.

1.7 WARRANTIES

A. Material Workmanship: 10 years.

B. Exterior Fiberglass Color Change: 20 years.

C. Fiberglass Fiberbloom: 25 years.

D. Metal Finishes: 10 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1. Kalwall Corporation.
2. Major Industries Inc.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design translucent fiberglass-sandwich-panel wall systems.

B. Design Loads: As indicated on Drawings.

1. Deflection: Deflection of framing members normal to plane of glazing shall not exceed L/100.

2. Safety Factors: Allowable stresses shall incorporate following safety factors:

a. Load Carrying Members: 1.65.

b. Load Carrying Fasteners: 2.0.

3. Expansion and Contraction: Design and install components with provisions for expansion and contraction due to a 130 degree .

4. U-Factor: 0.20; NFRC 100-2004 certified values for complete system (including internal grid and perimeter framing - thermally broken).

2.3 FIBERGLASS-SANDWICH-PANEL SYSTEMS

A. Provide factory-assembled translucent panel systems that include glazing, extruded-aluminum framing and glazing retainers, gaskets, and inner frames and that are capable of withstanding performance requirements indicated.

B. Fiberglass-Sandwich-Panel Glazing: Manufacturer's standard with uniformly colored, translucent, fiberglass-reinforced-polymer face sheets permanently adhered to a grid core.

1. Grid Pattern: 12 inch x 24 inch shoji or vertical only.
2. Thickness: Not less than 4 inches.
3. Color: White of crystal, as selected by Architect.

C. Glazing Gaskets: Manufacturer's standard.

D. Condensation Control: Fabricate translucent fiberglass-sandwich-panel systems with integral internal gutters and nonclogging weeps to collect and drain condensation to the exterior.

E. Thermal Break: Fabricate translucent panel wall systems with thermal barrier separating exterior and interior metal framing.

2.4 ACCESSORY MATERIALS

A. Sill Flashing: Formed from ASTM B 209 aluminum sheet, alloy and temper recommended by manufacturer for type of use and finish indicated, 0.032 inch minimum thick, in compliance with Section 07 62 00 "Sheet Metal Flashing and Trim."

B. Flashing and Vapor Barriers: Provide as required to ensure system is resistant to infiltration of water vapor and vehicles exhausts from building interior.

C. Fasteners: Same metal as metal being fastened, nonmagnetic stainless steel, or other noncorrosive metal as recommended by manufacturer. Finish exposed fasteners to match material being fastened.

1. Where removal of exterior exposed fasteners might allow access to building, provide non-removable fastener heads.

D. Installation Accessories: Corrosion-resistant, nonstaining, nonbleeding sealants, shims, gaskets, anchors and other accessories as indicated and as required for installation in compliance with performance requirements and compatible with adjacent materials.

1. Coordinate requirements for installation of louvers in translucent fiberglass-sandwich-panel wall systems with louver supplier.

E. Bituminous Coating: Cold-applied asphalt mastic paint, complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.5 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install translucent fiberglass-sandwich-panel systems using back-fastened method.

B. Coordinate installation of translucent fiberglass-sandwich-panel systems with installation of substrates, louvers, vapor retarders, insulation, roofing membrane, and flashing as required to ensure that each element of the Work performs properly and that combined elements are waterproof, weathertight and resistant to infiltration of water vapor and vehicles exhausts.

C. Comply with recommendations in AAMA 1607 and with manufacturer's written instructions for installing translucent fiberglass-sandwich-panel systems.

D. Install translucent fiberglass-sandwich-panel systems level, plumb, and true to line, without distortion.

E. Anchor translucent fiberglass-sandwich-panel systems securely to supporting substrates.

F. Where aluminum surfaces of translucent fiberglass-sandwich-panel systems will contact another metal or corrosive substrates, such as preservative-treated wood, apply bituminous coating on concealed metal surfaces or provide other approved permanent separation recommended in writing by translucent panel wall system manufacturer.

3.3 CLEANING

A. Clean exposed translucent fiberglass-sandwich-panel surfaces according to manufacturer's written instructions. Remove excess sealants, glazing materials, dirt, and other substances. Touch up damaged metal coatings and finishes.

B. Remove and replace glazing that has been damaged during construction period.

C. Protect translucent wall fiberglass-sandwich-panel surfaces from contact with contaminating substances resulting from construction operations.

END OF SECTION 08 45 23

SECTION 08 71 00 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Hollow Metal Doors and Frames”.
2. Division 08 Section “Flush Wood Doors”.
3. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.

D. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.3 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same

order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: After a keying meeting with the owner has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

D. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.

D. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.

2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

E. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

F. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

G. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.7 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:

1. Ten years for mortise locks and latches.
2. Five years for exit hardware.
3. Twenty five years for manual surface door closer bodies.
4. Two years for electromechanical door hardware.

1.8 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

B. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

C. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

D. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.2 HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:

a. Two Hinges: For doors with heights up to 60 inches.
b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3’0”: 4-1/2” standard or heavy weight as specified.
b. Sizes from 3’1” to 4’0”: 5” standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:

a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the all out-swinging lockable doors.

5. Acceptable Manufacturers:

a. Ives (IVE) Basis of design.
b. Stanley (STA).
c. McKinney Products (MCK).

B. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 certified continuous geared hinge. with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Acceptable Manufacturers:

a. Ives (IVE) Basis of design.
b. McKinney Products (MCK).
c. Pemko Manufacturing (PEM).

2.3 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified.

1. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

5. Acceptable Manufacturers:

a. Ives (IVE) Basis of design.
b. Hiawatha (HIA).
c. Trimco (TRI).

B. Door Push Plates and Pulls: ANS/BHMA A156.6 certified door pushes and pulls of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

5. Acceptable Manufacturers:

a. Ives (IVE) Basis of design.
b. Hiawatha (HIA).
c. Trimco (TRI).

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

1. Acceptable Manufacturers:

a. Schlage (SCH) Everest 29T Basis of design.
b. Sargent Manufacturing (SAR).
c. Best Locks (BES).

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and cams to suit hardware application.
2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
4. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
5. Keyway: Manufacturer's Standard.

D. High Security Cylinders: ANSI/BHMA A156.5, Grade 1, patented high security cylinders and keys able to be used together under the same facility master or grandmaster key system. Provide certified high security cylinders, employing a utility patented locking mechanism requiring the use of a patented key and pick resistance; cylinders are to be factory keyed.

1. Acceptable Manufacturers:

a. Schlage (SCH) Everest 29T Basis of design.
b. Sargent Manufacturing (SAR).
c. Best Locks (BES).

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Two (2)
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).
4. Construction Control Keys (where required): Two (2).
5. Permanent Control Keys (where required): Two (2).

F. Construction Keying: Provide construction master keyed cylinders.

G. Construction Keying: Provide temporary keyed construction cores.

H. Key Registration List (Bitting List):

1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Owner.

2.5 MECHANICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified.

1. Acceptable Manufacturers:

   a. Schlage (SCH) ND Rhodes Basis of design.
   b. Sargent Manufacturing (SAR) 10-Line.
   c. Best Locks (BES) 9K3 Line.

2.6 ELECTRIC STRIKES

A. Electric Strikes, Grade 1 (Heavy Duty): UL Listed as burglary resistant.

1. Acceptable Manufacturers:
   a. Von Duprin (VON) 6200 series Basis of design.
   b. Folger Adams (FOL) 300 series.

2.7 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.

2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.

3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.

4. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.

5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

   a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
   b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

6. Vertical Rod Exit Devices: Provide and install interior surface and concealed vertical rod exit devices as Less Bottom Rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.

7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.

8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

9. Rail Sizing: Provide exit device rails factory sized for proper door width application.

10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device latch to be stainless steel, pullman type, with deadlock feature.

1. Acceptable Manufacturers:

a. Von Duprin (VON) - 99 Series Basis of Design.
b. Sargent Manufacturing (SAR) - 80 Series.
c. Precision (PRE) apex Series.

2.8 DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.

2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.

3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.

4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.

5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.

6. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.

7. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt and security type fasteners as required for proper installation.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron body construction, with adjustable backcheck for closing sweep and latch speed control. Provide non-handed units standard. Pressure relief valves are not allowed.

1. Acceptable Manufacturers:

    a. LCN Closers (LCN) – 4010 or 4110 Series Basis of Design.
    b. Sargent Manufacturing (SAR) - 281 Series.
    c. Norton Door Controls (NOR) - 9500 Series.

2.9 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.

2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Protection Plates: ANSI/BHMA A156.6 certified protection plates (kick, armor, or mop), fabricated from the following:

    a. Stainless Steel: 300 grade, 050-inch thick.

4. Options and fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets. Provide countersunk screw holes.

5. Acceptable Manufacturers:

    a. Ives (IVE) Basis of design.
    b. Hiawatha (HIA).
    c. Trimco (TRI).

2.10 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Acceptable Manufacturers:

    a. Ives (IVE) Basis of design.
    b. Hiawatha (HIA).
    c. Trimco (TRI).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Acceptable Manufacturers:

    a. Glynn Johnson (GLY) Basis of Design.
    b. Rixson (RIX).
    c. Sargent Manufacturing (SAR).

2.11 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

    1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

    1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Acceptable Manufacturers:

    1. Zero International (ZER) Basis of Design.
    2. National Guard Products (NGP).
    3. Reese Enterprises, Inc. (REE).

2.12 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

B. Power Supply: Provide fewest number required per manufacturers published requirements.

C. Provide Remote mounted desk button as specified.

    1. Acceptable Manufacturers:

a. Schlage Electronics (SCE) or Von Duprin (VON) Basis of Design.
b. Security Door Controls (SDC).
c. Securitron (SEC).

2.13 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.14 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

E. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SCHEDULE

A. The hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

B. Manufacturer's Abbreviations:

1. IVE - Ives
2. VON – Von Duprin
3. SCH - Schlage
4. GLY – Glynn Johnson
5. LCN – LCN Closers
6. ZER – Zero International
7. SCE – Schlage Electronics

HARDWARE SCHEDULE

Hardware Group No. 01

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	112HD EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	QEL+-SD-99-NL-OP-110MD-1439	626	VON
1	EA	RIM CYLINDER	20-057 EV29 T	626	SCH
1	EA	MORTISE CYLINDER	20-061 XQ11-948 EV29 T	626	SCH
1	EA	90 DEG OFFSET PULL	8190HD 10" O	630	IVE
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	MOUNTING PLATE	4110-18	689	LCN
1	EA	BLADE STOP SPACER	4110-61	689	LCN
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	625A-MSLA-10	A	ZER
1	EA	DESK MOUNT BUTTON	660-PB	628	SCE
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS	LGR	VON

Perimeter weatherstripping is by the aluminum door manufacturer.

Credential reader device and interfacing with the "QEL" electric latch retraction feature inside the exit device, the desk mounted button remote release and the door position switch is by the security system supplier.

Power for the "QEL" electric latch retraction feature is by the PS902 power supply.

Hardware Group No. 02

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	112HD EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	QEL+-SD-99-NL-OP-110MD-1439	626	VON
1	EA	RIM CYLINDER	20-057 EV29 T	626	SCH
1	EA	MORTISE CYLINDER	20-061 XQ11-948 EV29 T	626	SCH
1	EA	90 DEG OFFSET PULL	8190HD 10" O	630	IVE
1	EA	OH STOP	100S	630	GLY
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	MOUNTING PLATE	4110-18	689	LCN
1	EA	BLADE STOP SPACER	4110-61	689	LCN
1	EA	FLOOR STOP	FS18L	BLK	IVE
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	625A-MSLA-10	A	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE
1	EA	POWER SUPPLY	PS902 900-2RS	LGR	VON

Perimeter weatherstripping is by the aluminum door manufacturer.

Credential reader device and interfacing with the "QEL" electric latch retraction feature inside the exit device and the door position switch is by the security system supplier.

Power for the "QEL" electric latch retraction feature is by the PS902 power supply.

Hardware Group No. 03

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	112HD EPT	628	IVE
1	EA	POWER TRANSFER	EPT10	689	VON
1	EA	ELEC PANIC HARDWARE	QEL+-SD-99-NL-OP-110MD-1439	626	VON
1	EA	RIM CYLINDER	20-057 EV29 T	626	SCH
1	EA	MORTISE CYLINDER	20-061 XQ11-948 EV29 T	626	SCH
1	EA	90 DEG OFFSET PULL	8190HD 10" O	630	IVE
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	MOUNTING PLATE	4110-18	689	LCN
1	EA	BLADE STOP SPACER	4110-61	689	LCN
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Credential reader device and interfacing with the "QEL" electric latch retraction feature inside the exit device and the door position switch is by the security system supplier.

Power for the "QEL" electric latch retraction feature is by the PS902 power supply specified at door # 100-1.

Hardware Group No. 04

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	PANIC HARDWARE	CDSI-99-L-NL-06	626	VON
1	EA	RIM CYLINDER	20-057 EV29 T	626	SCH
1	EA	MORTISE CYLINDER	20-061 XQ11-948 EV29 T	626	SCH
1	EA	SURFACE CLOSER	4111 SHCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	328AA	AA	ZER
1	EA	GASKETING	429A	A	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-MSLA-10	A	ZER
1	EA	RAIN DRIP	142A	A	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Mount 429A head seal prior to mounting closer.

Monitoring of the door position switch is by the security system supplier.

Hardware Group No. 05

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	PANIC HARDWARE	CDSI-99-L-NL-06 WH RAL 49/72020	PRI	VON
1	EA	RIM CYLINDER	20-057 EV29 T	626	SCH
1	EA	MORTISE CYLINDER	20-061 XQ11-948 EV29 T	626	SCH
1	EA	SURFACE CLOSER	4111 SHCUSH SRI	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	328AA	AA	ZER
1	EA	GASKETING	429A	A	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-MSLA-10	A	ZER
1	EA	RAIN DRIP	142A	A	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Mount 429A head seal prior to mounting closer.

Monitoring of the door position switch is by the security system supplier.

Hardware Group No. 06

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	STOREROOM LOCK	ND80LD RHO	626	SCH

1	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE	630	VON
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	328AA	AA	ZER
1	EA	GASKETING	429A	A	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-MSLA-10	A	ZER
1	EA	RAIN DRIP	142A	A	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Mount 429A head seal prior to mounting closer.

Credential reader device and interfacing with the electric strike and the door position switch is by the security system supplier.

Hardware Group No. 07

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	DBL CYL STORE LOCK	ND66LD RHO	626	SCH
2	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	328AA	AA	ZER
1	EA	GASKETING	429A	A	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-MSLA-10	A	ZER
1	EA	RAIN DRIP	142A	A	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Mount 429A head seal prior to mounting closer.

Hardware Group No. 08

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	STOREROOM LOCK	ND80LD 8RO RHO	626	SCH
1	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH
1	EA	SURFACE CLOSER	4111 CUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	328AA	AA	ZER

Hardware Group No. 09

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80LD RHO	626	SCH
1	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH
1	EA	ELECTRIC STRIKE	6211 FSE	630	VON
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	188S-BK	S-Bk	ZER
1	EA	DOOR CONTACT	679-05HM	BLK	SCE

Credential reader device and interfacing with the electric strike and the door position switch is by the security system supplier.

Hardware Group No. 10

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80LD RHO	626	SCH
1	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 11

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80LD 8RO RHO	626	SCH
1	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 12

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50LD RHO	626	SCH
1	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH

1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	188S-BK	S-Bk	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-MSLA-10	A	ZER

Hardware Group No. 13

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50LD RHO	626	SCH
1	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH
1	EA	OH STOP	90S	630	GLY
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	188S-BK	S-Bk	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-MSLA-10	A	ZER

Hardware Group No. 14

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	CLASSROOM LOCK	ND70LD RHO	626	SCH
1	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE
1	EA	GASKETING	328AA	AA	ZER
1	EA	GASKETING	429A	A	ZER
1	EA	DOOR SWEEP	39A	A	ZER
1	EA	THRESHOLD	566A-MSLA-10	A	ZER

Mount 429A head seal prior to mounting closer.

Hardware Group No. 15

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	CONT. HINGE	224HD	628	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE

Hardware Group No. 16

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PUSH PLATE	8200 4" X 16"	630	IVE
1	EA	PULL PLATE	8305 10" 4" X 16"	630	IVE
1	EA	SURFACE CLOSER	4011	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	MOP PLATE	8400 4" X 1" LDW B-CS	630	IVE
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 17

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
2	EA	CONT. HINGE	224HD	628	IVE
2	EA	MANUAL FLUSH BOLT	FB458	626	IVE
1	EA	DUST PROOF STRIKE	DP2	626	IVE
1	EA	STOREROOM LOCK	ND80LD RHO	626	SCH
1	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH
2	EA	OH STOP & HOLDER	450F	630	GLY
1	EA	GASKETING	188S-BK	S-Bk	ZER
1	EA	ASTRAGAL	139A	A	ZER

Hardware Group No. 18

Provide each PR door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
6	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
2	EA	ROLLER LATCH	RL32	626	IVE
2	EA	SINGLE DUMMY TRIM	ND170 RHO	626	SCH
2	EA	OH STOP & HOLDER	450F	630	GLY

Hardware Group No. 19

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	ND80LD RHO	626	SCH
1	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 20

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50LD RHO	626	SCH
1	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 21

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	ENTRANCE/OFFICE LOCK	ND50LD RHO	626	SCH
1	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH
1	EA	OH STOP & HOLDER	90F J	630	GLY

Hardware Group No. 22

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	CLASSROOM LOCK	ND70LD RHO	626	SCH
1	EA	CONVENTIONAL CYLINDER	23-065 EV29 T	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 23

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
3	EA	HINGE	5BB1 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	ND10S RHO	626	SCH
1	EA	WALL STOP	WS406/407CCV	630	IVE

Hardware Group No. 24

Provide each SGL door(s) with the following:

Qty		Description	Catalog Number	Finish	Mfr
1	EA	DOOR CONTACT	674-OH	628	SCE

All other hardware by door manufacturer.

END OF SECTION 08 71 00

SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Glass for doors, interior borrowed lites and storefront framing.
2. Glazing sealants and accessories.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass; 12 inches square.

1.4 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.2 GLASS PRODUCTS

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

1. Minimum Thickness: 6 mm.

D. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Minimum Thickness: 6 mm.

E. Pyrolytic-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide coating applied by pyrolytic deposition process during initial manufacture, and complying with other requirements specified.

F. Sputter-Coated Float Glass: ASTM C 1376, float glass with metallic-oxide or -nitride coating deposited by vacuum deposition process after manufacture and heat treatment (if any), and complying with other requirements specified.

2.3 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

1. Overall Unit Thickness: 1-inch.

2. Outdoor Lite: Class 1 (clear) float glass:
   a. Heat-treated, Kind FT (fully tempered) for exterior doors, sidelites and elsewhere as indicated.

3. Sealing System: Dual seals.
   a. Spacer: Thermally improved warm edge type, fabricated from aluminum or steel with a polymer bridge, or extruded polymer.
   b. Inter-space Content: Air.

4. Indoor Lite: Class 1 (clear) float glass.

a. Annealed, unless otherwise indicated.
b. Heat-treated, Kind FT (fully tempered) for exterior doors, sidelites and elsewhere as indicated.

5. Low-E Coating: Pyrolytic or sputtered on second or third surface.

6. Performance Requirements:

1) Visible Light Transmittance: 70 percent minimum.
2) Winter Nighttime U-Factor: 0.29 maximum.
3) Summer Daytime U-Factor: 0.28 maximum.
4) Solar Heat Gain Coefficient: 0.38 maximum.
5) Outdoor Visible Reflectance: 11 percent maximum.

2.4 SPANDREL GLASS UNITS

A. Construction: Provide units that comply with requirements specified for insulating-glass units above except for indoor lite:

1. Ceramic-coated or silicone-coated spandrel glass.
a. Kind: HS (heat strengthened)

2. Basis-of-Design Coating: Opaci-Coat-300; Industrial Control Development, Inc. (I.C.D.)

3. Color: As selected by Architect from manufacturer's full range.

4. Coating Location: Fourth surface.

5. Fallout Resistance: Provide spandrel units identical to those passing the fallout-resistance test for spandrel glass specified in ASTM C 1048.

2.5 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

2.6 MISCELLANEOUS GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Center glass lites in openings on setting blocks, and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.4 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

END OF SECTION 08 80 00

SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

B. Related Requirements:

1. Section 05 40 00 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. Select steel studs in accordance with manufacturer's standard load tables and the following design pressures and maximum deflections; where elements meet multiple conditions use most stringent Design Pressure and Deflection values:

Use Condition	Design Pressure	Max deflection
Walls enclosing stairs, elevator hoistways and other vertical shafts.	10 lbs/sf	L/240
Walls enclosing vestibules, ground floor lobbies, and similar spaces subject to intermittent exposure to exterior wind conditions.	15 lbs/sf	L/240
Walls scheduled with Tile Backer Board, Moisture-resistant or Abuse-resistant Gypsum Wallboard and walls scheduled to receive Tile.	5 lbs/sf	L/360
Typical interior walls/partitions (those not listed above)	5 lb/sf	L/240
Interior ceilings, soffits and bulkheads	5 lb/sf	L/360

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.

B. Studs and Runners: ASTM C 645. C-shaped, roll formed studs and runners.

C. Use either steel studs and runners or dimpled steel studs and runners.

1. Steel Studs and Runners:

a. Minimum Base-Metal Thickness: As indicated on Drawings 0.018 inch.
b. Depth: As indicated by wall type.

2. Dimpled Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.015 inch.
b. Depth: As indicated by wall type.

3. Minimum flange width: 1-1/4 inch.

4. A jambs of openings, upgrade framing members to two minimum 30 mil (20 gage) studs.

5. In lieu of greater stud thickness, design may employ diagonal braces above ceiling to reduce overall span and thus stiffen wall frame.
a. Coordinate locations with building service items.
b. Do not employ studs with stud thickness less than that allowed by fire resistance-rated assemblies.
6. High strength 50KSI studs shall comply with design criteria of equivalent thickness standard 33KSI studs listed.

D. Slip-Type Head Joints: Where indicated, provide the following:

1. Slotted Top Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
2) MBA Building Supplies; FlatSteel Deflection Track.
3) Steel Network Inc. (The); VertiClip SLD Series.
4) Telling Industries; Vertical Slip Track.

b. Deep leg, vertically slotted track.

c. Cold-formed steel sheet; galvanized; G60.

d. Thickness: 30 mil (20 gage) minimum.

e. Width: As required for stud sizes indicated.

f. Depth: Minimum 2-1/2 inch down-standing legs with 1/4 inch wide by 1-1/2 inch high slots spaced 1 inch on center.

E. Metal Blocking: C-shaped modified track runners.

1. Galvanized G40
2. Backing height: 6 inches minimum.
3. Flange width: 1-1/4 inchThickness 30 mil (20 gage).

F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.018 inch.
2. Depth: 7/8 inch.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

B. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.

1. Depth: 1-1/2 inches.

C. Furring Channels (Furring Members):

1. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.

a. Minimum Base-Metal Thickness: 0.018 inch.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide the following:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

a. Install two studs at each jamb unless otherwise indicated.

3. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring: Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 16 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Do not attach hangers to steel roof deck.

4. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.

5. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.

6. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 22 16

SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Firestopping joints in or between fire-resistance-rated gypsum board constructions.

B. Related Requirements:

1. Section 06 16 00 "Sheathing" for gypsum sheathing for exterior walls.
2. Section 09 22 16 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.
3. Section 09 30 13 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Firestopping Installer Qualifications:
1. Certified, licensed or approved by firestopping manufacturer, trained to install firestop products per specified requirements.
2. Licensed by State or local authority, where applicable.
3. Shown to have successfully completed not less than five (5) comparable scale projects.

B. Provide firestop systems in compliance with following requirements:
1. Obtain firestop system for each type of construction condition from a single firestop systems manufacturer.
2. Firestopping tests, performed by qualified, testing and inspection agency.
   a. UL or other agency, performing testing and follow up inspection services for firestop systems, acceptable to local authorities having jurisdiction.
3. Existing applications for which no tested and listed classified system is available through a manufacturer:
   a. Provide Engineering Judgment or Equivalent Fire Resistance Rated Assembly (EFRRA) for submittal derived from similar UL system designs or other tests approved by local authorities having jurisdiction, prior to installation.
   b. Engineering judgment drawings must follow requirements set forth by International Firestop Council.

4. Mold Resistance: Less than 1 per ASTM G21.
5. Inspect applied firestopping systems in accordance with International Building Code (IBC) Chapter 17.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.

1.7 WARRANTY FOR FIRESTOPPING SYSTEMS

A. Written five year warranty guaranteeing quality of installation and meeting requirements of manufacturer’s written instructions and tested systems.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. CertainTeed Corp.
2. Georgia Pacific Building Products
3. National Gypsum Company.
4. USG Corporation.

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Application: Use unless otherwise indicated.
2. Thickness: 5/8 inch.
3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

D. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and glass mat facet.

1. Application: Use for interior faces of exterior walls and rooms where moisture or high humidity is present.

a. Apply continuously to interior face of exterior stud walls prior to framing interior partitions and ceilings.

2. Base Product: DensArmor Plus Interior Panel and DensArmor Plus Fireguard Interior Panel by Geaorgia Pacific.
3. Core: 5/8 inch Type X.
4. Long Edges: Tapered.
5. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.2 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound.
c. Expansion (control) joint.

2.3 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape: Paper.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.

2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.

a. Use setting-type compound for installing paper-faced metal trim accessories.

3. Fill Coat: For second coat, use setting-type, sandable topping compound.

4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.

2.4 AUXILIARY GYPSUM BOARD ASSEMBLY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.

C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Pecora Corporation; AIS-919.
b. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
c. USG Corporation; SHEETROCK Acoustical Sealant.

2.5 ACOUSTICAL MATERIALS

A. General:
1. Provide where indicated.
2. Minimum nominal thickness: As required to achieve STC indicated for wall systems.
3. Density: required to achieve STC indicated for wall systems.

B. Sound Attenuation Batts (SAB):
1. Glass or mineral fiber.
2. Commercial sound blanket, ASTM C665, Type I, un-faced, produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool or rock wool.
3. Surface burning characteristics per ASTM E84:
   a. Maximum flame spread: 10.
   b. Maximum smoke developed: 10.
4. Fire rated assemblies: select SAB materials and thicknesses that are approved for use in assemblies listed.
5. Acoustically rated assemblies: Select SAB materials and thicknesses that are approved for use in assemblies listed.
6. Base Product: Sound Attenuation Batt Insulation by Owens Corning.

C. STC Improvement and Acoustical Seal for Wall Boxes:
1. Molded neoprene, durometer A-40 complying with ASTM D2000, formed to fit the electrical device, outlet and service box
2. Sound Reduction: 6 db in accordance to ASTM E90.
3. Color: Black
4. Provide at electrical and service box penetrations in sound-rated walls.
5. Base Product: Box Seal by STC Architectural Products.

2.6 JOINT FIRESTOPPING SYSTEMS

A. Joint firestopping systems shall accommodate building movements without impairing their ability to resist the passage of fire and hot gases.

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1. 3M Fire Protection Systems
2. A/D Fire Protection Systems Inc.

3. Hilti, Inc.
4. Thermafiber, Inc.; an Owens Corning company
5. Tremco, Inc.

C. Joints in or between Fire-Resistance-Rated Construction: Provide joint firestopping systems with ratings determined per ASTM E 1966 or UL 2079.

1. Fire-Resistance Rating: Equal to or exceeding the fire-resistance rating of the wall, floor, or roof in or between which it is installed.

2. Joint firestopping systems shall bear classification marking of a qualified testing agency.

a. UL in its "Fire Resistance Directory."
b. Intertek Group in its "Directory of Listed Building Products."

D. Fire Resistive Joint Assemblies
1. Where joint will be exposed to elements, fire resistive joint sealant must be approved by manufacturer for use in exterior applications and shall comply with ASTM C920.
2. Head of Wall Assemblies:
a. General:
1) Use at top of fire rated and smoke barrier walls and partitions where they abut floor and roof structures above.
2) Select systems with D designation, rated for dynamic movement capability.
3) Select systems that can accommodate deflection of structure above.
4) Maximum Leakage for Fire resistive Joints in Smoke Barriers: 5 CFM or less per linear foot as tested in accordance with UL 2079.
3. Minimum F and T ratings:
a. The minimum fire rating for firestop assemblies in walls shall equal that of wall, but not less than 1-HR.
b. The minimum temperature rating of firestop assemblies in walls may equal zero.
4. Acceptable Systems:
a. Metal stud and drywall partitions: Select system from UL HW-D-0000 Series.
b. Concrete and Masonry Walls: Select system from UL HW-D-1000 Series.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.

B. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated and minimize end joints.

1. Stagger abutting end joints not less than one framing member in alternate courses of panels.

C. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

3.4 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Interior Trim: Install in the following locations:

1. Cornerbead: Use at outside corners unless otherwise indicated.
2. LC-Bead: Use at exposed panel edges.

3.5 CONTROL JOINTS (CJ)

A. General: Install control joints in locations indicated and as described in this article.

1. Install suitable backing material to maintain required rating where control joints occur in fire rated or sound rated assemblies.

B. Partitions: Provide Vertical control joints on both wall faces which align with door frames, window frames, and similar openings as follows:

1. Single Doors and Cased Openings: Locate CJ's at both jambs, from head of opening to top of partition.
2. Pairs of Doors: Locate CJ's at both jambs, from head of opening to top of partition.
   a. Exception: Control joints are not required where partition forms a cross-corridor condition.
3. Doors with Adjacent Sidelights: Locate CJ's at both jambs, from head of opening to top of partition and from sill to floor at sidelight jambs.
4. Sliding Doors: Locate CJ's at both jambs, from head of opening to top of partition.
5. Punched Windows Less than 30 feet in Width: Locate CJ's at both jambs, from head of opening to top of partition and from sill edge to floor.
6. Ribbon Windows Greater than 30 feet in Width: Locate CJ's at both jambs, from head of opening to top of partition and from sill edge to floor.
   a. Locate additional intermediate CJ's so maximum distance between CJ's does not exceed 30 feet.
7. Provide additional vertical CJ's, spaced no more than 30 feet apart from each other, from opening related CJ's, or from corners.
8. Provide horizontal CJ's at partitions which are more than one story in height.
   a. Locate horizontal CJ's where partitions bypass intermediate floors.
   b. Align CJ with floor line, unless otherwise indicated.

C. Ceilings: Use control joints to subdivide ceilings and soffits as indicated, and within the following limits:
1. Ceilings with perimeter relief: Subdivide so no area exceeds 2500 square feet and has no length which exceeds 50 feet.
   a. Exception: Where ceiling occurs at exterior, subdivide so that no area exceeds 900 square feet and has no length which exceeds 30 feet.

3.6 FIRESTOPPING SYSTEMS

A. Install fire-resistive joint systems to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming materials and other accessories of types required to support elastomeric fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

1. After installing elastomeric fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of fire-resistive joint system.

C. Install elastomeric fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Elastomeric fill voids and cavities formed by joints and forming materials as required to achieve fire-resistance ratings indicated.
2. Apply elastomeric fill materials so they contact and adhere to substrates formed by joints.

3. For elastomeric fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.7 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 09 91 23 "Interior Painting."

3.8 IDENTIFICATION OF JOINT FIRESTOPPING SYSTEMS

A. Identify joint firestopping systems with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of joint edge so labels are visible to anyone seeking to remove or joint firestopping system. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Joint Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.9 IDENTIFICATION OF FIRE AND SMOKE WALLS

A. Identify walls indicated on Drawings as having required fire and smoke rating
1. Follow guidelines set in Chapter 7 of the International Building Code.
2. Permanently identify rating and type of barrier with stencil and paint in contrasting 3 inch high letters in a manner acceptable to authorities having jusidiction.
3. Text for fire and smoke barriers: "X HOUR FIRE AND/OR SMOKE BARRIER – PROTECT ALL OPENINGS."

3.10 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00

SECTION 09 30 13 - CERAMIC TILING

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. Ceramic tile.
2. Tile backing panels.
3. Waterproof membrane for thinset applications.
4. Metal edge strips.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples:

1. Each type and composition of tile and for each color and finish required.
2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a five-star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
2. Installer's supervisor for Project holds the International Masonry Institute's Foreman Certification.
3. Installer employs Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers.

B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of tile installation, at least 48 by 48 inches.

2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide Standard-grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 TILE PRODUCTS

A. Ceramic Tile.

1. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated in Finish Schedule on Drawings or comparable products by one of the following:

   a. American Marazzi Tile, Inc.
   b. American Olean Corporation.
   c. Dal-Tile Corporation.
   d. Florim USA.
   e. Interceramic.
   f. Porcelanite.
   g. Seneca Tiles, Inc.
   h. Vitromex USA.

B. Accessories: Provide vitreous china accessories of type and size indicated, suitable for installing by same method as used for adjoining wall tile.

1. One soap holder with grab handle for each shower and tub indicated.
2. Color and Finish: Match adjoining glazed wall tile.

2.3 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. C-Cure; C-Cure Board 990.
   b. Custom Building Products; Wonderboard.
   c. FinPan, Inc.; ProTEC Concrete Backer Board.
   d. USG Corporation; DUROCK Cement Board.

2. Thickness: 1/2 inch.

2.4 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Chlorinated Polyethylene Sheet: Nonplasticized, chlorinated polyethylene faced on both sides with nonwoven polyester fabric.

1. Products: Subject to compliance with requirements, provide the following:

a. Noble Company (The); Nobleseal TS.

2. Nominal Thickness: 0.030 inch.

C. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.

1. Products: Subject to compliance with requirements, provide the following:

a. Schluter Systems L.P.; KERDI..

D. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Ardex Americas; Ardex S 1-K One-Component Waterproofing Compound.
b. Bonsal American, an Oldcastle company; B 6000 Waterproof-Crack Isolation Membrane.
c. Bostik, Inc.; Durabond D-222 Duraguard Membrane.
d. Laticrete International, Inc.; Laticrete Hydro Ban.
e. MAPEI Corporation; Mapelastic AquaDefense.
f. TEC, H. B. Fuller Construction Products Inc.; HydraFlex - Waterproofing Crack Isolation Membrane.

2.5 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Ardex Americas.
b. Bonsal American; an Oldcastle company.
c. Bostik, Inc.
d. Custom Building Products.
e. Laticrete International, Inc.
f. MAPEI Corporation.
g. Merkrete Systems; Parex USA, Inc.
h. Southern Grouts & Mortars, Inc.
i. Summitville Tiles, Inc.
j. TEC; H. B. Fuller Construction Products Inc.

2. Provide either prepackaged, dry-mortar mix to which only water must be added at Project site or prepackaged, dry-mortar mix combined with liquid-latex additive at Project site.

3. For wall applications, provide nonsagging mortar.

2.6 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. High-Performance Tile Grout: ANSI A118.7.

1. Manufacturers: Same as setting materials.
2. Polymer Type: Dry, redispersible form, prepackaged with other dry ingredients or liquid-latex form for addition to prepackaged dry-grout mix.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; nickel silver exposed-edge material.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Blanke Corporation.
b. Ceramic Tool Company, Inc.
c. Schluter Systems L.P.

C. Grout Sealer: Grout manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors comply with surface finish requirements in ANSI A108.01 for installations indicated.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:

   a. Tile floors in wet areas.
   b. Tile floors consisting of tiles 8 by 8 inches or larger.
   c. Tile floors consisting of rib-backed tiles.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. Pressed Floor Tile: 1/4 inch.
2. Glazed Wall Tile: 1/16 inch.
3. Porcelain Tile: 1/4 inch.

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

K. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

L. Tile Backing Panels: Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

M. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

END OF SECTION 09 30 13

SECTION 09 51 00 - ACOUSTICAL CEILINGS

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 acoustical panels and exposed suspension systems for ceilings.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.

1. Acoustical Panel: Set of 6-inch- square Samples of each type, color, pattern, and texture.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient

temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS, GENERAL

A. Source Limitations:

1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
2. Suspension System: Obtain each type from single source from single manufacturer.

B. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

C. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.3 ACOUSTICAL PANELS

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. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:

1. Type and Form: Type III, mineral base with painted finish; Form 2, water felted.
2. Pattern: CD (perforated, small holes and fissured).

C. Edge/Joint Detail: Square.

D. Thickness: 5/8 inch.

E. Modular Size: 24 by 24 inches.

2.4 METAL SUSPENSION SYSTEMS

A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch diameter wire.

D. 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. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. USG Interiors, Inc.; Subsidiary of USG Corporation.

E. Wide-Face, Capped, Double-Web,Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 15/16-inch- wide metal caps on flanges.

1. Structural Classification: Intermediate-duty system.
2. End Condition of Cross Runners: Butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Steel or aluminum cold-rolled sheet.
5. Cap Finish: Painted white.

2.5 METAL EDGE MOLDINGS AND TRI

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. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.

2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
6. Do not attach hangers to steel deck tabs.
7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:

a. As indicated on reflected ceiling plans, or if not so indicated:
b. Install panels with pattern running in one direction parallel to short axis of space.

2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.

3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 51 00

SECTION 09 65 13 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.5 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 VINYL BASE

A. Product Standard: ASTM F 1861, Type TV (vinyl, thermoplastic).

1. Group: I (solid, homogeneous).

2. Style and Location:

a. Style A, Straight: Provide in areas with carpet.
b. Style B, Cove: Provide in areas with resilient flooring.

B. Thickness: 0.125 inch.

C. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.

D. Outside Corners: Preformed.

E. Inside Corners: Job formed.

F. Colors: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

A. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

C. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

H. Job-Formed Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.

a. Miter or cope corners to minimize open joints.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Remove adhesive and other blemishes from exposed surfaces immediately after completing resilient-product installation.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 65 13

SECTION 09 65 19 - RESILIENT TILE FLOORING

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. Rubber floor tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation indicated.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 RUBBER FLOOR TILE

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

1. Burke Mercer Flooring Products, Division of Burke Industries Inc;.
2. Johnsonite; A Tarkett Company;.
3. Mannington Mills, Inc;.
4. Nora Rubber Flooring, Freudenberg Building Systems, Inc;.
5. Roppe Corporation, USA;.

B. Tile Standard: ASTM F 1344, Class I-B, homogeneous rubber tile, through mottled.

C. Hardness: Not less than 85 as required by ASTM F 1344, measured using Shore, Type A durometer per ASTM D 2240.

D. Wearing Surface: Smooth.

E. Thickness: 0.125 inch.

F. Size: 12 by 12 inches.

G. Colors and Patterns: As selected by Architect from full range of industry colors.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:

a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles square with room axis.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover floor tile until Substantial Completion.

END OF SECTION 09 65 19

SECTION 09 67 00 – EPOXY FLOORING SYSTEM

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. Surface preparation of substrate.
2. Epoxy flooring system.

1.3 QUALITY ASSURANCE

A. Qualifications:
1. Applicator shall be licensed or approved, in writing, by manufacturer.
2. Applicator to have minimum of five (5) years experience installing epoxy flooring systems similar to system specified.

B. Mock-Ups:
1. Construct sample floor area minimum 4 x 4 feet in color selected utilizing all specified or required components for review and acceptance.
   a. Sample area shall be constructed using same substrate condition as exists for areas where flooring material is to be installed.
   b. For concrete substrate, provide minimum 3 inch thick slab with welded wire reinforcement.
   c. Sample shall include all corners, coves, bases, expansion joints and other special detailing as required by Project conditions.

C. Manufacturer's authorized representative shall observe and accept, in writing, the substrate prior to application of system.

1.4 DEFINITIONS

A. Installer or Applicator:
1. Installer or applicator is the person(s) actually installing or applying the product in the field at the Project site.
2. Installer and applicator are synonymous.

B. DFT: Dry film thickness.

1.5 SUBMITTALS

A. Shop Drawings:
1. Product technical data including:

a. Acknowledgement that products submitted meet requirements of standards referenced.
b. Manufacturer's installation instructions.
c. Complete physical and chemical characteristics.
d. Chemical-resistance information.
e. Manufacturer's recommendations for adhesives, primer, and miscellaneous materials used.
f. Manufacturer's curing and finishing requirements for concrete floor substrates.

B. Applicator qualifications.
1. Certification that installer is licensed or approved in writing by manufacturer to install material.
2. Provide references for minimum of three (3) projects in last five (5) years including:
a. Type of installation.
b. Product installed.
c. Square footage of material installed.
d. Name and telephone number of client contact.
3. Letter from manufacturer's authorized representative stating that the substrate surface preparation is acceptable for installation of material.

C. Samples:
1. 4 x 4 inch color samples of manufacturer's full range of colors for Engineer's initial color selection.
2. Provide range of skid resistance available.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements, the following manufacturers are acceptable:
1. Epoxy Flooring System:
a. Dudick, Inc.
b. Stonhard.
c. Tnemec.

2.2 MATERIALS

A. Products listed below are manufactured by Tnemec.
1. Products of other listed manufacturers are acceptable for use providing the product is of the same generic resin, requires comparable surface preparation, has comparable application requirements, provides the same finish and color options and will withstand the atmospheric conditions of the location where it is to be applied.

B. Filler-Surfacer: 100 percent solids epoxy with fumed silica.
1. Tnemec Series 215 Surfacing Epoxy.

C. Substrate Primer: 100 percent solids epoxy.
1. Tnemec Series 201 Epoxoprime.

D. Intermediate Coat: 100 percent solids epoxy with colored quartz aggregate.
1. Tnemec Series 222 Deco-Tread.

E. Grout Coat: 100 percent solids clear epoxy.
1. Tnemec Series 284 Deco-Clear.

F. Top Coat: Clear aliphatic moisture-cured urethane.
   1. Tnemec Series 248 Everthane.

G. Color:
   1. Manufacturer's standard to be selected by Architect.

2.3 ACCESSORIES

A. Cove base cap, termination strips and transition strips as necessary for type and thickness of system.

2.4 Performance Requirements

A. Tensile Strength: ASTM 307, 2100 psi.

B. Hardness: ASTM D2240, Shore D 70.

C. Abrasion Resistance: ASTM D4060.
   1. CS-17 wheel, 1,000 cycles; not more than 60{72}mg lost.

D. Adhesion: ASTM D7234, cohesive failure of concrete.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrate in accordance with manufacturer's instructions.
   1. Cure concrete in accordance with manufacturer's recommendations.
      a. New concrete shall cure minimum 28 days prior to installation of flooring system.
   2. Concrete to be free of oil, grease, curing compounds, form release agents, surface laitance, dirt and any other contaminant that will prohibit the bonding of the flooring material.
   3. Protect adjacent equipment and other surfaces not requiring coating.
   4. Grind concrete surfaces as required to produce a smooth, level surface, and remove contaminants.
   5. Abrasive blast concrete surfaces scheduled to receive Epoxy Flooring System in accordance with SSPC SP 13/NACE No. 6.
      a. Provide Concrete Surface Profile 4 to 9 per ICRI 310.2.
   6. Fill all voids with filler-surfacer compound as necessary to provide a smooth, flat substrate.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
   1. Mix and place in accordance with manufacturer's instructions.
   2. Cure each coat in accordance with manufacturer's instructions and place subsequent coats within allowable recoat window.
   3. Match selected samples and mock-up.

B. Ensure substrate temperature, moisture content and pH are within manufacturer's published limitations.

C. Ensure application environment, temperature and humidity level are within manufacturer's published limitations.

D. Prime in accordance with manufacturer's instructions.
   1. Apply primer at 150 to 250 SF per GAL.
   2. Do not permit primer to collect in depressions.
   3. If necessary, apply second primer coat to porous areas.

E. Install base and edge terminations and transition strips using adhesive concealed mechanical anchorages.
   1. No feathered edges will be accepted.

F. Place double-broadcast intermediate coat directly over primed concrete.
   1. Provide 2 coats to a total thickness of 1/8 IN.

G. Apply the grout coat(s) over the intermediate coat.
   1. Apply 1 or 2 coats at 160 to 200 SF per GAL as necessary to provide 8.0 to 10.0 mil DFT per coat as necessary to achieve texture and slip resistance to match approved mock-up.

H. Apply top coat over grout coat.
   1. Apply top coat at 590 SF per GAL to provide 2.5 mil DFT.

I. Specifier: Edit as necessary for project specific details.

J. Provide radius cove base_ IN high} {to top of curb at concrete curb or containment areas}.

K. Provide manufacturer’s recommended cove cap at top of coved base.

L. Provide termination strips where abutting dissimilar materials.

M. Provide transition strips at stair openings, doorways or other areas adjacent to different floor finishes.

N. Provide texture in accordance with approved mock-up for all skid resistant floor areas.

O. Flooring is to be installed in continuous single operation with no cold joints unless approved in writing by Engineer.
   1. If applicator requires cold joints, submit written request to Engineer identifying where the joint is to be located and how the joint is to be treated to accomplish a "seamless" appearance and a "seamless" performance in the floor.

P. Repair or remove and replace unacceptable flooring and base to satisfaction of Engineer at no additional expense to Owner.

Q. Cure coating in accordance with manufacturer's recommendations.
   1. Allow no traffic on recently installed floor until completely cured.

3.3 FIELD QUALITY CONTROL

A. Contractor Performed Testing:
   1. The Contractor shall provide ongoing testing and inspection as specified herein, including but not limited to the following:
      a. Thickness Testing:
         1) Measure wet film thickness during application in accordance with ASTM D4414.
         2) Ensure a monolithic coating and uniform thickness during the application process.
         3) Dry Film Thickness (DFT) shall be measured in accordance with ASTM D6132.
      b. Bond Strength:
         1) Measure bond strength of the protective coating to the concrete substrate in accordance with ASTM D7234.

2) Bond strength of the coating to the concrete shall be greater then the tensile strength of the concrete.
3) One 50 mm dolly shall be fixed to each location and pulled in accordance with ASTM D7234.
   a) For each test that fails, two (2) additional tests shall be performed in the adjacent area.
   b) Further bond tests may be performed to determine the extent of potentially deficient bonded areas at no additional cost to the Owner.
   c) Repairs shall be made by applicator in strict accordance with manufacturer's recommendations.
   d) The number of test sites and locations to be tested shall be determined by the Owner after application of coating. The Contractor will apply the dollies, perform the tests and repair the coating in the presence of the Owner.
   e) Any coated areas that do not pass the bond strength tests shall be removed and replaced at the expense of the Contractor.

3.4 PROTECTION

A. After material has achieved initial cure, provide non-staining paper and 1/2 IN thick plywood or particleboard protection until building is accepted by Owner.

3.5 CLEANING

A. Immediately prior to acceptance by Owner, remove floor protection and clean floors as recommended by manufacturer.

END OF SECTION

SECTION 09 68 13 - TILE CARPETING

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 modular carpet tile.

B. Related Requirements:

1. Section 09 65 13 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation recommendations for each type of substrate.

B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.

C. Samples for Verification: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size Sample.
2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Build mockups at locations and in sizes shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI's "CRI Carpet Installation Standard."

1.8 FIELD CONDITIONS

A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.9 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.

2. Failures include, but are not limited to, the following:

   a. More than 10 percent edge raveling, snags, and runs.
   b. Dimensional instability.
   c. Excess static discharge.
   d. Loss of tuft-bind strength.
   e. Loss of face fiber.
   f. Delamination.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CARPET TILE

A. Carpet tile is specified in Finish Schedule by manufacturer's designations.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.

B. Examine carpet tile for type, color, pattern, and potential defects.

C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 03 30 00 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.

   1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.

a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns indicated on Drawings. If not so indicated, as recommended in writing by carpet tile manufacturer.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13

SECTION 09 91 00 - PAINTING

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 surface preparation and the application of paint systems on the following substrates:

1. Concrete masonry units (CMU).
2. Steel.
3. Gypsum board.
4. Concrete floors.

1.3 DEFINITIONS

A. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.

B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.

1. Submit Samples on rigid backing, 8 inches square.
2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

C. Product List: For each product indicated, include the following:

1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

1.5 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.

    a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft..
    b. Other Items: Architect will designate items or areas required.

2. Final approval of color selections will be based on mockups.

    a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.

3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

    1. Maintain containers in clean condition, free of foreign materials and residue.
    2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Benjamin Moore & Co.
    2. Diamond Vogel Paints.
    3. Hallman Lindsay Paints.
    4. ICI Paints.
    5. PPG Architectural Finishes, Inc.
    6. Pratt & Lambert.
    7. Sherwin-Williams Company (The).

B. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

2.2 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. Colors: As selected by Architect from manufacturer's full range.

2.3 BLOCK FILLERS

A. Block Filler, Latex, Interior/Exterior: MPI #4.

2.4 PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior: MPI #50.

2.5 METAL PRIMERS

A. Primer, Rust-Inhibitive, Water Based: MPI #107.

2.6 WATER-BASED PAINTS

A. Latex, Interior, High Performance Architectural, (Gloss Level 3): MPI #139.

B. Latex, Interior, High Performance Architectural, Semi-Gloss (Gloss Level 5): MPI #141.

C. Light Industrial Coating, Interior, Water Based, Semi-Gloss (Gloss Level 5): MPI #153.

2.7 DRY FOG/FALL COATINGS

A. Dry Fall, Latex, Flat: MPI #118.

2.8 EPOXY COATINGS

A. Epoxy, Gloss: MPI #77.

2.9 SEALER FOR CONCRETE FLOORS

A. Epoxy Non-Slip Deck Coating System: MPI #82.

2.10 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Masonry (Clay and CMU): 12 percent.
3. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:

   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Pipe hangers and supports.
   d. Metal conduit.

2. Paint the following work where exposed in occupied spaces:

   a. Uninsulated metal piping.
   b. Pipe hangers and supports.
   c. Metal conduit.
   d. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 PAINTING SCHEDULE

A. CMU Substrates:

1. High-Performance Architectural Latex System:

   a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
   b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
   c. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5), MPI #141.

2. Epoxy System:

   a. Block Filler: Block filler, latex, interior/exterior, MPI #4.
   b. Intermediate Coat: Epoxy, gloss, MPI #77.
   c. Topcoat: Epoxy, gloss, MPI #77.

B. Overhead Steel Substrates:

1. Water-Based Dry-Fall System:
   a. Prime Coat: Shop primer specified in Section where substrate is specified.
   b. Topcoat: Dry fall, latex, flat, MPI #118.

C. Other Steel Substrates:

1. Water-Based Light Industrial Coating System:

a. Prime Coat: Primer, rust-inhibitive, water based MPI #107.
b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
c. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 5), MPI #153.

D. Gypsum Board Substrates:

1. High-Performance Architectural Latex System:

a. Prime Coat: Primer sealer, latex, interior, MPI #50.
b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3), MPI #139.

E. Concrete Substrates, Floors

1. Epoxy Non-Slip Deck Coating System:

a. Prime Coat: As recommended in writing by topcoat manufacturer.
b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
c. Topcoat: Epoxy deck coating (slip resistant), MPI #82.

END OF SECTION 09 91 00

SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Room-identification signs.

1.3 DEFINITIONS

A. Accessible: In accordance with the accessibility standard.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each type of sign at least half size.

C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Room-Identification Signs: Full-size Sample.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.2 SIGNS

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. 2/90 Sign Systems, Inc.
3. ASI Sign Systems, Inc.
4. Poblocki Sign Company, LLC.

B. Room-Identification Signs: Vinyl tactile signs with pictogram, Grade 2 Braille and square corners,.

1. Basis-of-Design Products: InPro Corporation.

2. Except as otherwise indicated, provide Series S120 signs at each room.

a. Size: 6 inch x 6 inch
b. Copy: Room name and number

3. Toilet Rooms: Series S320 ADA compliant

a. Size: 8 inch x 8 inch
b. Copy: “Restroom” "Men" or "Women" as appropriate; accessibility symbol.

4. Font for Copy: Optima.

5. Color(s): As selected by Architect from manufacturer's full range.

6. Mounting: Surface mounted to wall with two-face tape.

2.3 ACCESSORIES

A. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Room-Identification Signs: Install in locations on walls and according to accessibility standard.

C. Mounting Method:

1. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 14 00

SECTION 10 21 13 - TOILET COMPARTMENTS

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. Steel toilet compartments configured as toilet enclosures and urinal screens.

B. Related Sections:

1. Section 05 50 00 "Metal Fabrications" for supports that attach ceiling-hung compartments to overhead structural system.
2. Section 06 10 00 "Rough Carpentry" for blocking.
3. Section 10 28 13 "Toilet Accessories" for toilet tissue dispensers, grab bars and similar accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.

1. Show locations of cutouts for compartment-mounted toilet accessories.
2. Show locations of reinforcements for compartment-mounted grab bars.
3. Show locations of centerlines of toilet fixtures.
4. Show overhead support or bracing locations.

C. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:

1. Each type of material, color, and finish required for units, prepared on 6-inch square Samples of same thickness and material indicated for Work.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Comply with requirements in GSA's CID-A-A-60003, "Partitions, Toilets, Complete."

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.

1. Electrolytically Zinc Coated: ASTM A 879/A 879M, 01Z.
2. Hot-Dip Galvanized: ASTM A 653/A 653M, either hot-dip galvanized or galvannealed.

B. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

C. Stainless-Steel Castings: ASTM A 743/A 743M.

D. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.2 STEEL UNITS >

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bradley Corporation; Mills Partitions.
2. General Partitions Mfg. Corp.
3. Global Steel Products Corp.
4. Hadrian Manufacturing Inc.
5. Metpar Corp.
6. Sanymetal; a Crane Plumbing company.

B. Toilet-Enclosure Style: Ceiling hung.

C. Urinal-Screen Style: Wall hung, flat panel.

D. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.

1. Core Material: Manufacturer's standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch for doors and panels and 1-1/4 inches for pilasters.
2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.

E. Urinal-Screen Construction:

1. Flat-Panel Urinal Screen: Matching panel construction.
2. Integral-Flange, Wall-Hung Urinal Screen: Similar to panel construction, with integral full-height flanges for wall attachment, and maximum 1-1/4 inches thick.

F. Facing Sheets and Closures: Electrolytically coated or hot-dip galvanized-steel sheet with nominal base-metal (uncoated) thicknesses as follows:

1. Pilasters, Unbraced at One End: Manufacturer's standard thickness, but not less than 0.048 inch.
2. Panels: Manufacturer's standard thickness, but not less than 0.030 inch.
3. Doors: Manufacturer's standard thickness, but not less than 0.030 inch.
4. Flat-Panel Urinal Screens: Thickness matching the panels.

G. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than 0.031-inch nominal thickness and 3 inches high, finished to match hardware.

H. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets; stainless steel.

I. Steel-Sheet Finish: Immediately after cleaning and pretreating, apply manufacturer's standard baked-on finish, including thermosetting, electrostatically applied, and powder coatings. Comply with coating manufacturer's written instructions for applying and baking. Apply one color in each room.

1. Color: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

1. Material: Stainless steel.
2. Hinges: Manufacturer's standard continuous, cam type that swings to a closed or partially open position.
3. Latch and Keeper: Manufacturer's standard surface-mounted latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 FABRICATION

A. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch- wide, in-swinging doors for standard toilet compartments and 36-inch- wide, out-swinging doors with a minimum 32-inch- wide, clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

   a. Pilasters and Panels: 1/2 inch.
   b. Panels and Walls: 1 inch.

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

   a. Align brackets at pilasters with brackets at walls.

B. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 21 13

SECTION 10 26 00 - WALL AND DOOR PROTECTION

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. Corner guards.
2. Abuse-resistant wall coverings.

B. Related Requirements:

1. Section 087100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For each type of wall and door protection showing locations and extent.

1. Include plans, elevations, sections, and attachment details.

C. Samples: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of wall and door protection product to include in maintenance manuals.

1. Include recommended methods and frequency of maintenance for maintaining best condition of plastic covers under anticipated traffic and use conditions. Include precautions against using cleaning materials and methods that may be detrimental to finishes and performance.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.

1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
2. Keep plastic materials out of direct sunlight.
3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.

a. Store corner-guard covers in a vertical position.
b. Store wall-guard covers in a horizontal position.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including detachment of components from each other or from the substrates, delamination, and permanent deformation beyond normal use.
b. Deterioration of metals, metal finishes, plastics, and other materials beyond normal use.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Products are indicated in Finish Schedule.

1. Subject to compliance with requirements, provide either the Basis of Design product for each category or comparable products by one of following:

a. Construction Specialties, Inc.
b. InPro Corporation (IPC).
c. Korogard Wall Protection Systems; Division of RJF International Corporation.
d. Pawling Corporation

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

2.3 CORNER GUARDS

A. Surface-Mounted, Plastic-Cover Corner Guards: Manufacturer's standard, PVC-free assembly consisting of snap-on, resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.

B. Cover: Extruded rigid plastic, minimum 0.100-inch wall thickness; as follows:

   a. Profile: Nominal 2-inch-long leg and 1/4-inch corner radius.
   b. Height: As indicated.
   c. Color and Texture: As indicated by manufacturer's designations.

C. Continuous Retainer: Minimum 0.060-inch-thick, one-piece, extruded aluminum.

D. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

2.4 ABUSE-RESISTANT WALL COVERINGS

A. Abuse-Resistant Sheet Wall Covering: Fabricated from semirigid, plastic sheet wall-covering material.
   1. Size: 48 by 120 inches for roll.
   2. Sheet Thickness: 0.040 inch.
   3. Color and Texture: As indicated by manufacturer's designations.
   4. Height: As indicated.
   5. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.
   6. Mounting: Adhesive.

2.5 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

C. Adhesive: As recommended by protection product manufacturer.

2.6 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.7 FINISHES

A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated on Drawings.

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.
2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
3. Adjust end and top caps as required to ensure tight seams.

D. Abuse-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 26 00

SECTION 10 28 13 - TOILET 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. Public-use washroom accessories.
2. Custodial accessories.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

1.4 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

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.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.

C. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

D. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

E. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

F. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Coat Hook TA-1

1. Basis-of-Design Product: Bradley Corporation, Model No: 9124.
2. Description: Double-prong unit.
3. Material and Finish: Stainless steel, No. 4 finish (satin).

B. Seat-Cover Dispenser TA-2

1. Basis-of-Design Product: Bradley Corporation, Model No: 584.
2. Mounting: Recessed.
3. Minimum Capacity: 500 seat covers.
4. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
5. Lockset: Tumbler type.

C. Sanitary-Napkin Disposal Unit TA-3:

1. Basis-of-Design Product: Bradley Corporation, Model No: 4722-10-15
2. Mounting: Recessed.
3. Door or Cover: Self-closing, disposal-opening cover and hinged face panel with tumbler lockset.
4. Receptacle: Removable.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

D. Grab Bar TA-4:

1. Basis-of-Design Product: Bradley Corporation, Model No: 832
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch thick, smooth, No. 4 finish (satin).
4. Outside Diameter: 1-1/4 inches.
5. Configuration and Length: As indicated on Drawings.

E. Toilet Tissue (Jumbo-Roll) Dispenser TA-5

1. Basis-of-Design Product: Bradley Corporation, Model No: 5425.
2. Description: Two-roll unit with sliding panel to expose other roll.
3. Mounting: Surface mounted.
4. Capacity: 9- or 10-inch- diameter rolls.
5. Material and Finish: Stainless steel, No. 4 finish (satin).
6. Lockset: Tumbler type.
7. Refill Indicator: Pierced slots at front.

F. Liquid-Soap Dispenser TA-6:

1. Basis-of-Design Product: Bradley Corporation, Model No: 6326
2. Description: Piston-and-spout-type unit with polyethylene reservoir, brightly polished stainless-steel piston and 6-inch-long spout; and chrome-plated brass deck escutcheon.
3. Mounting: Deck mounted on vanity.
4. Capacity: 16oz.

G. Combination Towel (Folded) Dispenser/Waste Receptacle TA-7

1. Basis-of-Design Product: Bradley Corporation, Model No: 234.
2. Description: Combination unit for dispensing C-fold or multifold towels, with removable waste receptacle.
3. Mounting: Recessed with projecting receptacle, designed for nominal 4-inch wall depth.
4. Minimum Towel-Dispenser Capacity: 600 C-fold or 800 multifold paper towels.
5. Minimum Waste-Receptacle Capacity: 12 gal.
6. Material and Finish: Stainless steel, No. 4 finish (satin).
7. Liner: Reusable, vinyl waste-receptacle liner.
8. Lockset: Tumbler type for towel-dispenser compartment and waste receptacle.

H. Mirror Unit TA-9

1. Basis-of-Design Product: Bradley Corporation, Model No: 780
2. Frame: Stainless-steel angle, 0.05 inch thick, with manufacturer's standard corners.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
4. Size: As indicated on Drawings.

2.3 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder:

1. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
2. Length: 36 inches.
3. Hooks: Three.
4. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

    a. Shelf: Not less than nominal 0.05-inch- thick stainless steel.
    b. Rod: Approximately 1/4-inch- diameter stainless steel.

2.4 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of three keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION 10 28 13

SECTION 10 44 00 - FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Portable, hand-carried fire extinguishers
2. Mounting brackets for fire extinguishers.
3. Cabinets for fire extinguishers.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For fire-extinguisher cabinets.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 COORDINATION

A. Coordinate size of fire-extinguisher cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-extinguisher cabinets with wall depths.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers which fail in materials or workmanship within specified warranty period.

1. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire Extinguishers:

1. Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
2. Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 FIRE EXTINGUISHERS

A. Multipurpose Dry-Chemical Type, UL-rated 10 lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Badger Fire Protection.
2. Guardian Fire Equipment, Inc.
3. JL Industries, Inc.; a division of the Activar Construction Products Group.
4. Kidde Residential and Commercial Division; Subsidiary of Kidde plc.
5. Larsens Manufacturing Company.
6. Nystrom Building Products.
7. Potter Roemer LLC.

C. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

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. Badger Fire Protection.
b. Guardian Fire Equipment, Inc.
c. JL Industries, Inc.; a division of the Activar Construction Products Group.
d. Larsens Manufacturing Company.
e. Nystrom Building Products.
f. Potter Roemer LLC.

2.4 FIRE-EXTINGUISHER CABINETS

A. Semirecessed Cabinets: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

B. Manufacturers: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. JL Industries, Inc.; a division of the Activar Construction Products Group.
b. Larsens Manufacturing Company.
c. Nystrom, Inc.
d. Potter Roemer LLC.

C. Cabinet Construction: Nonrated.

D. Cabinet Material: Cold-rolled steel sheet.

E. Edge Trim: Square, 1-1/4 to 1-1/2 inch backbend depth.

F. Door Style: Fully glazed, frameless, backless, acrylic panel.

1. Acrylic Sheet Color: Clear transparent acrylic sheet.

G. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

H. Materials:

1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

a. Finish: Baked enamel or powder coat.
b. Color: As selected by Architect from full range of industry colors and color densities.

2. Transparent Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), 3 mm thick, with Finish 1 (smooth or polished).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare recesses for semi-recessed fire-extinguisher cabinets as required by type and size of cabinet and trim style.

B. Install fire-extinguisher cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

1. Fasten cabinets to structure, square and plumb.
2. Adjust cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

D. Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

1. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated, 54 inches above finished floor to top of fire extinguisher.

END OF SECTION 10 44 00

SECTION 10 51 13 - METAL LOCKERS

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. Corridor lockers.
2. Locker benches

1.3 ACTION SUBMITTALS

A. Product Data: For each type of metal locker.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.

B. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Show locker trim and accessories.
3. Include locker identification system and numbering sequence.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.6 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures.
b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.

3. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain metal lockers and accessories from single source from single locker manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC A117.1.

2.3 CORRIDOR LOCKERS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. General Storage Systems, Div. of North American Steel
2. Hadrian Manufacturing Inc.
3. Olympus Lockers and Storage Products, Inc.
4. Lyon Workspace Products.
5. Republic Storage Systems Company.

B. Doors: One piece; fabricated from 0.060 inch nominal-thickness steel sheet; outer panel, with double bend at edges, welded to 0.024 inch thick inner panel to form a rigid box.

1. Door Style: Unperforated panel.

C. Body: Assembled by welding, riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch nominal thickness, with single bend at sides.
2. Backs and Sides: 0.024-inch nominal thickness, with full-height, double-flanged connections.

3. Shelves: 0.024-inchnominal thickness, with double bend at front and single bend at sides and back.

D. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

1. Frame Vents: Fabricate face frames with vents.

E. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees; self-closing.

1. Continuous Hinges: Manufacturer's standard, steel, full height.

F. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

1. Single-Point Latching: Nonmoving latch hook with steel padlock loop that projects through recessed cup and is finished to match metal locker body.

a. Latch Hook: Equip each door with one latch hook, fabricated from 0.105-inch nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.

G. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.

H. Hooks: Manufacturer's standard ball-pointed type hooks, aluminum or steel; zinc plated.

I. Continuous Zee Base: Fabricated from 0.075-inch nominal-thickness steel sheet.

1. Height: 4 inches.

J. Continuous Sloping Tops: Fabricated from 0.036-inch nominal-thickness steel sheet.

1. Closures: Vertical-end type.
2. Sloping-top corner fillers, mitered.

K. Filler Panels: Fabricated from 0.036-inch nominal-thickness steel sheet.

L. Boxed End Panels: Fabricated from 0.060-inch nominal-thickness steel sheet.

M. Materials:

1. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 zinc-iron, alloy (galvannealed) coating designation.

N. Finish: Baked enamel or powder coat.

1. Color: As selected by Architect from manufacturer's full range.

2.4 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.

C. Equipment: Provide each locker with an identification plate and the following equipment:

1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.

D. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

E. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.

F. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

1. Sloping-top corner fillers, mitered.

G. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

H. Boxed End Panels: Fabricated with 1-inch- wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.5 ACCESSORIES

A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

B. Anchors: Material, type, and size required for secure anchorage to each substrate.

1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts for corrosion resistance.
2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.6 LOCKER BENCHES

A. Bench Tops: 1-piece laminated maple units, minimum 9-1/2 inches wide x 1-1/4 inches thick, with rounded corners and edges, one coat of clear sealer on all surfaces, and one coat of clear lacquer on top and sides.

B. Pedestals: 1-1/4 inch diameter steel tubing, with steel flanges with predrilled fastener holes at top and base; complete with fasteners and anchors. Provide no fewer than 2 pedestals for each bench, uniformly spaced not more than 72 inches apart.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top of lockers and to floor.
3. Anchor back-to-back metal lockers to floor.

B. Knocked-Down Lockers: Assemble with standard fasteners, with no exposed fasteners on door faces or face frames.

C. Equipment:

1. Attach hooks with at least two fasteners.
2. Attach door locks on doors using security-type fasteners.
3. Identification Plates: Identify metal lockers with identification indicated on Drawings.

   a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
   b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach recess trim to recessed metal lockers with concealed clips.
2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
3. Attach sloping-top units to metal lockers, with closures at exposed ends.

4. Attach boxed end panels using concealed fasteners to conceal exposed ends of nonrecessed metal lockers.

E. Fixed Locker Benches: Securely fasten tops of pedestals to undersides of bench tops, and anchor bases to floor.

3.3 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

3.4 PROTECTION

A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 51 13

SECTION 10 56 00 - STORAGE EQUIPMENT

PART 1 - GENERAL

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

1.1 WORK INCLUDED

A. Equipment items as listed below by Equipment Identifier:

1. 1098 Board, peg, tool (Ref. Part 2.1)
2. 1106 Cabinet, 5 drawer, 33 inches, underbench (Ref. Part 2.2)
3. 1110 Cabinet, 10 drawer, 59 inches (Ref. Part 2.3)
4. 1140 Cabinet, flammable materials, large (Ref. Part 2.4)
5. 1185 Cabinet, storage, shop (Ref. Part 2.5)
6. 1200 Cart, parts (Ref. Part 2.6)
7. 1215 Chair, shop, electronic, static dissipative (Ref. Part 2.7)
8. 1455 Rack, bulk storage (Ref. Part 2.8)
9. 1545 Rack, pallet, high bay (Ref. Part 2.9)
10. 1570 Rack, spool, wire (Ref. Part 2.10)
11. 1688 Shelving unit, 18 inches (Ref. Part 2.11)
12. 1805 Workbench, electronics, static dissipative (Ref. Part 2.12)

B. Installation of equipment with labor, services, and incidentals necessary for complete and operational equipment installation.

C. Utilities to be roughed in at location recommended by manufacturer.

1.2 QUALITY ASSURANCE

A. Equipment shall be produced by a manufacturer of established reputation with a minimum of five years' experience supplying specified equipment.

1.3 Buy America Compliance

A. The Contractor shall comply with the applicable Buy America requirements set forth in 49 U.S.C. 5323(j) and the applicable regulations in 49 C.F.R. Part 661, as amended. If the Contractor procures any capital items with Federal funds, it is the Contractor's responsibility to obtain the Buy America certification required under such regulations.

B. Reference Division 1 for Buy America compliance.

1.4 SUBMITTALS

A. Product Data:

1. Submit Product Data in accordance with Division 1 - General Requirements of these specifications.
2. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.
3. Additional costs resulting from substitution of products other than those specified, including drawing changes and construction, will be at the expense of the contractor.

B. Operations and Maintenance Manual:

1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
3. Description of system and components.
4. Schematic diagrams of electrical, plumbing, and compressed air system.
5. Manufacturer's printed operating instructions.
6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.

1.5 PRODUCT SUBSTITUTIONS

A. Follow requirements specified in Division 1 - General Requirements.

B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.

C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

1.6 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situations resulting from non-performance of a manufacturer's recommended preventive maintenance schedule.

D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.

E. All parts shall be readily available locally in the United States.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.

C. Provide equipment and material specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

PART 2 - PRODUCTS

2.1 BOARD, PEG, TOOL
Equipment Identifier: 1098

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a.	Kennedy Manufacturing Company
b.	Van Wert, OH (418) 238-2442
c.	Model No.: 50004UGY

2. Alternate manufacturers: Contingent *upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a.	Modern Metal Products, Owatonna, MN (507) 451-7114
b.	Trion Industries, Inc., Wilkes-Barre, PA (570) 824-1000

B. Capacities/Dimensions:

1. Overall dimensions, nominal:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	72	1/2	36

C. Features/Performance/Construction:

1. The panels shall be steel reinforced with square hole perforations. Flanged panels shall be reinforced to support heavy loads.
2. Panels shall be capable of being attached to any surface that can support the weight of heavy tools (fasteners not included).
3. Panels shall be manufactured of chip resistant material that will withstand abuse over time.
4. Individual panels shall be 18 by 36 inches and be assembled so that the complete length of the four-panel system shall be 72 inches.
5. Hooks, clips, and accessories shall be heavy-duty steel and capable of locking onto the panel.
6. The tool board system shall include the following (60 piece set) items:

    a. Single hooks, 33 each
    b. Double hooks, nine each
    c. Pliers hooks, four each
    d. Spring clips, 10 each
    e. Screwdriver unit, one each
    f. Wrench rack, one each
    g. Hex key unit, one each

D. Finish: Gray, durable chip-resistant baked on finish

2.2 CABINET, SIX DRAWER, 33 INCHES, UNDERBENCH
Equipment Identifier: 1106

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a. Equipto b. Tatamy, PA (610) 253-2775 c. Model No.: 4433

2. Alternate manufacturers: Contingent *upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Lyon Workspace Products, Montgomery, IL (630) 892-8941 b. Stanley Vidmar, Allentown, PA (800) 523-9462

B. Capacities/Dimensions:

1. Overall dimensions, nominal:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	30	27-3/4	33-1/2

2. Quantity of drawers: Six
3. Drawer capacity: 400 pounds each (minimum)
4. Drawer dimensions:

    a. Usable width: 27-1/2 inches
    b. Usable depth: 25-1/8 inches
    c. Drawer usable height (drawers numbered top to bottom):

        1) Drawer 1: 3 inches
        2) Drawers 2, 3, and 4: 4-1/2 inches
        3) Drawers 5 and 6: 6 inches

C. Features/Performance/Construction:

1. Cabinet shall be heavy gauge channel formed sheet steel with mountings permitting installation of various height drawers, front columns with drilled and tapped bolt holes.
2. Base design shall include front and rear forklift openings of ample strength to permit moving of fully loaded cabinet. Front base plate shall be provided. Base shall be drilled for bolting to the floor.
3. Drawer suspension shall be designed for total interchangeability for all drawer heights. Sealed steel roller bearing system shall permit full drawer extension at rated capacity without sagging.
4. Drawers and trays shall be fabricated of smooth sheet metal with partition and divider mounting hole grid punched on 3/4 inch centers. Drawer walls shall be slotted on 3/4 inch centers for mounting dividers and partitions.
5. Drawer pulls shall be nominal 3/4 drawer width with 1 inch high label holder provided with paper labels and protective vinyl shields and end caps.
6. Drawer dividers shall have a minimum of 12 divided sections.
7. Drawer heights shall be available in front heights of 3 to 12 inches in not over 1-1/2 inch increments.
8. Drawer dividers (drawers numbered top to bottom):

    a. Drawer 1: Divider set, Equipto No. 4133F10 (one each)
    b. Drawer 2, 3, 4: Divider set, Equipto No. 413F15 (three each)
    c. Drawer 5, 6: Divider set, Equipto No. 4135F20 (two each)

9. Provide seismic bracing and anchorage to meet any local, state, and national codes and provisions.

D. Finish: Phosphate primer covered by durable enamel in Owner’s choice of manufacturer’s standard color

2.3 CABINET, 10 DRAWER, 59 INCHES
Equipment Identifier: 1110

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a.	Equipto
b.	Tatamy, PA (610) 253-2775
c.	Model No.: 4424

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a.	Lyon Workspace Products, Montgomery IL (630) 892-8941
b.	Stanley-Vidmar, Allentown, PA (800) 523-9462

B. Capacities/Dimensions:

1. Overall dimensions, nominal:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	30	27-3/4	59

2. Quantity of drawers: 10
3. Drawer capacity: 400 pounds each (minimum)
4. Drawer dimensions:

a. Usable width: 25-1/8 inches
b. Usable depth: 25-1/8 inches
c. Drawer front height and body height respectively (drawers numbered top to bottom):

1) Drawers 1, 2, and 3: 3 inches, 2-1/8 inches
2) Drawers 4, 5, and 6: 4-1/2 inches, 3-1/8 inches
3) Drawers 7 and 8: 6 inches, 4-5/8 inches
4) Drawer 9: 7-1/2 inches, 4-5/8 inches
5) Drawer 10: 12 inches, 4-5/8 inches

d. Partition and divider adjustment: 3/4 inch centers

C. Features/Performance/Construction:

1. Cabinet shall be heavy gauge, channel formed sheet steel with mountings permitting installation of various height drawers, front columns with drilled and tapped bolt holes.
2. Base design shall include front and rear forklift openings of ample strength to permit moving of fully loaded cabinet. Front base plate shall be provided. Base shall be drilled for bolting to floor.
3. Drawer suspension shall be designed for total interchangeability for all drawer heights. Sealed steel roller bearing system shall permit full drawer extension at rated capacity without sagging.
4. Drawers and trays shall be fabricated of smooth sheet metal with partition and divider mounting hole grid punched on 3/4 inch centers. Drawer walls shall be slotted on 3/4 inch centers for mounting dividers and partitions.
5. Drawer pulls shall be nominal 3/4 drawer width with 1 inch high label holder provided with paper labels and protective vinyl shields and end caps.
6. Drawer dividers shall have a minimum of 12 divided sections.
7. Drawer heights shall be available in front heights of 3 to 12 inches in not over 1-1/2 inch increments.
8. Drawer dividers (drawers numbered top to bottom):

    a. Drawers 1,2, 3: Drawer divider, Equipto No. 4133F10 (three each)
    b. Drawers 4, 5, 6: Drawer divider, Equipto No. 4134F15 (three each)
    c. Drawers 7, 8, 9, 10: Drawer divider, Equipto No. 4135F20 (four each)

9. Provide seismic bracing and anchorage to meet any local, state, and national codes and provisions.

D. Finish: Phosphate primer covered by durable enamel in Owner's choice of manufacturer's standard colors

2.4 CABINET, FLAMMABLE MATERIALS, LARGE
Equipment Identifier: 1140

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

a. Equipto b. Tatamy, PA (610) 253-2775 c. Model No.: FSC45S

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Lyon Workspace Products, Montgomery, IL (630) 892-8941 b. Justrite Manufacturing Co., Des Plaines, IL (847) 298-9250

B. Capacities/Dimensions:

1. Overall dimensions, nominal:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	43	18	65

2. Weight, nominal: 353 pounds
3. Storage capacity: Up to nine each, 5 gallon containers

C. Features/Performance/Construction:

1. Cabinet shall comply with NFPA combustible liquids Code No. 30 and OSHA safety requirements.
2. Construction shall consist of double wall 18 gauge sheet steel with 2 inch air space between inner and outer walls.
3. Cabinet shall have a 2 inch pan-type bottom.
4. Two screened flame arrester vents per cabinet, one each at left side bottom and right side top, shall be threaded for and provided with 2 inch NPT steel plugs.
5. Leveling feet shall be provided at all four corners.
6. Electrical grounding attachments shall be provided on each side.
7. A spring-loaded fusible link with 160 degree Fahrenheit melting point shall actuate self-closing double swinging doors mounted with full-length piano hinges. Doors shall be provided with three-point latch mechanism and key lock.
8. Two each adjustable shelves shall be provided between 5-3/8 inches from top and 7-5/16 inches from bottom on 1-5/8 inch centers.
9. Provide seismic bracing and anchorage to meet any local, state, and national codes and provisions.

D. Accessories:

1. Anchors, floor: Equipto No. 190317A for seismic bracing (for each per unit)

E. Finish: Durable enamel in safety sun yellow with "FLAMMABLE - KEEP FIRE AWAY" in bright red letters across doors

2.5 CABINET, STORAGE, SHOP
Equipment Identifier: 1185

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a.	Equipto
b.	Tatamy, PA (610) 253-2775
c.	Model No.: 1710

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a.	Lyon Workspace Products, Inc., Montgomery IL (630) 892-8941
b.	Republic Storage Systems, Canton, OH (330) 438-5800

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	36	18	78

2. Space remaining four shelves evenly, approximately 15 inches center to center
3. Shelf capacity: 200 pounds per shelf (minimum)

C. Features/Performance/Construction:

1. Four shelves, flanged, constructed of 18 gauge steel. Shelf adjustments on maximum 2 inch centers without removing fasteners.
2. Doors shall have a three-point locking system with factory key-lockable handle. Doors shall open a full 180 degrees and be flush mounted when closed with latching actuated cast steel handle.
3. Each door shall be hinged on three welded heavy-duty steel pin hinges.
4. Back, front, and sides shall be flush with no bolt heads on front or sides.
5. Provide seismic bracing and anchorage to meet any local, state, and national codes and provisions.

D. Finish: Durable enamel in Owner's choice of manufacturer's standard color

2.6 CART, PARTS
Equipment Identifier: 1200

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a.	Pucel Enterprises, Inc.
b.	Cleveland, OH (216) 881-4604
c.	Model No.: 2448-DT-3-P

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a.	Durham Manufacturing Company, Inc., Durham, CT (860) 349-3427
b.	Equipto, Tatamy, PA (610) 253-2775

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)				
		Length	Width	Height
a.	Equipment	24	48	32-1/2

2. Cart capacity: 1,000 pounds (minimum)

C. Features/Performance/Construction:

1. Cart and shelves shall be constructed of 12 gauge steel.
2. Shelves shall be tray style with a clearance between shelves of 10 inches.
3. Casters shall be phenolic with two casters rigid and two casters swivel. Casters shall be able to accommodate 1,000 pounds.

D. Finish: Durable enamel in Owner's choice of manufacturer's standard colors

2.7 CHAIR, SHOP, ELECTRONIC, STATIC DISSIPATIVE
Equipment Identifier: 1215

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a. Lyon Workspace Products
b. Montgomery, IL (630) 892-8941
c. Model No.: 2054N

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Equipto, Tatamy, PA (610) 253-2775
b. Stanley Supply and Services, Inc., North Andover, MA (800) 225-5370

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	18	18	19

2. Seat height adjustment: Adjustable up to 27 inches
3. Foot ring diameter: 20 inches
4. Capacity: 250 pounds

C. Features/Performance/Construction:

1. Chair shall have abrasion resistant fabric, 2-1/2 inches thick.
2. Chair backrest depth and height shall adjust by 3 inches.
3. Chair shall have adjustable 20 inch diameter circular foot ring.

D. Finish: ESD seat and back shall have copper fibers and ESD treatment with a durable fabric in manufacturer's standard color

2.8 RACK, BULK STORAGE
Equipment Identifier: 1455

A. Manufacturer's Reference:

1. Prime Manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a.	Equipto
b.	Tatamy, PA (610) 253-2775
c.	Model No.: 1028D62S starter and 1028D62A add-on with accessories

2. Alternate Manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

a.	Lyon Workspace Products, Montgomery, IL (630) 892-8941
b.	Republic Storage Systems, Canton, OH (330) 438-5800

B. Capacities/Dimensions:

1. Overall dimensions, nominal:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	72	24	96

2. Beams:

a. Capacity: 2,630 pounds per pair of beams
b. Dimensions:

1) Length: 72 inches
2) Width: 3-1/2 inches
3) Height: 96 inches

c. Number of beams per rack section: Eight total (four pairs)
d. Installed beam height from finished floor:

1) Top beam: 96 inches
2) Middle beam (first): 72 inches
3) Middle beam (second): 36 inches
4) Bottom beam: 6 inches

5) Verify beam heights with Owner prior to installation

3. Uprights:

a. Capacity: 8,900 pounds per upright
b. Dimensions:

1) Width: 1-5/8 inches
2) Depth, nominal: 24 inches
3) Height: 96 inches

c. Number of uprights per rack section: Two minimum

4. Weight: 220 pounds

C. Features/Performance/Construction:

1. Beams:

a. Construction: Beams shall be solid shaped welded heavy gauge steel with heavy beam clips MIG-welded to beam ends.
b. Attachment: Beam clips shall have three beam hooks each for insertion into upright slots.

2. Supports: Tie bars for each pair of beams shall fit into slots in beams. There shall be a minimum of two supports provided for each pair of beams.
3. Uprights:

a. Construction: Upright posts shall be heavy duty 1-5/8 by 1-13/16 inch welded 16 gauge steel with tubular steel cross and diagonal members.
b. Adjustment: Upright posts shall have tapered slots on 1-1/2 inch centers for vertical beam adjustment

4. Decking:

a. Construction: Decking shall be 18 gauge corrugated shaped steel.
b. Capacity: Decking shall have a capacity of 2,778 pounds but load is limited to support capacity of beams and uprights.

5. Provide seismic bracing and anchorage to meet any local, state, and national codes and provisions.

D. Accessories:

1. Anchor: Equipto No. 190317A (four per starter)
2. Anchor: Equipto No. 190317A (two per add on)

E. Finish: Durable enamel in Owner's choice of manufacturer's standard colors.

2.9 RACK, PALLET, HIGH BAY
Equipment Identifier: 1545

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

a.	Lyon Workspace Products
b.	Montgomery, IL (630) 892-8941
c.	Model No.: Uprights 42X192, beams N108, decking WD5242L

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a.	Unarco Materials Handling, Lewisville, TX (972) 436-5581
b.	Interlake, Chicago, IL (877) 211-7016

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	108	42	192

2. Beams:

a. Minimum capacity: 4,900 pounds per pair of beams
b. Dimensions:

1) Length: 108 inches
2) Thickness: 4-3/10 inches

c. Installed beam height from finished floor:

1) Top beams: 192 inches
2) Remaining four beam levels: 36 inch spacing
3) Verify beam heights with Owner prior to installation

3. Uprights:

a. Capacity: 29,055 pounds per pair of uprights
b. Dimensions:

1) Thickness: 3 inches wide by 3 inches deep
2) Depth: 42 inches
3) Height: 192 inches

4. Decking:

a. Width: 52 inches
b. Depth: 42 inches
c. Number of channels: Three
d. Capacity: 2,500 pounds
e. Panels per shelf: Two

C. Features/Performance/Construction:

1. Beams:

a. Construction: Beams shall be welded, step-type, heavy gauge steel box channel.
b. Attachment: High tensile studs, four each on each end shall engage tapered keyhole slots in uprights. Integral safety catch automatically snaps and locks into place when beam is properly seated.

2. Uprights:

a. Construction: Continuously MIG welded, heavy gauge steel box section uprights shall have deep channel cross and diagonal K-brace members.
b. Adjustment: Tapered keyhole slots on 2 inch centers shall be provided for vertical beam adjustments.
c. Base plate: Heavy gauge steel shall be LAP welded to upright with holes for anchoring to floor.
d. Row ends: An extra upright frame shall be provided to finish each row as indicated on equipment drawings.

3. Decking:

a. Wire mesh: Continuously MIG welded, 2-1/2 by 4 inches by 6 gauge
b. Support channels: 13 gauge steel

4. Provide seismic bracing and anchorage to meet any local, state, and national codes and provisions.

D. Finish: Durable enamel in Owner's choice of manufacturer's standard colors

2.10 RACK, SPOOL, WIRE
Equipment Identifier: 1570

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

a.	Equipto
b.	Tatamy, PA (610) 253-2775
c.	Model No.: 880-7

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a.	Lyon Workspace Products, Montgomery, IL (630) 892-8941
b.	Republic Storage Systems, Canton, OH (330) 438-5800

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	36	8	84

C. Features/Performance/Construction:

1. Rack shall be able to hold wire reels up to 16 inches in diameter on seven shelves.
2. Rack shall have V-shaped shelves with center rod.
3. Shelves shall have fiberboard to deaden noise and prevent excessive uncoiling.
4. Provide seismic bracing and anchorage to meet any local, state, and national codes and provisions.

D. Finish: Durable enamel in Owner's choice of manufacturer's standard colors

2.11 SHELVING UNIT, 18 INCH
Equipment Identifier: 1688

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a.	Equipto
b.	Tatamy, PA (610) 253-2775
c.	Model No.: 773-8S starter with 773-8A add on with accessories

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Lyon Workspace Products, Montgomery, IL (630) 892-8941
b. Burroughs Corporation, Kalamazoo, MI (800) 748-0227

B. Capacities/Dimensions:

1. Overall dimensions, nominal:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	36	18	84

2. Number of shelves: Eight
3. Shelf capacity: 1,000 pounds per shelf
4. Installed height from finished floor, nominal:

   a. Bottom shelf: 4-1/2 inches
   b. Top shelf: 84 inches
   c. Space remaining bottom six shelves evenly, approximately 12 inches center to center, and the top two shelves 10-1/2 inches center to center

5. Weight: 170 pounds

C. Features/Performance/Construction:

1. Shelf construction shall be double flange18 gauge steel and double flanged box-formed edges on all four sides.
2. Uprights shall be double flanged uprights with tapered bracket slots punched on 1-1/2 inch centers for vertical shelf adjustment.
3. Shelf fastening shall consist of slip-in shelf brackets which reinforce and securely lock shelf into place in all four corners.
4. Units shall share common end panels with adjoining units. Back-to-back units shall be joined with common upright joints.
5. Provide seismic bracing and anchoring to meet any local, state, and national codes and provisions.

D. Accessories:

1. Anchors, floor: Equipto No. 190317A, for seismic bracing (four per starter unit, two per add on)

E. Finish: Durable enamel in owner's choice of manufacturer's standard colors

2.12 WORKBENCH, ELECTRONICS, STATIC DISSIPATIVE
Equipment Identifier: 1805

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a. Equipto
b. Tatamy, PA (610) 253-2775
c. Model No.: 388-5C with accessories

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

a. Lyon Workspace Products, Montgomery, IL (630) 892-8941
b. Lista International, Holliston, MA (508) 429-1350

B. Capacities/Dimensions:

1. Overall dimensions, nominal:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	60	30	33-1/2

2. Instrument shelf:

a. Length: 60 inches
b. Width: 13-1/2 inches
c. Height: 14 inches

3. Workbench top:

a. Length: 60 inches
b. Width: 30 inches

4. Weight:

a. Workbench: 141 pounds
b. Instrument shelf: 56 pounds

C. Features/Performance/Construction:

1. Work surface shall be industrial quality dissipative type with 10^6 to 10^9 OHMS per square inch resistivity and be constructed of 1-3/4 inch static dissipative plastic laminate with grounding kit. The top shall have a 180 degree full wrap laminate soft edge at the front.
2. Bench legs shall have leveling guides to level the bench.
3. Instrument shelf shall be constructed of 1-3/4 inch static dissipative plastic laminate with front 180 degree full wrap laminate soft edge and have 10^6 to 10^9 OHMS per square inch resistivity. Shelf top shall be supported by steel supports on each end. One instrument shelf shall be provided per bench.
4. Comes with two pedestal legs with UL approved fused electrical outlets. All work centers include a bottom shelf and modesty panels.

D. Accessories:

1. Shelf assembly, instrument: Equipto No. 464C5 (one per bench)

E. Utility Requirements:

1. Electrical:

a.

Connection Requirements	Power Strip	Instrument Shelf
Voltage	120	120
Phase	1	1
Amps	15	15

F. Finish: Table structure shall be durable enamel in Owner's choice of manufacturer's standard colors and the worktop shall be a static dissipative laminate

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.

3.2 INSTALLATION

A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect or designated representative.

B. Install equipment in accordance with plans, shop drawings, and manufacturer's instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.
2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
3. Anchorage: Attach equipment as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. After final installation is complete and prior to authorizing payment, specified equipment shall be checked with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

3.4 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing and installation debris from job site.

D. Notify Architect or designated representative for final observation (punch list).

END OF SECTION

SECTION 10 71 13 - EXTERIOR SUN CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Furnish all labor, materials, tools, equipment, and services required for fabrication and installation of Exterior Sun Control Devices as indicated in the drawings.

B. Completely coordinate with work of other trades.

1.3 QUALITY ASSURANCE

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

B. ASTM D2244 - Standard Test Method for Calculation of Color Differences From Instrumentally Measured Color Coordinates.

C. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.4 DESIGN CRITERIA

A. Provide engineering design performed and sealed by registered Engineer, licensed to practice Structural Engineering in the State of Wisconsin.

B. Design Loads:

1. Wind Load: Use the greater of the following:
   a. Wind Pressures as required per local building code based on wind speed, exposure factor and importance factor noted in the Structural Drawings.
   b. Wind Pressures defined by Building Code as locally adopted and amended.
   c. 40 PSF.
2. Snow or Roof Load: Use the greater of the following:
   a. Snow load listed on Design Requirements on Structural Drawings.
   b. Snow load defined by Building Code as locally adopted and amended.
3. Adjust both of the above snow load values for possible drift conditions.
   a. 20 PSF minimum.
4. Limit deflection to L/175 and allowable stress with a safety factor of 1.65
5. Comply with local Building Code where more restrictive.
6. Thermal Expansion and Structural Movement:

a. Expansion and contraction, caused by changes in surface temperature equal to ΔT (delta T).
   1) ΔT for this project: 200 DegF.
b. Thermal contraction/expansion in this range shall not cause buckling, stresses on glass, failure of joint seals, undue stress on structural elements, damaging loads on fasteners, reduction of performance, or other detrimental effects over this temperature range.
c. Operating windows and doors shall function normally over this temperature range.

7. Drainage: Design Wall System to intercept, collect, contain, and drain water (which may infiltrate system) harmlessly to exterior.

1.5 SUBMITTALS

A. Shop Drawings:
   1. Layout and dimensions.
   2. Sections and details indicating profiles.
   3. Connection details and fasteners.
   4. Outline method or systems to isolate dissimilar metals.
   5. Indicate method of compensating for thermal expansion

B. Samples: Range of anodic finishes.

C. Project Information: Structural calculations prepared by a registered Engineer (licensed to practice Structural Engineering in the state where project is located) made by or for curtainwall manufacturer for review of interface between curtainwall support system and building structural frame.
   1. Submit concurrently with Shop Drawings.

1.6 JOB CONDITIONS

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

C. Handling: Protect materials and finishes during handling and installation to prevent damage.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Base: Construction Specialties.

B. Optional:
   1. The Airolite Company, LLC.
   2. Ruskin Manufacturing.

2.2 MATERIALS

A. Extruded Aluminum: ASTM B221; 6063-T5 alloy and temper.

B. Sheet Aluminum: ASTM B209; 6061-T6 alloy and temper.

D. Accessories: Fabricate anchors, reinforcing, and required ancillary items of compatible material.

2.3 EXTERIOR SUN CONTROL DEVICES

A. Support: Cantilever support from curtainwall mullions.

B. Components:
1. Outriggers: Flat bar 9.5 mm 0.375 IN thick aluminum or tube with 0.081 IN wall profile as detailed:
   a. Bullet.
2. Fascia: Fabricated from the following configurations, fabricated from minimum 0.081 IN wall thickness extruded aluminum:
   a. Bullnose.
3. Blades: Fabricated from the following configurations, fabricated from minimum 0.081 IN wall thickness extruded aluminum:
   a. Airfoil.
4. Mounting brackets: Fabricated from minimum 9.5 mm 0.375 IN aluminum, designed to receive and anchor the outrigger to the substructure

2.4 FABRICATION

A. Provide fixed shade units in maximum panel length or as required for optimal performance, with respect to strength, span ability and uniform appearance.

B. Blades shall be mechanically fastened with stainless steel screws to the outriggers.

C. For tube to tube connection, use shear blocks with mechanical attachment.

D. Spot welds only to be used where mechanical fastening of parts is prohibitive.

E. No exposed perimeter welds acceptable.

F. Shades shall be radius curved at areas indicated on drawings.

G. Include supports, anchorage and accessories required for complete assembly.

H. Provide a means to isolate dissimilar metals at bolted connections to shear tabs and other locations where dissimilar metals come into contact.

I. Provide spacers, slotted holes, or other means to compensate for thermal expansion.

2.5 ALUMINUM FINISH

A. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF or FEVE resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

B. Identify unsatisfactory conditions and report them to the Contractor for correction.

C. Installation constitutes acceptance of responsibility for performance.

3.2 INSTALLATION

A. Anchor sunshade to building sub-structure as indicated on drawings.

B. Corners: Miter sunshade units at corners as shown on drawings. Maximum gap between any two components, other than at expansion compensation, shall not exceed 1.6 mm 0.0625 IN.

C. Cut and trim units during erection only with the approval of the manufacturer and in accordance with their recommendations. Restore finish completely.

END OF SECTION 10 71 13

SECTION 11 11 00 - VEHICLE SERVICE EQUIPMENT

PART 1 - GENERAL

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

1.1 WORK INCLUDED

A. Equipment items as listed below by Equipment Identifier:

1. 2161 Compressor, air, receiver mounted, 10 HP duplex (Ref. Part 2.1)
2. 2228 Dryer, air, refrigerated, 100 CFM (Ref. Part 2.2)
3. 7510 Pump, air piston (CG), with hoist (Ref. Part 2.3)
4. 7520 Pump, air piston, 10:1 ratio (GO) (Ref. Part 2.4)
5. 7540 Pump, diaphragm, used fluid evacuation (UO) (Ref. Part 2.5)
6. 7700 Reel banks, general (Ref. Part 2.6)
7. 7710 Reel bank (CA) (Ref. Part 2.7)
8. 7730 Reel bank (CA, CG, GO) (Ref. Part 2.8)
9. 7960 Tank, double wall, cube, 280 gallons (GO, UO) (Ref. Part 2.9)
10. 7999 Receiver, used oil, 25 gallons (Ref. Part 2.10)

B. Roughing-in installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

1.2 REFERENCES

A. ASME Code for Unfired Pressure Vessels

1.3 QUALITY ASSURANCE

A. Manufacturer’s Representative:

1. Installation: Provide a qualified manufacturer’s representative at site to supervise work related to equipment installation, check out, and start up.
2. Training: Provide a qualified manufacturer’s representative to provide training to Owner’s maintenance personnel in operation and maintenance of specified equipment.

1.4 Buy America Compliance

A. The Contractor shall comply with the applicable Buy America requirements set forth in 49 U.S.C. 5323(j) and the applicable regulations in 49 C.F.R. Part 661, as amended. If the Contractor procures any capital items with Federal funds, it is the Contractor’s responsibility to obtain the Buy America certification required under such regulations.

B. Reference Division 1 for Buy America compliance.

1.5 SUBMITTALS

A. Product Data:

1. Submit Product Data in accordance with Division 1 - General Requirements of these specifications.
2. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.

B. Operations and Maintenance Manual:

1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
3. Description of system and components.
4. Schematic diagrams of electrical, plumbing, and compressed air system.
5. Manufacturer's printed operating instructions.
6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.

C. Shop Drawings: Submit Shop Drawings in accordance with of Division 1 - General Requirements of these specifications.

D. Include certified data for each unit and accessory system indicating the following:

1. Air compressor performance curves at summer design condition
2. Intercooler performance at summer design condition
3. Air dryer performance at 38 degrees F, dew point at 175 PSIG
4. Indicate components, assembly, dimensions, weights and loadings, required clearances, location and size of field connections, intake air filter outline, blow-off silencer outline, main motor drive data, aftercoolers, control panel, and electrical pneumatic schematics.

1.6 PRODUCT SUBSTITUTIONS

A. Follow requirements specified in Division 1 - General Requirements.

B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.

C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

1.7 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situations resulting from non-performance of a manufacturer's recommended preventive maintenance schedule.

1.8 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.

C. Provide equipment and material specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.9 LABELING

A. Manufacturer shall securely attach in a prominent location, on each major item of equipment, a non-corrosive nameplate showing manufacturer's name, address, model number, serial number, and pertinent utility or operating data.

B. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (UL) in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

C. Provide air receivers meeting requirements of ASME Code for Unfired Pressure Vessels and carry ASME approval stamp.

PART 2 - PRODUCTS

2.1 COMPRESSOR, AIR, RECEIVER MOUNTED, 10 HP DUPLEX
Equipment Identifier: 2161

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

a. Champion
b. Princeton, IL (866) 276-3440
c. Model No.: HR10D-25 with accessories

d. Reference Details on Service Equipment Layout Drawing Sheet

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Ingersoll Rand, Davidson, NC (704) 655-4000
b. Quincy Compressor, Quincy, IL (217) 222-7000

B. General Description: Provide duplex compressor unit consisting of air-cooled motor compressors (10 HP), air receiver, after-cooler, pressure reducing station, spring isolators, and operating controls.

C. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	88	29	57

2. Receiver: 250 gallons
3. Speed: 740 RPM
4. Displacement: 43.1 CFM each
5. Bore diameters: 4-5/8 and 2-1/2 inches
6. Stroke: 3 inches
7. Number of cylinders: 4
8. Output valve: 3/4 inch NPT(F)
9. Boltdown dimensions:

   a. Length: 55 inches
   b. Width: 27-1/2 inches

10. Weight (approximate): 1,725 pounds

D. Features/Performance/Construction:

1. Compressor construction:

   a. Construct compressor unit with cast iron housing and head, heat treated forged steel or ductile iron shaft, aluminum alloy connection rods, aluminum pistons with lubricated carbon steel rings, high-strength alloy suction and discharge valves. Statically and dynamically balance rotating parts.
   b. Mount motor and compressor on one-piece ribbed cast iron or welded steel base with provision for V-belt adjustment.

2. After-cooler:

a. Provide air compressor with air after cooler suitable for operation under 135 PSIG working pressure.
b. Provide a belt guard style after cooler mounted on the compressor belt guard, with automatic condensate trap and automatic float drain.
c. After cooler capacity to cool discharge air to within 25 degrees Fahrenheit of ambient air temperature with compressors operating at specified capacity.

3. Air receiver:

a. Provide a horizontal receiver stamped ASME rated for working pressure of 200 PSIG. Flange or screw inlet and outlet connections, welded steel construction.
b. Fittings to include adjustable pressure regulator, safety valve, pressure gauge, drain cock, and automatic pneumatic tank drain.

4. Pressure reducing valve:

a. Provide pressure reducing stations complete with automatic reducing valve and bypass, and low pressure side relief valve and gauge.
b. Compressor shall be provided with automatic start/stop capacity controls. In addition, provide centrifugal unloading to ensure for an unloaded compressor at start-up.
c. Valve capacity suitable to reduce compressor pressure from 180 PSI to 50 PSI. Pressure reducing valve to be adjustable upward from reduced pressure.
d. Provide valves with bronze or semi-steel bodies with stainless steel springs, stems, and seats.

5. Vibration isolators: Unit shall include vibration isolators, Champion No. VI (one set per compressor)
6. Low level oil monitor shall shut down the unit when oil levels are below an adequate level and prevents the unit from restarting if oil levels are not at an adequate level, Champion No. LOLM (one each per compressor)

E. Controls:

1. Pressure switch to cutout at 100 PSI with minimum differential of 20 PSI.

F. Utility Requirements:

1. Electrical:

a.

Connection Requirements	Unit
Voltage	460
Phase	3
HP	20
Amps	20

G. Finish: Durable enamel in manufacturer's standard color

2.2 DRYER, AIR, REFRIGERATED, 100 CFM
Equipment Identifier: 2228

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a. Champion
b. Princeton, IL (815) 875-3321
c. CRN100 with Option F

d. Reference Detail on Service Equipment Layout Drawing Sheet QS501

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Ingersoll Rand, Davidson, NC (704) 896-4000
b. Quincy Compressor, Quincy, IL (217) 222-7000

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	29	20	38

2. Capacity:

a. 38 degrees F: 100 CFM

3. Drain connection: 1 inch NPT(F)
4. Air connection: 1 inch NPT(M)
5. Maximum working pressure: 232 PSIG (Level 2 controller standard)
6. Weight: 251 pounds

C. Features/Performance/Construction:

1. Provide refrigerated air dryer of self-contained mechanical refrigeration type complete with heat exchanger, refrigeration compressor, moisture removal trap, internal wiring and piping, and full refrigerant charge.
2. Provide air inlet and outlet connections at same level and factory insulated.

3. Heat exchangers to consist of air-to-air and refrigerant-to-air coils. Provide centrifugal type moisture separator located at discharge of heat exchanger. Provide heat exchangers with automatic control system to bypass refrigeration system on low or no load condition.
4. Refrigeration unit of hermetically sealed type to operate continuously to maintain specified 38 degree F dew point. House unit in steel cabinet provided with access door and panel for maintenance and inspection.
5. Panel mounted gauges: Provide air inlet temperature gauge, air outlet pressure gauge, refrigerant suction pressure and refrigerant head pressure.
6. Provide high temperature alarm with dry contacts.
7. Coalescing oil filter: Provide Grade E cold coalescing oil removal filter. Oil filter shall extract oils and aerosols from supply air stream down to 0.008 PPM and solids down to 0.01 microns. Dedicated drain trap shall be provided. Unit shall include internal automatic drain.
8. Particulate filter: Provide air line filter capable of filtering particulates down to 1 micron and 1 PPM. Unit shall include internal automatic drain
9. Provide maintenance kit with separator element, drain, drain tube, hose fastener, wave spring, head O-ring, lube packet, and service reminder detail.
10. Provide coalescing maintenance kit with filter elements, electric drain rebuild kit, drain tube, hose fastener, head O-rings, lube packet, and service reminder decal.
11. Provide seismic bracing and anchorage to meet any local, state, and national codes and provisions.

D. Controls:

1. I-Controller Level 1: Provide controls with On/Off switch, power-on light, pneumatic, pilot operated drain trap.

E. Utility Requirements:

1. Electrical:

a. Connection Requirements

	Unit
Voltage	120
Phase	1
Amps	10.2

F. Finish: Durable enamel in manufacturer’s standard color

2.3 PUMP, AIR PISTON (CG), WITH HOIST
Equipment Identifier: 7510

A. Manufacturer’s Reference:

1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standard of quality, performance, features and construction.

a. Graco, Incorporated b. Minneapolis, MN (612) 623-6000 c. Model No.: 226018

d. Reference Detail on Service Equipment Drawing Layout Sheet QS501

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Balcrank Corporation, Inc., Weaverville, NC (828) 645-4261 b. Lincoln Industrial Corporation, St. Louis, MO (314) 679-4200

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	24	30	56

2. Products: Chassis grease (CG)
3. Maximum fluid pressure: 4,000 PSI
4. Air motor diameter: 4-1/4 inches
5. Operating range: 40 to 80 PSI
6. Maximum continuous duty flow rate: 3.35 pounds per minute
7. Material outlet: 3/8 inch NPT(F)
8. Material inlet: Slotted

C. Features/Performance/Construction:

1. Provide pneumatic operated piston pump operable with maximum air pressure of 150 PSI.
2. Provide complete assembly with the following standard compressed air line accessories:

   a. Combination air filter-regulator, 3/4 inch: Graco No. 246948
   b. Bleed type air shut-off valve to relieve air trapped between air motor and valve.
   c. Lubricator, 3/4 inch NPT
   d. Air and product valves
   e. Provide compressed air runaway valve before product fluid pump to eliminate unregulated fluid flow in the event of a product pipe break.

3. Air motor shall be a non-corrosive design with no metal-to-metal contact compatible with product being delivered.
4. Provide base, inductor plate, elevator, and carriage support system for chassis grease.

5. Provide connection from pump back to product tank for proper drain back of fluid in piping riser line and pump.
6. Provide complete assembly complete with the following standard fluid line accessories:

   a. Hose and fitting kit suitable for product
   b. Fluid drain valve to assist in relieving fluid pressure in the pump, hoses, and dispensing valve
   c. Pump grounding wires to reduce the risk of static sparking

D. Utility Requirements:

1. Plumbing:

   a. Compressed Air:

Connection (inches)	1/2
Volume (CFM)	19
Capacity (PSI)	120

2.4 PUMP, AIR PISTON 10:1 RATIO (GO)
Equipment Identifier: 7520

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standard of quality, performance, features and construction.

a. Graco, Inc.
b. Minneapolis, MN (800) 533-9655
c. Model No.: 425 Fire-Ball

d. Reference Detail Service Equipment Layout Drawing Sheet QS501

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Balcrank Corporation, Inc., Weaverville, NC (828) 645-4261
b. Lincoln Industrial Corporation St. Louis, MO (314) 679-4200

B. Capacities/Dimensions:

1. Overall pump dimensions:

Dimensions (inches)		
	Length	Height
a. Equipment	6 dia.	12

2. Products: Gear Oil (GO)
3. Maximum fluid pressure: 1,800 PSI
4. Air motor diameter: 4-1/4 inches
5. Operating range: 40 to 180 PSI
6. Continuous duty flow rate at 100 PSI: 4 GPM
7. Air consumption at 100 PSI: 32 CFM
8. Air inlet: 1/2 inch NPT (F)
9. Fluid outlet: 3/4 inch NPT(F)
10. Fluid inlet: 1-1/2 inch NPT(F)

C. Features/Performance/Construction:

1. Provide pneumatic operated piston pump operable within the pressure range of 40 PSI to 180 PSI.
2. Air motor shall be a non-corrosive design with no metal-to-metal contact compatible with product being delivered.
3. Provide with complete and operable assembly for connection to both compressed air and lube system including the following:

   a. Lube system components:

      1) Provide adapters for mounting on storage tanks.
      2) Provide product valves compatible with product being delivered.
      3) Provide hose and fitting kit suitable for product being delivered.
      4) Provide thermal relief valves for the pumping system. Provide connection from pump back to product tank for proper drain back of fluid in piping riser line and pump
      5) Provide suction tube properly sized for tank of product being delivered.
      6) Provide lower level cut-off valve.

   b. Compressed air components:

      1) Provide combination air filter, regulator and pressure gauge, 3/4 inch NPT.
      2) Provide air lubricator, 3/4 inch NPT.
      3) Provide hose and fitting kit for air connection to the pump.
      4) Provide compressed air runaway valve before product fluid pump to eliminate unregulated fluid flow in the event of a product pipe break.
      5) Provide air valves as required.

D. Utility Requirements:

1. Plumbing:

a. Compressed Air:

Connection (inches)	1/2 NPT(F)
Volume (CFM)	32
Capacity (PSI)	100

2.5 PUMP, DIAPHRAGM, USED FLUID EVACUATION (UO)
Equipment Identifier: 7540

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standards of quality, performance, features and construction.

a. Graco, Inc.
b. Minneapolis, MN (800) 533-9655
c. Model No.: 647016 with accessories

d. Reference Detail on Service Equipment Layout Sheet QS500

2. Alternate manufacturers: *Contingent upon compliance with these specification* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Balcrank Corp., Weaverville, NC (828) 645-4261
b. Lincoln Industrial, St. Louis, MO (314) 679-4200

B. Capacities/Dimensions:

1. Products: Used oil
2. Pump ratio: 1:1
3. Maximum air pressure: 120 PSI
4. Maximum fluid outlet pressure: 100 PSI
5. Free flow rate: 50 GPM
6. Continuous duty delivery: 2.4 GPM
7. Air inlet: 1/2 inch NPT(F)
8. Fluid outlet: 1 inch NPT(M)
9. Fluid inlet: 1 inch NPT(M)

C. Features/Performance/Construction:

1. Provide 120 PSI air pressure for diaphragm pump size and capacity as scheduled.

2. Pump shall be provided in complete assembly, including the following:

   a. Wall bracket accessory kit, Graco Model No. 24C637
   b. Filter/regulator assembly: 1/2 inch NPT(f), Graco Model No. 246947 and appropriate fittings and hoses for a complete and operable installation
   c. Fluid installation kit, Graco Model No. 240685, includes swivel union, 4 foot coupled fluid hose, short nipple, y-strainer, 10 foot coupled fluid hose, ball valve, elbow, and nipple
   d. Drum adapter kit, Graco Model No. 240832, includes elbow, nipple, valve, male and female camlock couplers
   e. Grounding wire and clamp, Graco Model No. 238909
   f. Quick connect air coupler, 1/2 inch NPT, Graco Model No. 110199
   g. Quick connect air nipple, 1/2 inch NPT, Graco Model No. 110196
   h. Air muffler, Graco Model No. 112182
   i. Provide label "USED OIL" on pump to identify product (minimum 1 inch lettering)

3. Materials: Compatible with product being delivered.
4. Pump shall handle oil, hydraulic oil, automatic transmission fluid, anti-freeze, windshield washer fluid, water, or fuel.
5. Pump shall have a tank monitoring system that shuts off the pump via solenoid valve when the used fluid tank is full.

   a. Monitoring system shall notify users with a strobe light and an audible alarm system.

      1) Manufacturer: BJ Enterprises, (800) 457-0749
      2) Tank monitoring system: BJE Model No. 007575 (one each per tank), with remote strobe light, one each per pump
      3) Solenoid valve: BJE Model No. 007SV-7580, one each per pump

   b. Audible alarm shall be a minimum of 250 milliamps.

D. Accessories:

1. Hose filter: Banjo Corp. No. LST100-16 (one each per unit)

E. Utility Requirements:

1. Electrical:	
a. Connection Requirements	Solenoid Valve
Voltage	120
Phase	1
Amps	2
2. Plumbing:	
a. Compressed Air:	Unit
Connection (inches)	1/2
Volume (CFM)	67
Capacity (PSI)	120

2.6 REEL BANKS, GENERAL
Equipment Identifier: 7700

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified by manufacturer's name and model to establish acceptable standards of quality, performance, features and construction.

a.	Graco, Inc.
b.	Minneapolis, MN (612) 623-6000
c.	Model No.: XD Series

2. Alternate manufacturers: *Contingent upon compliance with these specification* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may be* considered as equal.

a.	Lincoln Industrial Corporation, St. Louis, MO (314) 679-4200
b.	Balcrank Corporation, Weaverville, NC (828) 645-4261

B. General Description: High performance, heavy duty hose reels. Reels are available for the following products:

1. Compressed air (CA): Graco No. HSL56B
2. Chassis grease (CG): Graco No. HSH55B
3. Gear oil (GO): Graco No. HSM65B

C. Capacities/Dimensions:

1. Overall reel dimensions, XD20 series (CA, CG, GO) nominal:

    a. Length: 20 inches
    b. Width: 7-1/2 inches
    c. Height: 25-1/2 inches

2. Reel fluid inlet:

    a. CA: 1/2 inch NPT(M)
    b. CG: 3/8 inch NPT(M)
    c. GO: 1/2 inch NPT (M)

3. Hose:

    a. CA:

        1) Length: 65 feet
        2) Inside diameter: 3/8 inch
        3) Working pressure: 180 PSI

    b. CG:

        1) Length: 50 feet
        2) Inside diameter: 3/8 inch
        3) Working pressure: 4,000 PSI

    c. GO:

        1) Length: 50 feet
        2) Inside diameter: 1/2 inch
        3) Working pressure: 1,500 PSI

D. Features/Performance/Construction:

1. Reels:

    a. Construction: Frames, discs, and drum shall be fabricated of heavy gauge steel.
    b. Double pedestal arm: Reel frame shall have double pedestal arms that are welded and gusseted.
    c. Hose guide arm: Reel hose guide arm shall be adjustable with nylon rollers on all four sides of roller assembly at hose opening.
    d. Rewind mechanism: Reel spring shall be enclosed and fastened to reel drum with a reinforcing clip.
    e. Bearings and ratchet latch: Reel shall have permanently lubricated bearings and extra-large ratchet latch with audible hose position lock.

2. Ball stop: Adjustment of hose extension length shall be permitted by ball stop:

    a. 3/8 inch hose, Graco No. 218341, (one per hose reel) (CA, CG)
    b. 1/2 inch hose, Graco No. 218341, (one per hose reel) (GO)

3. Hose covers and tubes: Chassis grease hose shall have Buna-N tube and Buna-N PVC cover. All other commodity hoses shall have Buna N nitrile tube with nitrile PVC cover.

4. Delivery kits: Each commodity hose shall be fitted with the dispensing control as listed.

   a. CA: Quick disconnect air coupler with necessary adapter fitting, Industrial Interchange Series 3/8 inch female
   b. CG: High pressure control valve with knurled grip body, 1/4 inch, Graco No. 242056 with taper nose coupler and extension; "Z" swivel, Graco No. 202577
   c. GO: Electronic in-line style english metered totalizing dispenser set to dispense(up to 5 GPM) in pints to 0.01 increments, Graco No. 255352

5. Inlet hose kit: Each commodity reel shall be fitted with the inlet hose kit as listed.

   a. CA: 1/2 inch ID by 24 inches, medium pressure hose and fittings, rated for 2,000 PSI, Graco No. 218549, (one each)
   b. CG: 3/8 inch ID by 24 inches, high pressure hose and fittings, rated for 4,000 PSI, Graco No. 218550, (one each)
   c. GO: 1/2 inch ID by 24 inches, medium pressure hose and fittings, rated for 2,000 PSI, Graco No. 218549, (one each)

6. Mounting bracket: Graco No. 204741, one per three reels
7. Identification labels: Each commodity reel shall have a 3/4 by 4-1/4 inch metal identification label indicating the commodity, attached adjacent to each hose guide arm roller assembly. Label kits including label and mounting hardware as listed for each commodity.

   a. CA: Graco No. 218675
   b. CG: Graco No. 218671
   c. GO: Similar to Graco No. 218672

8. Mounting channel supply as required for specific reel bank:

   a. One reel: Graco No. 24A219
   b. Three reels: Graco No. 24A221

E. Utility Requirements: Contractor shall provide process piping from product pumps to point of connection for each reel specified herein. Contractor shall provide compressed air piping from main compressed air loop to point of connection for hose reel specified herein.

F. Finish: Durable enamel in manufacturer's standard color

2.7 REEL BANK (CA)
Equipment Identifier: 7710

A. Reel bank shall consist of one each (CA) reel as delineated in part 2.06 REEL BANKS, GENERAL of this specification section.

B. Reference Detail on Service Equipment Layout Drawing Sheet QS501.

2.8 REEL BANK (CA, CG, GO)
Equipment Identifier: 7730

A. Reel bank shall consist of one each (CA) reel, one each (CG) reel, and one each (GO) reel as delineated in part 2.06 REEL BANKS, GENERAL of this specification section.

B. Reference Detail on Service Equipment Layout Drawing Sheet QS500.

2.9 TANK, DOUBLE WALL, CUBE, 280 GALLON (GO, UO)
Equipment Identifier: 7960

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimum acceptable standards of quality, features, performance, and construction.

a.	Containment Solutions, Incorporated
b.	Conroe, TX (936) 756-7731
c.	Model No.: LC280DW with accessories

d. Reference Detail on Service Equipment Layout Drawing Sheet QS500 (WO) and QS501.

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a.	Dynafab Corp., Tomball, TX (281) 590-5467
b.	Highland Tanks and Manufacturing, Stoystown, PA (814) 893-5701

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	58	34	49

2. Capacity: 280 gallons
3. Dry weight: 850 pounds

C. Features/Performance/Construction:

1. Above ground used oil collection and fluid storage systems shall be constructed in accordance with national, state, and locally recognized *Above Ground Storage Tank* standards, including: Uniform Fire Code, Article 79, National Fire Protection Association Sections 30, 30A, and 31, and Underwriters Laboratory Standard 142.
2. The components of the system shall be assembled and tested at the factory and shall be covered under warranty.
3. The above ground double wall tank shall be designed and UL listed as an atmospheric tank with a maximum working pressure of one PSI.
4. The primary and secondary storage tanks shall have passed a proof of design hydrostatic pressure test of 25 PSI.
5. The above ground double wall tank shall be equipped with nine NPT openings including two for primary and secondary emergency venting as required by UL-142.
6. Primary tank enclosure:

    a. Primary storage tank shall be rectangular in design and constructed with ASTM A-569 or A-36 carbon steel with continuous welds. Tank shall be equipped with lifting lugs.
    b. Primary storage tank shall be constructed and pressure tested (minimum 3 PSI) in accordance with UL-142 standards and carry the appropriate marking.
    c. Tank enclosure shall be supported by two 3-inch high steel support feet channels with internal anchoring holes to maintain ground clearance.

7. Secondary tank enclosure:

    a. Secondary storage tank shall be a rectangular design constructed with ASTM A-569 or A-36 carbon steel with continuous welds and listed by Underwriters Laboratories as secondary containment.
    b. Secondary enclosure shall provide a minimum of 110 percent secondary containment.
    c. Secondary enclosure shall be equipped with a 2 inch monitoring port and a 4 or 6 or 8 inch emergency vent port as required by Underwriters Laboratories.
    d. Secondary storage tank shall be constructed and pressure tested (minimum 3 to 5 PSI) in accordance with UL-142 standards and carry the appropriate marking.

8. Installation of tank shall include seismic bracing and anchoring to meet all local, state, and federal codes and provisions.
9. Double float tank gauge that is calibrated by gallons or inches (Scully or equal).
10. Venting:

    a. Primary: 4 inch NPT(M) (Morrison Brothers or equal)
    b. Secondary: 6 inch NPT(M) (Morrison Brothers or equal)

11. Spill box, 7 gallon, welded to tank

D. Accessories:

1. For UO/UC: Tank monitoring system with high level detection and alarm siren: BJ Enterprises, (800) 457-0749, Model No. 007 Audible and Visual Tank Gauge, one per sstem 2. Remote overfill guard tank sensor (one per tank)

E. Utility Requirements:

1. Electrical:

a. Connection Requirements

	Tank Monitor
Voltage	120
Phase	1
Amps	2

F. Finish: Durable enamel in manufacturer's standard color

2.10 RECEIVER, USED OIL, 25 GALLON
Equipment Identifier: 7999

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a. Graco, Inc. b. Minneapolis, MN (800) 533-9655 c. Model No.: 238866

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Balcrank Corporation, Weaverville, NC (828) 645-4261 b. Lincoln (A Pentair Company), St. Louis, MO (314) 679-4200

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	24	24	45

2. Fluid inlet/inspection port size: 3 inch (76 millimeter) buttress
3. Fluid outlet fitting size: 3/4 inch NPT
4. Collection funnel size: 22 by 24 inches
5. Capacity: 25 gallons

C. Features/Performance/Construction:

1. Unit shall be constructed of heavy duty, durable UV-stabilized polymer.
2. Unit shall include a gravity feed drain valve and a quick disconnect method of suction-evacuation from the top of the unit.
3. Unit shall be mounted on semi-pneumatic, synthetic rubber wheels and polyurethane front casters.
4. Unit shall contain a funnel assembly capable of extending to 72 inches.
5. Unit shall be dent, rust, and corrosion resistant.
6. Unit shall be capable of handling oil at temperatures of below 31 degrees F to above 219 degrees F.
7. Tank shall be equipped with tool holders and a sight gauge.
8. Tank shall be equipped with a removable filter to prevent debris from entering the tank.

D. Finish: UV-stabilized polymer complete with necessary markings to readily identify contents

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.

3.2 INSTALLATION

A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.

B. Install equipment in accordance with plans, shop drawings, and manufacturer’s instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.

2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
3. Anchorage: Attach equipment as detailed or directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.
4. Air compressor and dryer system:

    a. Install compressor unit on concrete foundation with sole plates and isolators. Level, grout, and bolt in place.
    b. Make air cock and drain connection on horizontal casing.
    c. Install line size ball valve and anti-return valve on compressor discharge.
    d. Install replaceable cartridge type filter silencer of adequate capacity for each compressor.
    e. Install condensate filter between compressor and dryer
    f. Connect condensate drains to nearest floor drain.
    g. Install valved bypass around air dryer. Factory insulate inlet and outlet connections.
    h. Install takeoffs to outlets from top of main with shutoff valve after takeoff.

5. Fluid storage tanks:

    a. Tank shall be seismically braced and anchored to meet all local, state, and federal codes and provisions.
    b. Used oil tank shall be vented to the outside of the building.
    c. Remove support feet channels prior to final installation.

C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

3.4 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing and installation debris from job site.

D. Notify Architect or designated representative for final observation (punch list).

3.5 TRAINING

A. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. 2161 Compressor, air, receiver mounted, 10 HP duplex; 1 hour (minimum)
2. 2228 Dryer, air, refrigerated, 100 CFM; 1 hour (minimum)
3. 7510 Pump, air piston (CG), with hoist; 1 hour (minimum)
4. 7520 Pump, air piston, 10:1 ratio (GO); 1 hour (minimum)
5. 7540 Pump, diaphragm, used fluid evacuation (UO) ; 1 hour (minimum)
6. 7700 Reel banks, general; 2 hours (minimum)
7. 7960 Tank, double wall, cube, 280 gallons (GO, UO) ; 1 hour (minimum)
8. 7999 Receiver, used oil, 25 gallons; 1 hour (minimum)

B. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

END OF SECTION 11 11 00

SECTION 11 11 29 - SHOP EQUIPMENT

PART 1 - GENERAL

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

1.1 WORK INCLUDED

A. Equipment items as listed below by Equipment Identifier:

1. 2090 Buffer/grinder, 10 inches, with dust collector (Ref. Part 2.1)
2. 2220 Drill press, variable speed, 20 inch (Ref. Part 2.2)
3. 2600 Press, electric/hydraulic, 100 ton (Ref. Part 2.3)
4. 2832 Vise, combination, swivel base, 5 inches (Ref. Part 2.4)
5. 2880 Vise, electronics, swivel base (Ref. Part 2.5)
6. 3085 Cabinet, abrasive blast, with dust collector (Ref. Part 2.6)
7. 3540 Tank, parts cleaning (Ref. Part 2.7)
8. 3718 Washer, high pressure, hot water, NG, 4 GPM (Ref. Part 2.8)
9. 3810 Washer, walk-around, vehicle (Ref. Part 2.9)
10. 5404 Forklift, electric, 4,000 pound (Ref. Part 2.10)

B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

C. Piping, wiring, and switching between equipment and utilities.

1.2 QUALITY ASSURANCE

A. Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.

B. Manufacturer’s Representative:

1. Installation: Provide a qualified manufacturer’s representative at site to supervise work related to equipment installation, check out, and start up.
2. Training: Provide technical representative to provide training to Owner’s maintenance personnel in operation and maintenance of specified equipment.

1.3 Buy America Compliance

A. The Contractor shall comply with the applicable Buy America requirements set forth in 49 U.S.C. 5323(j) and the applicable regulations in 49 C.F.R. Part 661, as amended. If the Contractor procures any capital items with Federal funds, it is the Contractor’s responsibility to obtain the Buy America certification required under such regulations.

B. Reference Division 1 for Buy America compliance.

1.4 SUBMITTALS

A. Product Data:

1. Submit Product Data in accordance with Division 1 - General Requirements of these specifications.
2. Restrict submitted material to pertinent data. For instance, do not include manufacturer's complete catalog when pertinent information is contained on a single page.

B.

1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
3. Description of system and components.
4. Schematic diagrams of electrical, plumbing, and compressed air system.
5. Manufacturer's printed operating instructions.
6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.

C. Shop Drawings:

1. Submit Shop Drawings in accordance with of Division 1 - General Requirements of these specifications.
2. Submit site specific installation drawings and procedures.

1.5 PRODUCT SUBSTITUTIONS

A. Follow requirements specified in Division 1 - General Requirements.

B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.

C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

1.6 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish.

D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.

E. All parts shall be readily available locally in the United States.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.

C. Provide equipment and materials specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

1.8 LABELING

A. Manufacturer shall securely attach in a prominent location, on each major item of equipment, a non-corrosive nameplate showing manufacturer's name, address, model number, serial number, and pertinent utility or operating data.

B. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (UL) in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

PART 2 - PRODUCTS

2.1 BUFFER/GRINDER, 10 INCHES, WITH DUST COLLECTOR
Equipment Identifier: 2090

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a.	Cincinnati Electrical Tools
b.	Cleves, OH (513) 353-3662
c.	Model No.: 602-201

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Delta Machinery, Inc., Jackson, TN (800) 223-7278 b. Baldor, Fort Smith, AR (479) 646-4711

B. Capacities/Dimensions:

1. Overall dimensions (nominal):

Dimensions (inches)			
	Length	Width	Height
a. Equipment	32	27	70

2. Wheel:

   a. Diameter: 10 inches
   b. ess: 1-1/4 inch
   c. Bore: 7/8 inch

3. Weight: 660 pounds
4. Distance between wheels: 17-5/8 inches
5. Height to center of spindle: 40-3/8 inches
6. Motor: 1 HP, 1,800 RPM

C. Features/Performance/Construction:

1. Motor shall be totally enclosed, direct drive motor rated for continuous service, with permanently lubricated ball bearings.
2. Wheel shall consist of one medium grit wheel, 10 by 1-1/3 by 7/8 inch and one general purpose wire wheel, 10 by 1-1/4 by 7/8 inch.
3. Wheel guards shall be adjustable for wheel wear and shall include adjustable work rests and spark breakers.
4. Light bulbs associated with illuminated eye shields shall be controlled by push button magnetic starter for buffer/grinder.
5. Quenching pot shall be mounted on pedestal that supports grinder.
6. Dust collector shall be enclosed with fan and motor in clean air chamber. External bag type dust collectors are not acceptable.
7. Eye shields, Cincinnati No. 000-133, shall be an illuminated set of two per grinder.
8. Starter: Cincinnati No. 000-533

D. Controls: Push button magnetic starter, Cincinnati No. 000-533 shall have “On/Off” push button switch; motor thermal overload and under voltage protection.

E. Utility Requirements:

1. Electrical:	
a. Connection Requirements	Unit
Voltage	460
Phase	3
HP	1

F. Finish: Durable enamel in manufacturer's standard color

2.2 DRILL PRESS, VARIABLE SPEED, 20 INCH
Equipment Identifier: 2220

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

a.	Clausing Industrial
b.	Kalamazoo, MI (800) 323-0972
c.	Model No.: 2277 with accessories

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a.	WMH Tool/Wilton, La Vergne, TN (615) 793-8900
b.	Dake Machine, Grand Haven, MI (800) 937-3253

B. Capacities/Dimensions:

1. Overall dimensions, nominal:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	22	36	69

2. Working dimensions:

a. Chuck to table: 33 inches
b. Chuck to base: 43 inches

3. Table working surface:

    a. Width: 22 inches
    b. Depth: 19-1/2 inches
    c. Tilt range: 90 degrees to left and right

4. Base working surface:

    a. Width: 15-1/2 inches
    b. Depth: 13 inches

5. Motor: 1.5 HP
6. Speed: 150 to 2,000 RPM
7. Capacities:

    a. Spindle: 3MT, 1.74 inches
    b. Spindle travel: 6-1/2 inches
    c. Drill to center of circle: 20 inch diameter
    d. Hand feed: 1.25 inch diameter
    e. Column: Ground steel, 4 inches diameter and 1/2 inch wall thickness

C. Features/Performance/Construction:

1. Speed control shall permit positive speed changing while machine is running and hold speed setting constant under all load conditions.
2. Belt drive shall remain aligned and automatically maintain full power transmission to spindle at all times.
3. Work table shall have slots, side ledges, and machined front apron with mounting holes shall be provided for clamping of work with mounting holes.
4. Tilt table shall have scale to provide accurate readings to 90 degrees right and left with index pin at level and 45 degrees left and right positions.
5. Table lock shall have expanding bushing to provide rigid positioning of tables at any angle.
6. Hand gear crank shall be provided for table adjustment.
7. Safety features shall include self-ejecting chuck key and completely enclosed drive belt and pulleys.
8. Motor shall be totally enclosed fan-cooled (TEFC):

D. Controls:

1. Push-button switch shall include shrouded START button and protruding STOP button. Switches and other electrical controls shall meet applicable National Electrical Code requirements.
2. Depth control shall be self-locking adjustable feed depth stop.
3. Function controls shall provide manual speed selection and feed via knobbed spoked wheels.

E. Accessories:

1. Chuck: Clausing No. 1897
2. Arbor adapter: Clausing No. 1898

F. Utility Requirements:

1. Electrical:	
a. Connection Requirements	Unit
Voltage	460
Phase	3
HP	1-1/2

2.3 PRESS, ELECTRIC/HYDRAULIC, 100 TON
Equipment Identifier: 2600

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

a. OTC-Bosch
b. Warren, MI (800) 533-6127
c. Model No.: 1854

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Nugier Industries, Gardena, CA (310) 515-6025
b. Dake, Grand Haven, MI (616) 842-7110

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	55-1/2	28	96

2. Press:

   a. Capacity: 100 tons
   b. Inside width: 35 inches
   c. Width between table rails: 6-3/8 inches
   d. Maximum vertical clearance: 49-5/8 inches
   e. Ram travel: 10 inches
   f. Table spacing increments: 8 inches

3. Electric/hydraulic pump:

   a. Overall dimensions:

      1) Width: 11-3/8 inches
      2) Depth: 9-1/4 inches
      3) Height: 18-1/2 inches

   b. Reservoir capacity: 1.9 gallons
   c. Oil Delivery: 17 cubic inches per minute at 10,000 PSI
   d. Speed: 42 seconds (fully extended a 10-ton ram with 10 inch stroke)
   e. Maximum operating pressure: 10,000 PSI

C. Features/Performance/Construction:

1. Head and bed rails shall be constructed of channel steel with channel ends and corners cut and ground.
2. Pump shall be two-stage electric hydraulic-type with 2-position/2-way manual valve and 6 foot remote control cord.
3. Table shall be vertically adjustable with self-locking winch mounted inside of frame.
4. Gauge shall be large dial-type, mounted on work head isolated from mechanical shock.
5. Hydraulic hose shall be a braid type, light weight and rugged hose capable of 10,000 PSI operating pressure

D. Utility Requirements:

1. Electrical:

   a.

Connection Requirements	Unit
Voltage	120
Phase	1
Amps	11

E. Finish: Durable enamel in manufacturer's standard color

2.4 VISE, COMBINATION, SWIVEL BASE, 5 INCHES
Equipment Identifier: 2832

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a.	WMH Tool Group/Wilton
b.	LaVergne, TN (615) 793-8900
c.	Model No.: 1755

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a.	Ridgid Tool Co., Elyria, OH (800) 474-3443
b.	Milwaukee Tool, Brookfield, WI (414) 645-0200

B. Capacities/Dimensions:

1. Overall dimensions, nominal:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	18	9	10

2. Weight: 51.5 pounds
3. Jaw width: 5-1/2 inches
4. Jaw opening: 5 inches
5. Throat depth: 3-3/4 inches
6. Pipe capacity: 1/4 to 3 inches

C. Features/Performance/Construction:

1. Base shall swivel 360 degrees and have locking device.
2. Construction shall be ductile-steel cast body and with a tensile strength of 60,000 PSI.
3. Jaws shall have replaceable facings.

2.5 VISE, ELECTRONICS, SWIVEL BASE
Equipment Identifier: 2880

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a.	Panavise
b.	Reno, NV (775) 850-2900
c.	Model No.: 350

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers *may* be considered as equal.

B. Capacities/Dimensions:

1. Overall dimensions, nominal:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	12	12	8

2. Weight : 5 pounds
3. Jaw opening: 9 inches
4. Throat depth: 1-7/8 inches

C. Features/Performance/Construction:

1. Slide bar shall be machined steel and move smoothly and precisely.
2. Base shall have 360 degree swivel base, tilting capabilities and have a locking device.
3. Base shall be capable of bolting to a workbench.
4. Jaws shall have replaceable anti-static facings capable of holding odd shaped objects gently

2.6 CABINET, ABRASIVE BLAST, WITH DUST COLLECTOR
Equipment Identifier: 3085

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

a.	Trinity Tool Company
b.	Fraser, MI (586) 296-5900
c.	Model No.: Master 36/BP

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a.	Larry Hess and Associates, Salisbury, NC (704) 637-3300
b.	Wheelabrator Technologies Inc., Hampton, NH (800) 682-0026

B. Capacities/Dimensions:

1. Cabinet:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	65	25	64

b. Side door: 17 by 11 inches
c. Flip up top: 36 by 13 inches
d. Viewing window: 12 by 24 inches

2. Dust collector:

a. Motor: 1-1/3 HP, 1,700 RPM
b. Vacuum rating: 100 CFM
c. Abrasive capacity: 2 gallons, minimum
d. Dimensions:

1) Diameter: 15 inches
2) Height: 54 inches

e. Weight: 300 pounds

C. Features/Performance/Construction:

1. Media type: Unit shall utilize glass bead and sand for dry blast media.
2. Cabinet: Blast cabinet shall be fabricated of 14 gauge welded steel.
3. Gloves: Heavyweight rubber gloves shall be attached to 8 inch armhole ports, two each.
4. Viewing window: Safety glass window shall be easily removable by loosening window frames.
5. Lighting: Interior cabinet lighting shall be provided with fluorescent tubes.
6. Air system: Unit shall be equipped with air pressure regulator and gauge.

7. Doors:

   a. Flip up top: Unit shall provide one flip up top door.
   b. Side: Unit shall provide one side door.

8. Dust collector:

   a. Construction: Dust collector shall be fabricated of 14 gauge steel.
   b. Motor: Unit shall be equipped with motor and impeller on clean air side.
   c. Filter bags: Unit shall utilize filter bags with 8 square feet of total surface area.

9. Orifice: Standard equipment for suction feed type media gun shall include a 5/16 inch ID orifice.
10. Blow off: Unit shall be provided with a pushbutton controlled valve at the media gun.
11. Nozzle: Nozzle and air jet shall be tungsten carbide.
12. Nozzle mount bracket: Unit shall be provided with bracket for nozzle.
13. Foot valve: Blasting control shall be provided by spring actuated three-way air foot valve.
14. Floor: Unit shall be equipped with 1/8 inch expanded steel recessed floor with a carbon screen cover.
15. Filter bags: Trinco No. 2-000-30 (six each)
16. Nozzle, 5/16: Trinco No. 2-000-71 (one each)
17. Blow-off: Trinco No. 2-00-555 (one each)
18. Nozzle mounting bracket: Trinco No. 4-000-42 (one each)
19. Air connection shall be 3/8 inch female connection to regulator.

D. Controls: ON/OFF toggle switch for lighting and dust collector. Electrical controls and switching shall meet all National Electrical Code requirements.

E. Utility Requirements:

1. Electrical:

   a. Connection Requirements — Unit

Voltage	120
Phase	1
Amps	9

2. Plumbing:

   a. Compressed Air:

Connection (inches)	3/8
Volume (CFM)	30
Capacity (PSI)	85

F. Finish: Durable enamel in manufacturer's standard color

2.7 TANK, PARTS CLEANING
Equipment Identifier: 3540

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish acceptable standards of quality, performance, features, and construction.

a.	Graymills
b.	Chicago, IL (773) 248-6825
c.	Model No.: PL36-A with accessories

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, may be considered as equal.

a.	Peterson Machine Tool, Council Grove, KS (800) 255-6308
b.	Kwik-way Manufacturing Co., Marion, IA (319) 377-9421

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	36	22	60

2. Tank shelf area:

a. Width: 29-1/2 inches
b. Depth: 22 inches

3. Fluid capacity: 20 gallons, maximum

C. Features/Performance/Construction:

1. Motor shall be variable speed air operated pump motor with screened intake
2. Flush hose shall be flexible metal with stream nozzle.
3. Workshelf shall be sloped and removable.
4. Filtration: Sludge collector and filter tray assembly easily removed for cleaning.
5. Safety: Spring loaded fusible link safety cover automatically closes at 165 degrees F.
6. Construction shall be of 16 gauge steel front, side, bottom, and rear panels.
7. Tank shall have a bottom drain for cleaning.

D. Accessories:

1. Sludge collector: Graymills No. 432-36376 (one each)
2. Drain shelf: Graymills No. L-61 (one each)

E. Utility Requirements:

1. Electrical:

a. Connection Requirements Unit

Voltage	120
Phase	1
HP	1/5
Amps	1.4

F. Finish: Durable enamel in manufacturer's standard color

2.8 WASHER, HIGH PRESSURE, HOT WATER, NG, 4 GPM
Equipment Identifier: 3718

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimum acceptable standards of quality, features, performance, and construction.

a. Hotsy Corporation
b. Camas, WA (360) 834-0983
c. Model No.: 945N with accessories

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Landa, Inc., Camas, WA (360) 833-9100
b. Alkota Cleaning Systems, Inc., Alcester, SD (800) 255-6823

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	45	18	50

2. Net weight: 545 pounds

3. Pump motor: 460 VAC, 3 phase, 5 HP

4. Operating pressure: 2,000 PSI

5. Maximum discharge capacity: 4 GPM

C. Features/Performance/Construction:

1. Burner: NG fired, 365,000 BTU/hr minimum capacity, AGA-listed gas controls, ring type with aspirating spuds, natural draft.

2. All open flames and fire rings shall be mounted at minimum of 18 inches above the finished floor.

3. Heating coil: Vertically-fired; 7/8 inch OD, hydrostatic-pressure tested; 14,900 PSI burst-rated.

4. Water pump: Triplex water pump with positive displacement, ceramic plungers, brass manifold, and oil bath crankcase.

5. Fabrication: Welded angle iron frame shall have heavy gauge tank and cabinet.

6. Piping: Supplier shall provide 1/2 inch OD piping ASTM-A-312 Schedule 40 stainless steel piping with minimum internal burst pressure of 19,464 PSI. Provide ANSI/ASME B 31.3 stainless steel fittings with a minimum pressure rating of 7,750 PSI NPT(M) or 4,950 NPT(F). Provide piping from high-pressure wash unit to each trigger gun wand for a complete and operable system.

7. Manufacturer shall supply all necessary soap system equipment including piping, fittings, distribution hose, and connections for a complete and operable soap distribution system.

8. Shall have a time delay shut down.

D. Controls: Adjustable temperature controller, safety pressure relief valve, pressure switch, ON/OFF electric motor switch with overload protection, unloader, water heater switch, detergent valve and automatic, non-contaminating float valve.

E. Accessories:

1.	Contractor supplied scabbard for trigger gun, wall mounted, fabricated, one each per trigger gun location
2.	Scabbard: Hotsy No. 711135 (one each per hose reel)
3.	Trigger gun: Hotsy No. 87512140 (one each per hose reel)
4.	50 foot hose: Hotsy No. 87391210 (one each per hose reel)
5.	36 inch wand: Hotsy No. 87253890 (one each per hose reel)
6.	Nozzle (154, 4,000 PSI hardened steel): Hotsy No. 87087020 (one each per hose reel)
7.	Quick coupler: Hotsy No. 87071020 (one each per hose reel)
8.	360 rapid reel pivot reel: Hotsy No. 87504860 (one each per location shown on Equipment Drawing)
9.	Remote starter: Hotsy No.89169890 (one each per hose reel)
10.	Remote starter, additional: Hotsy No. 89030140
11.	Remote soap option: Hotsy No. 8916988 (one each per hose reel)
12.	Additional nozzles (four pack, 0, 15, 25, 45 degrees, color coded, QC nozzles): Hotsy No. 87087120 (one each per washer)
13.	360 ceiling boom: Zierco No. 204, 12 feet (one each)
14.	Draft diverter: Hotsy No. 87177280 (one each per washer)
15.	Breakthrough detergent, 55 gallons: Hotsy No. 89053900 (one each per washer)
16.	Powershine plus detergent, 55 gallons: Hotsy No. 89051800 (one each per washer)
17.	Contractor supplied replacement nozzle holder, wall mounted, fabricated, one each per trigger gun location

F. Utility Requirements:

1. Electrical:

a. Connection Requirements — Unit

Voltage	460
Phase	3
HP	5
Amps	8

b. Connection Type — Provide disconnect

2. Plumbing:

a. Domestic Water:

Connection (I.D. inches)	5/8
Flow Rate (GPM)	4
Capacity (PSI)	30

b. Natural Gas:

Connection (inches)	3/4
Capacity (BTU/Hr)	365,000

3. Mechanical:

a. Venting:

Connection (inches)	8

G. Finish: Durable enamel in manufacturer's standard color

2.9 WASHER, WALK-AROUND, VEHICLE
Equipment Identifier: 3810

G. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimum acceptable standards of quality, features, performance, and construction.

a. Bitimec b. Greenwich, CT (203) 637-1900 c. Model No.: 626-EZ with accessories

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Awash System Corp., Niagara Falls, NY (800) 265-7405

H. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	42	48	180

2. Weight:

   a. Empty: 1,188 pounds (approximately)
   b. Full: 2,112 pounds (approximately)

I. Features/Performance/Construction:

1. The unit base and frame shall be manufactured of stainless steel and be void of all corrosion prone materials. All painted (powder coated) surfaces shall also be stainless steel.
2. Drive System:

   a. Battery: Industrial set of four in-line 6V deep cycle tubular.
   b. Traction: 24V-DC motor operated drive wheel under base shall be centrally located and spring loaded for maximum operating ease, traction, and maneuverability.
   c. Brush: 1 KW (1.25 HP) 24 V electric DC Drive Motor

3. Brush Inclination (tilt) System:

   a. The unit shall be equipped with a ‘brush only’ inclination mechanism operated by 24 V motor on a stainless steel guide. Inclination shall be push button controlled from both operating sides and have extra precise, smooth travel.
   b. The unit shall be capable of continuous tilting throughout the entire wash cycle. When in a tilt position, the ‘brush only’ shall be tilted. The base and water shield must remain in the 90 degree upright position in order to guarantee stability and

avoid machine frame from approaching/hitting/damaging the vehicle being washed.

4. Brush:

   a. Brush fiber type: Diamond/star shaped, designed to channel water, to reduce friction, and eliminate scratching. Diameter shall be 0.8 millimeters (other available diameter are 0.5 millimeter or 1.2 millimeter)
   b. Brush fibers shall be feathered at the ends.
   c. Brush fiber assembly shall be on a corrosion-proof main shaft, riveted in replaceable segments maximum 12 inches high, in order to allow minimal replacement cost in case of partial damage.

5. Water tank: The unit shall be totally autonomous and shall include a water tank of roll-molded plastic, with a capacity of 110 gallons minimum.
6. Wheels: Caster wheels shall be extreme service grade (8 inch or 10 inch size as required). Wheel bearings shall be sealed and turntable bearings shall include greasing apparatus for long life and smooth operation.
7. Safety:

   a. Automatic hands free stopping when operator releases controls.
   b. Safety switches on brush, water pump, and detergent pump. Safety switches must include a release to be pushed for the switch to engage. Safety switches shall be able to be engaged with one single finger motion, but only deliberately.
   c. The unit shall automatically reduce travel speed by 50 percent when brush rotation or water pump are engaged.

8. Rinse: The unit shall have two sets of nozzles along the entire height of the brush, each capable of effecting a 180 degree spray pattern on vehicles.

J. Controls: There shall be dual operating controls affording operator full unobstructed visibility for working in two directions. All machine power functions shall be operable from either set of controls.

K. Accessories:

1. EZ Control for safe work in two directions (one each)
2. Auto shutoff float switch: Bitimec No. ALL11
3. Detergent application system with independent spray hose, ceramic tipped: Bitimec No. ALL12

L. Utility Requirements:

1. Electrical:	
a. Connection Requirements	Unit
Voltage	120
Phase	1
HP	1-1/4

M. Finish: Durable enamel in manufacturer's standard color

2.10 FORK LIFT, ELECTRIC, 4,000 POUND
Equipment Identifier: 5404

N. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a. Clark Material Handling Company
b. Lexington, KY (859) 422-6400
c. Model No.: NPX20 with accessories

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Hyster Company, Danville, IL (253) 561-7113
b. Mitsubishi Forklifts, Houston, TX (713) 365-1000

O. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	96	40	113

2. Turning radius: 66-1/2 inches
3. Rated capacity: 4,000 pounds
4. Mast dimensions/capacities:

a. 24 inch load center
b. Fork length: 48 inches
c. Maximum fork height: 258 inches

5. Weight: 6,940 pounds
6. Power: 24/36 volt

P. Features/Performance/Construction:

1. Unit shall contain a battery with 6 hour rate maximum.
2. Unit shall have urethane tires.
3. Unit shall have automatic, spring applied parking brake
4. Unit shall have hydraulic assist, variable steering.
5. Unit shall have a service brake consisting of a drum and shoe.
6. Drive motor and steer/auxiliary motor shall be controlled by transistor, infinite.

Q. Accessories:

1. Crown battery with charger: Clark No. IPS (one each)

R. Utilities Requirements:

1. Electrical:	
a. Connection Requirements	Unit
Voltage	460
Phase	3
Amps	19

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather.

C. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items.

3.2 INSTALLATION

A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect or designated representative.

B. Install equipment in accordance with plans, shop drawings, and manufacturer's instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.
2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
3. Anchorage: Attach equipment as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

3.4 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing and installation debris from job site.

D. Notify Architect or designated representative for final observation (punch list).

3.5 TRAINING

A. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. 2090 Buffer/grinder, 10 inches, with dust collector; 1 hour (minimum)
2. 2220 Drill press, variable speed, 20 inch; 1 hour (minimum)
3. 2600 Press, electric/hydraulic, 100 ton; 1 hour (minimum)
4. 3085 Cabinet, abrasive blast, with dust collector; 1 hour (minimum)
5. 3540 Tank, parts washing; 1 hour (minimum)

6. 3718 Washer, high pressure, hot water, NG, 4 GPM 2 hours (minimum)
7. 3810 Washer, walk-around, vehicle; 2 hours (minimum)
8. 5404 Forklift, electric, 4,000 pound; 2 hours (minimum)

B. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

END OF SECTION 11 11 29

SECTION 12 24 13 - ROLLER WINDOW SHADES

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. Manually operated roller shades with single rollers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 3 inches square. Mark interior face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

D. Product Schedule: For roller shades. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For roller shades to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Subject to compliance with requirements, provide products by the following

1. Draper Inc.
2. Hunter Douglas Contract.
3. Lutron Electronics Co., Inc.
4. MechoShade Systems, Inc.
5. Silent Gliss USA, Inc.

B. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Nickel-plated metal or stainless steel.

a. Loop Length: Full length of roller shade.
b. Limit Stops: Provide upper and lower ball stops.
c. Chain-Retainer Type: Clip, jamb mount.

2. Spring Lift-Assist Mechanisms: Manufacturer's standard for balancing roller shade weight and for lifting heavy roller shades.

a. Provide for shadebands that weigh more than [**10 lb**] <**Insert value**> or for shades as recommended by manufacturer, whichever criterion is more stringent.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of interior face of shade.
2. Direction of Shadeband Roll: Regular, from back (exterior face) of roller.
3. Shadeband-to-Roller Attachment: Removable spline fitting into integral channel in tube.

D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Shadebands:

1. Shadeband Material: As indicated in Finish Schedule on Drawings, with flame-resistance rating in compliance with Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency..

2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

a. Type: Enclosed in sealed pocket of shadeband material.
b. Color and Finish: As selected by Architect from manufacturer's full range.

F. Installation Accessories:

1. Exposed Headbox: Rectangular, extruded-aluminum enclosure including front fascia, top and back covers, endcaps, and removable bottom closure.

a. Height: Manufacturer's standard height required to enclose roller and shadeband assembly when shade is fully open, but not less than 3 inches.

2. Installation Accessories Color and Finish: As selected from manufacturer's full range.

2.2 ROLLER SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible, except as follows:

1. Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.
2. Railroaded Materials: Railroad material where material roll width is less than the required width of shadeband and where indicated. Provide battens and seams as required by railroaded material to produce shadebands with full roll-width panel(s) plus, if required, one partial roll-width panel located at top of shadeband.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller shade surfaces, after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 12 24 13

SECTION 12 36 65 - SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Solid surface material countertops.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For solid surface material countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.

1. Build mockup of typical countertop as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements before countertop fabrication is complete.

1.8 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID SURFACE COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.

1. Colors and Patterns: As indicated by manufacturer's designations in Finish Schedule on Drawings.

B. Particleboard: ANSI A208.1, Grade M-2-Exterior Glue.

C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.

B. Configuration:

1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash: Matching backsplash.

C. Countertops: 1/2 inch thick, solid surface material with front edge built up with same material.

D. Backsplashes: 1/2 inch thick, solid surface material.

E. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid surface material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

F. Joints: Fabricate countertops without joints.

G. Cutouts and Holes:

1. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 92 00 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

D. Secure countertops to subtops with adhesive according to solid surface material manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

E. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

1. Seal edges of cutouts in particleboard subtops by saturating with varnish.

F. Apply sealant to gaps at walls; comply with Section 07 92 00 "Joint Sealants."

END OF SECTION 12 36 65

SECTION 14 43 19 - VERTICAL RECIPROCATING CONVEYORS

PART 1 - GENERAL

A. The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 01, apply to the Work in this Section.

1.2 WORK INCLUDED

A. Equipment items as listed below by Equipment Identifier:

1. 5432 Lift, parts, 3,000 pound (Ref. Part 2.1)

B. Piping, wiring, and switching between equipment and utilities.

C. Gates and enclosures

1.3 REFERENCES

A. ANSI - American National Standards Institute (ANSI B20.1)

B. AWS - American Welding Society.

C. NEMA - National Electrical Manufactures Association.

1.4 QUALITY ASSURANCE

A. Experience: Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.

B. All structural welding performed by manufacturer shall be done by welders certified to AWSD. 1. 1.

C. Comply with ANSI B20.1 and all Federal, State, and local codes on properly installed equipment.

D. Quality standards shall meet or exceed ISO-9001.

E. Manufacturer’s Representative:

1. Installer shall have the approval of the manufacture and have a minimum of five years experience in the installation of the product(s).
2. Installation: Provide a qualified manufacturer’s representative at site to supervise work related to equipment installation, check out, and start up.
3. Training: Provide technical representative to provide training to Owner’s maintenance personnel in operation and maintenance of specified equipment.
4. Quality standards shall meet or exceed ISO-9001.

1.5 Buy America Compliance

A. The Contractor shall comply with the applicable Buy America requirements set forth in 49 U.S.C. 5323(j) and the applicable regulations in 49 C.F.R. Part 661, as amended. If the Contractor procures any capital items with Federal funds, it is the Contractor's responsibility to obtain the Buy America certification required under such regulations.

B. Reference Division 1 for Buy America compliance.

1.6 SUBMITTALS

A. Product Data: Submit Product Data in accordance with Division 1 of these specifications.

B. Operations and Maintenance Manual:

1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
3. Description of system and components.
4. Schematic diagrams of electrical, plumbing, and compressed air system.
5. Manufacturer's printed operating instructions.
6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.

C. Shop Drawings:

1. Submit Shop Drawings in accordance with Division 1 - General Requirements.
2. Submit site specific installation drawings and procedures.

1.7 PRODUCT SUBSTITUTIONS

A. Follow requirements specified in Division 1 - General Requirements.

B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.

C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

1.8 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situations resulting from non-performance of a manufacturer's recommended preventive maintenance schedule.

D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.

E. All parts shall be readily available locally in the United States.

1.9 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.

1.10 LABELING

A. Manufacturer shall securely attach in a prominent location, on each major item of equipment, a non-corrosive nameplate showing manufacturer's name, address, model number, serial number, and pertinent utility or operating data.

B. All electrical equipment and materials shall be new and shall be listed by Underwriter's Laboratories, Inc. (UL) in categories for which standards have been set by that agency and labeled as such in the manufacturer's plant.

PART 2 - PRODUCTS

2.1 LIFT, PARTS, 3,000 POUND
Equipment identifier: 5432

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a. Pflow Industries, Inc.
b. Milwaukee, WI (414) 552-9000
c. Model No.: Series M VRC

B. General Description:

C. Capacity/Dimensions:

1. Overall lift height (with 3 inch minimum clearance): 24 feet
2. Vertical travel: 15 feet, 6 inches
3. Lift platform: The vertical reciprocating lift platform, also known as usable carriage, shall have steel deck plate and 48 inches high welded handrails and kick plates on non-operating ends and safety chains with snap hooks on operating ends.
4. Effective carriage length: 48 inches
5. Effective carriage width: 72 inches
6. Load height: 84 inches
7. Capacity: The vertical reciprocating lift shall be rated at a live load capacity of 3,000 pounds
8. Operating levels: Three
9. Operating configuration: "Z" pattern, front load, and rear unload (Reference Equipment Drawing).
10. Speed: The vertical reciprocating lift shall have a lifting speed of 25 to 30 feet per minute when loaded to capacity.

D. Features/Performance/Construction:

1. Support columns: The vertical reciprocating lift shall have a minimum of two 6-inch wide support columns.
2. Deflection under load: When loaded to rated capacity, no portion of the vertical reciprocating lift shall exhibit permanent deformations.
3. Lifting means: Raising and lowering of the carriage shall be provided by a chain over sprocket with common drive shaft connected to an efficient helical gear reducer assembly. The lifting chains shall be in a guidance assembly.
4. Safety Cams: Safety cams shall be mounted on the platform and connected directly to the lifting chains. The cams shall prevent the platform from falling more than 6" if tension is lost in the chains.
5. Safety enclosure: Guarding on all non-operating sides of the VRC shall be by safety enclosures a minimum of 8' high consisting of material which will reject a ball 1/2" in diameter.
6. Floor level gates: Gates are required on all operating sides of the vertical reciprocating lift at each level of operation.

    a. The gates shall be swing type.
    b. Each gate must be equipped with an electro-mechanical interlock to prevent opening of the gate unless the carriage is present, and to prevent operation of the vertical reciprocating lift unless all gates are closed.

7. Signs: "NO RIDER" signs shall be provided. Lettering shall be a minimum of 2 inches high for visibility.
8. Electric Motor:

    a. Motor horsepower shall be sized for the rated live load and specified speed.
    b. All motors shall be designed for continuous duty at ambient temperatures from 32 degrees to 102 degrees F.
    c. The motor shall not automatically restart when the overload device is reset.
    d. The motor shall be equipped with a heavy-duty, fast-acting, fail-safe industrial brake to ensure the brake will hold in case of power failure.

E. Controls:

1. Each operating floor level shall be equipped with a momentary contact push button control station with call, send, and mushroom style “E” stop operators for manual control of lift operation.
2. An internally pre-wired, NEMA 12 rated main control panel shall be provided with step-down transformer, reversing motor starter, overload relay, instantaneous current sensing jam relay, inrush bypass timer, field wiring terminal block, and positive acting brake contacts.
3. Travel Limit Switch: The VRC shall be equipped with a floor level, upper level, and overtravel limit switch to control positioning of the VRC platform.
4. Chain Tension Safety Device: Monitors each chain and shuts off motor while engaging brake in the event of a slack, taut, or broken chain.
5. Power source: A disconnect shall be installed within 10 feet of the location designated for installation of the vertical reciprocating lift.

F. Utility Requirements:

1. Electrical:

a. Connection Requirements

Voltage	460
Phase	3
HP	7-1/2

G. Finish: Paint with standard Pflow Blue industrial enamel. Prior to painting, all dirt, mill scale, oil, and grease shall be removed from carbon steel surfaces by a combination of brushing, wiping, and use of solvents. Clean surfaces to SSPC-SPC.

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.

C. Report in writing to the Architect, any damaged, missing or incomplete scheduled equipment and improper rough-in or utility stub-outs.

3.2 INSTALLATION

A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect or designated representative.

B. Install equipment in accordance with plans, shop drawings, and manufacturer's instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.
2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
3. Anchorage: Attach equipment as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.
4. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

B. Tests: Conduct tests in presence of Architect or designated representative. All testing procedures and calculation shall be documented and recorded in writing by Contractor. Include results of tests in Maintenance Manual.

1. Operating Load Test: Provide a test load equal to the rated capacity of the unit and load the vertical reciprocating lift at the ground level. The loaded vertical reciprocating lift platform shall be conveyed to the uppermost floor level and returned to the ground level to assure proper operation. If the vertical reciprocating lift cannot lift or lower the load, the vertical reciprocating lift shall fail the test.
2. Performance Test: This Test shall be performed in conjunction with Operating Load Test above. During the demonstration of the lifting and lowering test, measure the time required to lift and lower the capacity load. Calculate average times for lifting and lowering the load and calculate the average lifting and lowering speed. If the vertical reciprocating lift does not lift the load at the specified speed, or if the lowering speed exceeds the lifting speed by more than 10 percent, the vertical reciprocating lift shall fail the test.
3. Stationary Load Test: This Test shall be performed in conjunction with Operating Load Test above. The loaded vertical reciprocating lift platform shall remain stationary at the uppermost floor level for a minimum of 1 hour. After the 1 hour period, the vertical reciprocating lift shall be inspected for deflection of the components or drift of the platform. If deformation or downward drift is evident, the vertical reciprocating lift shall fail the test.

3.4 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing and installation debris from job site.

D. Notify Architect or designated representative when installation and cleanup is 100% complete and ready for final observation (punchlist).

3.5 TRAINING

A. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. 5432 Lift, parts, 3,000 pound; 2 hours (minimum)

B. Demonstrate each lift operation utilizing each item provided by Owner.

C. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

END OF SECTION 14 43 19

SECTION 14 45 01 - RAIL VEHICLE LIFT SYSTEMS

PART 1 - GENERAL

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

1.1 WORK INCLUDED

A. Equipment items as listed below by Equipment Identifier:

1. 5876 Jacks, portable, electric, 80,000 pound (set of 8) (Ref. Part 2.1)
2. 5881 Lift, table, bogie (Ref. Part 2.2)
3. 5950 Turntable, truck assembly, 144 inch diameter (Ref. Part 2.3) (ADD ALTERNATE 1)

B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

C. Piping, wiring, and switching between equipment and utilities.

1.2 DESCRIPTION

A. Design, fabricate, deliver, install and commission rail vehicle lift systems in the quantities and locations indicated on the Contract Drawings.

B. The rail vehicle lift system shall be capable of safely lifting the City of Milwaukee rail vehicle on its wheels to the specified elevation above the shop floor to permit the execution of inspection, maintenance and repair activities on the rail vehicle. The rail vehicle lift system shall be equipped with body stands that safely support the raised vehicle on its body jacking pads while the trucks are lowered for removal and replacement.

1.3 REFERENCE STANDARDS

A. The rail vehicle lift systems shall be designed in accordance with the Occupational Safety and Health Agency (OSHA) Standard for safety requirements in the construction; testing and validation of lift systems. The latest edition published shall be applied to this contract.

B. The rail vehicle lift systems shall comply with the requirements of the Wisconsin Building, Mechanical, Electrical, Fire and Plumbing codes, latest edition.

C. The electrical and electronic devices and components used in the construction of the rail vehicle lift systems shall be manufactured in accordance with the standards written by the following agencies

1. UL – Underwriters Laboratories
2. NEMA – National Electrical Manufacturers Association

1.4 Buy America Compliance

A. The Contractor shall comply with the applicable Buy America requirements set forth in 49 U.S.C. 5323(j) and the applicable regulations in 49 C.F.R. Part 661, as amended. If the Contractor procures any capital items with Federal funds, it is the Contractor's responsibility to obtain the Buy America certification required under such regulations.

B. Reference Division 1 for Buy America compliance.

1.5 SUBMITTALS

A. General: Submit Product Data in accordance with Section 01300 of these specifications.

B. Shop Drawings: Submit Shop Drawings for each lift system, containing the following information:

1. General arrangement, configuration, dimensions, and layout of the rail vehicle lift system structural, mechanical and electrical components.
2. Details of components and sub-components demonstrating compliance with technical specifications.
3. Electrical grounding diagrams for the hoists, spinning posts and body stands indicating all required wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
4. Electrical power wiring diagrams indicating all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
5. Electrical control wiring schematic diagrams. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
6. Logic diagrams showing sequence of events and their relationship.
7. Provide details of faces of control panels, including controls, instruments, and labeling.
8. Technical description of the operational features and functions of the rail vehicle lift systems.

C. Product Data: Submit manufacturer's technical product data for each component and sub-component(s) supplied by vendors other than the rail vehicle lift system manufacturer, with certificates of compliance, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials.

D. Test results and certificates from testing agencies and companies.

E. Operations and Maintenance Manual:

1. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
2. Assemble and provide copies of manual in 8-1/2 by 11 inch format. Fold out diagrams and illustrations are acceptable. Manual to be reproducible by dry copy method. Provide copies per provisions of Section 01300.

1.6 MANUFACTURER'S RESPONSIBILITIES

A. The Contractor shall arrange with the manufacturer of the rail vehicle lift system to provide the following services along with the specified equipment:

1. The manufacturer shall provide direct supervision throughout the duration of the installation period, check out, and start up. The manufacturer's representatives shall have a minimum of three years experience in the installation and commissioning of rail vehicle lift systems.
2. The manufacturer's technicians shall train the designated operators and maintainers of the rail vehicle lift systems, and shall evaluate their ability to safely operate and maintain the rail vehicle lift systems. The trainers shall have a minimum of three years experience training personnel in the operation of rail vehicle lift systems.
3. The manufacturer's representatives shall be the only personnel that shall start-up and test the rail vehicle lift systems prior to acceptance by the district.

1.7 QUALITY ASSURANCE

A. Electrical Standards: Provide electrical products, which have been tested, listed and labeled by UL and comply with NEMA standards.

B. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for electric and electronic control systems.

C. Qualifications of Manufacturers:

1. Manufacturers of the rail vehicle lift systems shall demonstrate at least five years experience in the engineering and fabrication of rail vehicle lift systems.
2. The contractor shall submit with the bid response a minimum of three reference locations where the lift manufacturer has similar specialized equipment installed that has been operating for a minimum of twelve months.
3. The contractor shall submit at bid time certification that the manufacturer meets the Federal Transit Administration, Department of Transportation Part 661 Buy America Requirements – Surface Transportation Assistance Act of 1982.
4. The manufacturer of the rail vehicle lift systems shall be ISO-9001 certified and registered. The manufacturer must submit with the bid response proof that it has implemented and maintains a quality system that fulfills the requirements of the ISO-9001 in the form of a certificate documenting the most recent quality audit and report.
5. The contractor shall submit with the bid response pit spatial requirement drawing(s).
6. The contractor shall submit a brief and concise mechanical and electrical technical description of the features and performance of the rail vehicle lift systems being offered.
7. Failure to submit the above-prescribed information will render the contractor non-conforming.

1.8 SPARE PARTS

A. The manufacturer shall supply spare parts in accordance with Specification Section 01790, Spare Parts and Maintenance Materials and the following:

1. The list below should be provided as a minimum and is not intended to be all inclusive:

Description	Quantity of Each Type for All Locations
Flexible Protection Boots	3
Drive Nut and Safety Nut Assemblies	2
Screw Jack Gear Sets	2
Miter Box Gear Sets	2
Gap Cover Struts	2
Spinning Post Linear Actuators	2
Bearings	2
Lifting Screws	1
Electric Drive Motors and Brakes	1
Flexible Shaft Couplings	1

2. Grease and other consumables shall be included for the initial start-up and warranty period.
3. The rail vehicle lift system lubrication system shall be fully charged prior to acceptance by the owner.
4. All spare parts shall be readily available in the United States

1.9 GUARANTY

A. The provisions of General Conditions, of the Contract Documents, Guaranty of Work shall apply to all work. The following additional requirements shall apply to rail vehicle lift systems:

1. The contractor shall provide maintenance for the entire rail vehicle lift system for the duration of the guaranty period. All maintenance required by the equipment

manufacturer shall be performed at the contractor's expense. The contractor shall submit the maintenance contractor's qualifications for review and approval prior to award of the maintenance contract.

1.10 LABELING

A. The manufacturer shall securely attach in a prominent location, on each major item of equipment, a non-corrosive nameplate with the manufacturer's name, address, model number, serial number, and pertinent utility or operating data.

PART 2 - PRODUCTS

2.1 JACKS, PORTABLE, ELECTRIC, 80,000 POUND (SET OF 8)
Equipment Identifier: 5876

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a.	Macton Corporation
b.	Oxford, CT (203) 267-1500
c.	Model No.: Hi-Lift 10 Ton

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation required set forth in Submittals, equipment produced by other manufacturers *may* be considered as equal.

a.	Whiting Corporation, Monee, IL (708) 587-2100

B. Capacities/Dimensions:

1. Overall dimensions (Portable Jack):

Dimensions (inches)			
	Length	Width	Height
a. Equipment	31-1/2	42	130

2. Minimum height: 6 inches

3. Effective lift: 78 inches minimum (verify it will function with Bogie Lift Table prior to fabrication.
4. Screw diameter: 3-5/16 inches
5. Lift capacities: 10 tons each, 80 ton, 8 total
6. Lifting speed: 9 inches per minute
7. Motor: 3 HP, each

C. Features/Performance/Construction:

1. Base of lift shall be of steel construction
2. Lifting carriage shall be guided by four, steel rollers within two C shaped beam sections rollers that have anti-friction bearing lubrication for the life of the roller.
3. All lifts shall be designed for portability. This shall be accomplished by mounting the jacks on wheels that are deployed when the jack is at the full down position. The rear wheel shall be a steering wheel and controlled by a handle. When lifting, the jacks shall rest on the shop floor entirely on a base plate of sufficient design to carry the rated load.
4. Load bearing nut shall be made of bronze and shall followed by a steel safety nut. In the event of failure of the bronze load nut, the load is secured by the steel. A limit switch shall monitor the gap between the load-bearing nut and the safety nut.
5. Dual limit switches shall be located at the travel extremes of the lifting nut. The first limit switch is for primary operation and provides a signal for the PLC. The second switch is for over travel and is hard wired to the motor starter for the particular jack.
6. Four thermal protection relays (one per motor) shall be provided to protect the motors against short circuits and overload.
7. A programmable controller shall monitor the up and down motion of the lifting carriages and shall fault the system when the height difference reaches 1 inch and stop all the jacks.

D. Controls: The control system shall incorporate a set of eight jacks. Each set of eight jacks shall have one primary jack and seven secondary jacks.

1. Jack shall be equipped with NEMA 12 panel construction with heavy duty NEMA rated starters and push-button operation.

   a. One “UP” push button (dead-man, constant pressure)
   b. One “DOWN” push button (dead-man, constant pressure)
   c. One “EMERGENCY STOP” push button (push-pull)
   d. One “POWER” green pilot light
   e. One two-position selector switch to operate the jacks INDIVIDUALLY or as a SYSTEM
   f. One two-position selector switch per pair of jacks

2. Units shall have an interface panel which will provide for display for operating status and fault messages. The panel will also allow the operator or maintenance technician to perform diagnostics of the system to determine at a minimum:

   a. Travel limit switch status on all jacks
   b. Nut wear status on all jacks
   c. Screw rotation counter operation on all jacks
   d. Reset counter system for each jack
   e. Communication status between the PLC and remote input/output modules
   f. Status of EMERGENCY STOP push button on each jack control station

3. A fusible disconnect switch to control source power that will only allow the box to be opened if the switch is in the off position.
4. Interconnecting cables with an oil resistant jacket shall be supplied to connect the Primary jack to the Secondary jacks, three of each cable type per four jack system. The inter-jack power supply cable and the control cable shall be 50 feet in length and shall have a quick disconnect connector.
5. A Secondary Control Box shall include NEMA type 12 (oil tight and dust tight) enclosure with receptacles for power cables, control cables, and for the pendant station.
6. One "UP-DOWN" pendent type push button station shall be supplied for every set of jacks. When the pendant station is plugged into a specific jack that jack becomes the master and all other connected jacks become slaves. Additionally, when the pendent is plugged in individual control of each jack is disabled. Pendent enclosure shall be NEMA 12 (oil tight and dust tight) type.
7. Motor shall be reversible electric.
8. Each lifting unit shall be powered by a NEMA D electric motor. Each motor reducer shall be equipped with an electromechanical brake that is spring engaged when the motor is not running and is electrically released when either the "UP" and "DOWN" controls are energized.

E. Utility Requirements:

1. Electrical:

a. Connection Requirements

	Unit
Voltage	460
Phase	3
HP	24
Amps	100

F. Finish: Heavy duty steel structure coated with one coat of rust inhibiting primer followed by two coats of yellow enamel.

2.2 LIFT, TABLE, BOGIE
Equipment Identifier: 5881

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a. Macton Corporation
b. Oxford, CT (203) 267-1500
c. Model No.: Bogie Lift Table

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation required set forth in Submittals, equipment produced by other manufacturers *may* be considered as equal.

a. Whiting Corporation, Monee, IL (708) 587-2000

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	120	68	36-1/2

2. Height (not extended): 30 inches
3. Height (fully extended): 78 inches
4. Lifting speed: 28 inches per minute
5. Lifting capacity: 13,500 pounds

C. Features/Performance/Construction:

1. The rail guided scissor shall be designed to support, traverse, lift and lower a truck.
2. Steel plate decking shall come complete with 115 pounds per yard steel tee rails for supporting the truck.
3. Rail gauge spacing shall be 4 feet, 8-1/2 inches.
4. A set of four manually applied rail stops will be provided to allow the Operator to retain the truck in position.
5. There shall only be one platform that is lifted from a set of scissor legs attached to the sub frame underneath.
6. The scissor legs shall be operated by one pump and move simultaneously.
7. A wobble plate shall be provided under the steel decking. When the locking pins are removed the wobble plate shall allow for 4 inches +/- lateral play (90 degrees to rail). The wobble plate shall allow for fine lateral movement to align the truck back to the rail vehicle body. Final location for locking pins of wobble plate to be determined in the field.
8. A flow divider shall be provided to control the speed of the platform when raising or lowering so the legs are in sync.
9. An anti-drift mechanism shall be provided to prevent lift movement when not connected to power.
10. The lift shall be operated by a simple Up/Down control switch.
11. The traversing of the lift shall be through battery power. The control of the traversing is through a hand held wireless pendent.
12. A battery charger shall be supplied for overnight re-charging of the system.
13. The load shall be stabilized through the mechanical stops.
14. The mechanical stops shall be mechanical chocks inserted behind each wheel. They shall slide along the rail; shall be pinned in place.
15. Verify Bogie Lift Table will function with portable lift jacks prior to fabrication.

D. Utility Requirements:

1. Electrical:	
a. Connection Requirements	Unit
Voltage	120
Phase	1
HP	1
Amps	15

E. Finish: Durable enamel in manufacturer's standard color

2.3 TURNTABLE, TRUCK ASSEMBLY, 144 INCH DIAMETER (ADD ALTERNATE 1)
Equipment Identifier: 5950

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a. Macton Corporation
b. Oxford, CT (203) 267-1500
c. Model No.: Turntable

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Whiting Corporation, Monee, IL (708) 331-4000

B. General Description:

1. Rail shop truck turntables are used for transferring rail truck assemblies from a service track to other tracks within a maintenance facility, and are designed for easy single-person operation; they are designed to function well in a rugged maintenance shop environment, and as a result require less maintenance and have less service difficulties and downtime versus other competing turntable designs

C. Capacities/Dimensions:

1. Crossing capacity: 120,000 pounds

2. Rotating capacity: 32,000 pounds
3. Rotation: 360 degrees
4. Crossing Rails: Cross rails are on the deck of the turntable at 90°, 180°, 270° and 360°
5. Rotational Direction: Either clockwise or counter-clockwise (as desired)
6. Pit Depth: 18 inches
7. Track gauge: 4 feet - 8-1/2 inches (US)
8. Turntable diameter: 12 feet

D. Features/Performance/Construction:

1. Deck Plate: Turntable deck consists of non-skid diamond plate steel and supports a uniform load of 300 PSF or a 6,000 lb concentrated load over a 6” diameter area for the non-rail portions of the turntable deck.
2. Push Bar: Stainless steel telescoping push bar with latch for manual rotation; push bar is built flush into the turntable deck when not in use.
3. Position Locking: Manual locking bars to lock turntable in place at 90° positions.
4. Center Bearing: Center bearing consists of a high capacity bearing sized to sustain high crossover loads while at the same time allowing for a smooth and easy rotation (a single person can easily rotate the table with a truck on it).
5. Steel Support Wheels: Eight (8) steel support wheels in the equipment pit provide additional structural support for the turntable, to minimize deflection of the structure when a rail vehicle crosses over.
6. Lifting points for turntable: Lifting points are built flush into the turntable deck to allow turntable to be lifted for both an easy initial installation and for future maintenance purposes.
7. Construction: Turntable structure and load carrying members are designed with a minimum safety factor of five-to-one based on the ultimate strength of the material.
8. A steel embedment box shall be provided to facilitate the foundation’s construction and ensure proper pit dimensions.

E. Finish: Structure primed with a high build epoxy and finish painted using an industrial grade polyurethane enamel in manufacturer’s standard colors.

PART 3 - EXECUTION

3.1 INSPECTION

A. The contractor shall inspect delivered equipment for damage during transport and exposure to outdoor elements and advise manufacturer of any abnormal findings.

B. The contractor shall verify quantities of equipment against packing lists and advise manufacturer of any discrepancies.

3.2 SITE PREPARATION

A. The contractor shall examine the proposed location(s) for the rail vehicle lift systems and verify that the site is be ready for the installation of the equipment.

B. The contractor shall verify that the pits have been constructed within the tolerances specified in the approved drawings.

C. The contractor shall verify that all electrical conduits have been installed in the locations; quantities and sizes specified in the approved drawings.

3.3 INSTALLATION

A. The contractor shall install the rail vehicle lift systems in accordance with the approved drawings, the manufacturer’s installation instructions and as directed by the engineer, the manufacturer’s field representative and OSHA requirements.

B. The contractor shall install the equipment to proper control lines, plumb and level, and without conflict with other adjacent work.

C. The contractor shall anchor the equipment to the structure as required by the manufacturer’s structural calculations.

D. Once the hoist has been installed plumb and level, the contractor shall use non-shrink grout to fill any voids remaining between the base frames and the structure.

E. The contractor shall install all field electrical conduits parallel to the structural surfaces and without conflict with other adjacent work.

F. All wiring shall be routed in conduit in the floor and bundled in wiring troughs within the pit. All wiring troughs shall have with removable covers. Internal wiring from the electrical devices shall be connected to terminal strips and numbered consistent with the electrical diagrams.

G. The contractor shall install all power and control wiring, and make final connections.

H. The contractor shall verify that all equipment shall be ready for start-up and field-testing.

3.4 TESTING

A. The manufacturer's field representatives shall perform all testing. All acceptance testing shall be performed in the presence of the Engineer.

B. Electrical Test: Verify electrical continuity of all power and control circuits.

C. Safety Test: Functionally trip all limits switches and safety devices, and verify that the appropriate actions and status indications occur. Manual tripping of limit switches shall not be an acceptable method of testing the control functions

D. Proof Load Tests: Overload tests shall be performed prior to operational and functional tests to increase the potential that any resulting impaired function will be apparent. All proof load tests shall be performed by an independent testing agency/company that has been approved by the Engineer.

1. Dynamic Overload Test: The contractor shall uniformly overload a representative vehicle to 115% of the rated load capacity. All movements with the test load shall be

carried out at accelerations and decelerations appropriate for safe control of the load. Demonstrate the rail vehicle lift system is capable of stopping and sustaining the test load.

2. Static Overload Test: The contractor shall raise a representative vehicle to a position that creates the maximum stresses in the rail vehicle lift system. At this position, uniformly overload the vehicle to 150% of the rated load capacity. After removing the load, verify that the rail vehicle lift system shows no permanent deformations or impaired function.

E. Functional Operating Test: Using a representative vehicle, operate the system through five complete cycles allowing for adequate cool down time between cycles so as not to overheat the drive nuts. The contractor shall demonstrate that the system operates smoothly for all motions, and that all actions and indications occur correctly.

F. Synchronization Test: Using a representative vehicle, the contractor shall simulate a synchronization fault and demonstrate that the leveling devices operate within the specified tolerances. The test shall be performed twice for each rail vehicle lift system, arbitrarily creating the fault on one vehicle car hoist during an UP cycle, and creating the fault on the other vehicle car hoist during the DOWN cycle.

G. Load Holding Test: Using a representative vehicle, demonstrate self-locking and non-reversing, by releasing the control system during descent and at approximately 12 inches above the workshop floor level.

H. The contractor shall inspect all components and their mating surfaces after the application of initial loading and after the application of overloads to check for construction stretch or seating of the various mating and load bearing components.

I. Prior to handing the rail vehicle lift system over to the Owner, the contractor shall accurately measure the gap between the drive nut and safety nut on all lifting screws and record the readings for inclusion in the maintenance manuals. The contractor shall permanently mark on each nut assembly where the readings were taken. Future readings at the same locations will be a measure of the degree of drive nut wear if any.

3.5 CLEANING

A. The contractor shall wipe and clean equipment of any lubricants, solvents and debris.

B. The contractor shall touch-up damaged, marred and scratched surfaces.

C. The contractor shall Sweep and clean area surrounding equipment installation, and remove any packing and installation debris from the job site.

3.6 TRAINING

A. Direct the technical representative to provide specified hours of training to designated Owner’s maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. 5876 Jacks, portable, electric, 80 pound (set of 8); 4 hours (minimum)

2. 5881 Lift, table, bogie; 2 hours (minimum)
3. 5950 Turntable, truck assembly, 144 inch diameter; 1 hours (minimum)

B. Demonstrate lift operation utilizing each of the vehicle types operated by Owner.

C. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

END OF SECTION 14 45 01

SECTION 21 05 00

COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 SCOPE

A. This section includes information common to two or more technical fire protection specification sections or items that are of a general nature, not conveniently fitting into other technical sections.

B. The specifications and drawings outline scope documents based on the Owner's requirements for the fire protection system. It is the intent of the documents to detail and specify the minimum requirements and components. It is the responsibility of the Contractor to design and install a complete fire protection system in compliance with NFPA, State, the Local Authority Having Jurisdiction and the Owner's Insurance Carrier's requirements. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Work
- 1.3 Reference
- 1.4 Standards
- 1.5 Quality Assurance
- 1.6 Electrical Coordination
- 1.7 Continuity of Existing Services
- 1.8 Protection of Finished Surfaces
- 1.9 Sleeves and Openings
- 1.10 Sealing and Fire Stopping
- 1.11 Off Site Storage
- 1.12 Codes
- 1.13 Design Criteria
- 1.14 Certificates and Inspections
- 1.15 Submittals
- 1.16 Operating and Maintenance Instructions
- 1.17 Training of Owner Personnel
- 1.18 Record Documents

PART 2 - Products
- 2.1 Access Panels and Doors
- 2.2 Identification
- 2.3 Sealing and Fire Stopping

PART 3 - Execution
- 3.1 Concrete Work
- 3.2 Cutting and Patching
- 3.3 Building Access
- 3.4 Equipment Access
- 3.5 Coordination
- 3.6 Identification
- 3.7 Lubrication
- 3.8 Sleeves
- 3.9 Sealing and Fire Stopping

1.2 RELATED WORK

A. This section applies to all Division 21 sections of fire suppression.

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 STANDARDS

A. Abbreviations of standards organizations referenced in this and other sections are as follows:
1. AGA American Gas Association
2. ANSI American National Standards Institute
3. ASME American Society of Mechanical Engineers
4. ASPE American society of Plumbing Engineers
5. ASTM American Society for Testing and Materials
6. AWWA American Water Works Association
7. AWS American Welding Society
8. CGA Compressed Gas Association
9. CS Commercial Standards, Products Standards Sections, Office of Engineering Standards Service, NBS
10. EPA Environmental Protection Agency
11. FM Factory Mutual
12. FS Federal Specifications, Superintendent of Documents, U.S.Government Printing Office
13. IAPMO International Association of Plumbing & Mechanical Officials
14. IEEE Institute of Electrical and Electronics Engineers
15. ISA Instrument Society of America
16. SPS State of Wisconsin Dept. of Safety and Professional Services
17. MCA Mechanical Contractors Association
18. MICA Midwest Insulation Contractors Association
19. MSS Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
20. NBS National Bureau of Standards
21. NEC National Electric Code
22. NEMA National Electrical Manufacturers Association
23. NFPA National Fire Protection Association
24. STI Steel Tank Institute
25. UL Underwriters Laboratories Inc.

1.5 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

B. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.

C. The use of a manufacturer’s name, model, or catalog number, as scheduled or specified, is for the purpose of establishing the standard of quality and general configuration. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the performance from the system into which these items are placed. Said costs may include, but are not limited to, modifications for:
1. Structural loading
2. Size
3. Maintenance accessibility
4. Electrical or plumbing connections
5. Finish
6. Performance and efficiency
7. Warranty
8. Changes found necessary during the testing, adjusting, and balancing phase of the project

1.6 ELECTRICAL COORDINATION

A. All relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment are furnished by the Electrical Contractor, except as specifically noted elsewhere in this division of specifications.

B. Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this Contractor. Should any change in size, horsepower rating or means of control be made to any motor or other electrical equipment after contracts are awarded, Contractor is to immediately notify the Electrical Contractor of this change and pay any costs due to this change.

C. Electrical Contractor will provide all power wiring and the Fire Protection Contractor shall provide all control wiring. Control wiring shall conform to Division 28 requirements for Control Wiring.

D. Furnish wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and indicated to be wired by the Electrical Contractor.

1.7 CONTINUITY OF EXISTING SERVICES

A. Do not interrupt or change existing services without prior written approval from the Owner's Project Representative. When interruption is required, coordinate scheduling of down-time with the Owner to minimize disruption to his activities. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.

1.8 PROTECTION OF FINISHED SURFACES

A. Refer to Division 1, General Requirements, Protection of Finished Construction.

1.9 SLEEVES AND OPENINGS

A. Refer to Division 1, General Requirements, Sleeves and Openings.

1.10 SEALING AND FIRE STOPPING

A. Sealing and fire stopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.11 OFF SITE STORAGE

A. Prior approval by owner and the A/E will be needed. The contractor shall submit a Storage Agreement Request to the owner and A/E for consideration of offsite materials storage. Generally, sleeves, pipe/pipe fittings and similar rough-in material will not be accepted for offsite storage. No material will be accepted for offsite storage unless shop drawings for the material have been approved.

1.12 CODES

A. Comply with requirements of Wisconsin Administrative Code, Dept. of Safety and Professional Services, NFPA Standards and local Fire Chief or Fire Marshal (AHJ, Authority Having Jurisdiction) regarding design, materials and installation.

1.13 DESIGN CRITERIA

A. Design fire protection systems in accordance with codes, standards and regulations noted above.

B. Hydraulically design system for the most remote area based on the following:

Location	Occupancy Classification	Area (SqFt)	Density (GPM/SqFt)
General Offices	Light Hazard	1500	0.10
Mechanical Rooms	Ordinary Hazard – Group 1	1500	0.15
Parking	Ordinary Hazard – Group 2	1500	0.20
Painting	Extra Hazard – Group 1	2500	0.30
Plastic Storage	Extra Hazard – Group 2	2500	0.40

C. Available water supply data for system design is as follows:
Test Date and Time: May 20, 2010
Performed By: Milwaukee Water Works

Hydrant Location	Outlet Elevation	Flow GPM	Static PSI	Residual PSI
N 4th Street and W St Paul Ave	7	1990	73	67

D. Water test data is preliminary for bidding purposes. Verify and obtain any additional test data required for design. Tests to be representative of high water use periods.

1.14 CERTIFICATES AND INSPECTIONS

A. Refer also to the General Conditions of the Contract, Permits, Regulations, Utilities and Taxes.

B. Obtain and pay for all required State or local installation inspections except those provided by the Architect/Engineer. Deliver originals of NFPA test certificates and test reports to the owner's construction representative. Include copies of the certificates and reports in the Operating and Maintenance Instructions.

1.15 SUBMITTALS

A. Refer to Section GC - General Conditions of the Contract, Submittals.

B. Not more than two weeks after award of contract but before any shop drawings are submitted, contractor to submit the following fire protection system data sheet. List piping material types, ASTM number, schedule or pressure class, joint type, manufacturer and model number where appropriate. List valves, specialties and equipment with manufacturer and model number. The approved fire protection system data sheet(s) will be made available to the Owners Project Representative for their use on this project.

C. FIRE PROTECTION SYSTEM DATA SHEET

Item	Pipe Service/Sizes	Manufacturer/Model No.	Remarks
Pipe			
Fittings			
Hangers & Supports			
Sprinkler Heads			
Valves			
Specialty Valves			
Pipe Specialties			
Fire Protection Specialties			
Fire Protection Equipment			

D. Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material index list page showing item designation, manufacturer and additional items supplied with the installation. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Include wiring diagrams of electrically powered equipment.

E. Submittals shall be sent to the local Fire Chief or Fire Marshal for review prior to the Architect/Engineer. Include copy of review/approval letter in submission to Architect/Engineer.

F. Submit plans indicating water supply location and size, piping layout and size, sprinkler locations and type, hanger locations and type, equipment locations and type, valve locations and type, occupancy classes, hydraulic reference points, design areas and discharge densities.

G. Submit hydraulic calculations for water supply and sprinkler systems. Include summary sheet and detailed work sheets. Describe characteristics of water supply and location of effective point used in calculations. Include graph illustration of water supply, hose demand, sprinkler demand and in-rack sprinkler demand. Where a fire pump is used, graph primary rating point, secondary rating point and churn pressure of pump and combined water supply.

H. Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:

1.	Operating and Maintenance Manuals	2 copies
2.	Architect/Engineer	1 copy
3.	Local Fire Chief or Marshal	1 copy

1.16 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Refer to Division 1, General Requirements, Operating and Maintenance Manuals and Instructions.

B. Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the data indicated in the General Requirements, include the following information:

1. Copies of all approved submittals along with approval letters.
2. Manufacturer's wiring diagrams for electrically powered equipment.
3. Records of tests performed to certify compliance with system requirements.
4. Certificates of inspection by regulatory agencies.
5. Parts lists for equipment and specialties.
6. Manufacturers installation, operation and maintenance recommendations for equipment and specialties.
7. Valve schedules charts
8. Lubrication instructions, including list/frequency of lubrication
9. Warranties
10. Additional information as indicated in the technical specification sections

1.17 TRAINING OF OWNER PERSONNEL

A. Instruct Owner's personnel in the proper operation, maintenance and testing of systems and equipment provided as part of this project. Include not less than 4 hours of instruction, using the Operating and Maintenance manuals and record drawings during this instruction. Demonstrate testing, startup and shutdown procedures for all equipment. All training to be during normal working hours. Videotape all instructions and provide Owner with copy.

1.18 RECORD DOCUMENTS

A. Refer to Division 1, General Requirements, Record Documents.

B. In addition to the data indicated in the General Requirements, maintain fire protection layout record drawings and hydraulic calculations on originals prepared by the installing contractor/subcontractor. Include copies of these record drawings and calculations with the Operating and Maintenance manuals.

C. Submit all record drawings in AutoCAD v. 2000 electronic format and one hard copy for engineer’s review. Contractor to include all addendums, RFIs, construction bulletins, and any modifications made in the field. Contractor to make revisions to Record Documents based on Engineer’s comments and resubmit electronic files and hard copies (same size sheets as bid documents and utilizing project title block) in accordance with the General Requirements.

PART 2 - PRODUCTS

2.1 ACCESS PANELS AND DOORS

A. Lay-in Ceilings

1. Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Division 09 are sufficient; no additional access provisions are required unless specifically indicated.

B. Plaster/Gypsum Board Walls and Ceilings

1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the equipment needing service; minimum size is 12" by 12".

2.2 IDENTIFICATION

A. Adhesive Labels

1. Pressure-sensitive, adhesive backed, vinyl pipe markers with applicable labeling, ¾” min. size for white lettering and surrounding red background tape on both ends. With flow arrows on piping. Conforming to ANSI/ASME A.13-2007 and NFPA standards. Seton Opti-Code, MSI, W.H. Brady, or engineer approved equal. Clean piping before application.

B. Snap-Around Markers

1. One-piece, pre-formed, vinyl construction, snap-around or strap-around pipe markers with applicable labeling, ¾” min. size for white lettering with red background in accordance with ANSI/ASME A.13-2007 and NFPA standards. Provide nylon ties on each end of pipe marker. Seton Setmark or engineer approved equal.

C. Signs

1. Weatherproof metal with baked porcelain enamel finish or rigid plastic construction signs, sizes conforming to NFPA No. 13 and Section 7.7.1.5, with holes and corrosion resistant s-hooks/chains for hanging or securing. With applicable labeling. MSI, Seton, W.H. Brady, or engineer approved equal.

D. Engraved Name Plates

1. White letters on a red background, 1/16 inch thick plastic laminate, beveled edges, screw mounting, Setonply Style 2060 by Seton Name Plate Company MSI, W.H. Brady or engineer approved equal.

E. Valve Tags

1. Round brass tags with 1/2 inch numbers, 1/4 inch system identification abbreviation, 1-1/4 inch minimum diameter, with brass jack chains with brass "S" hooks around the valve stem, available from MSI, Seton Name Plate Company, W. H. Brady, or engineer approved equal.

2.3 SEALING AND FIRE STOPPING

A. Fire And/Or Smoke Rated Penetrations

1. Manufacturers: 3M, Hilti, Tremco, or engineer approved equal.
2. All fire stopping systems shall be provided by the same manufacturer.
3. Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by the Department of Safety and Professional Services.
4. Fire stop assemblies with plastic sleeves will not be allowed for floors.
5. Submittals: Contractor shall submit product data for each fire stop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation

applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.

6. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
7. Use fire stop putty, caulk sealant, intumescent wrapstrips, intumescent fire stop collars, fire stop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

B. Non-Rated Penetrations

1. Pipe Penetrations

a. At pipe penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between pipe insulation and sleeve. For non-rated gypsum board, plaster or wood partitions where sleeve is not required, use urethane caulk in annular space between pipe insulation and wall material.

PART 3 - EXECUTION

3.1 CONCRETE WORK

A. Cast-in-place concrete within the building will be performed by the Division 3 Contractor. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for support or installation of plumbing piping, fixtures, specialties and equipment. Coordinate locations of equipment, pipe penetrations in wet areas, etc. with the Division 3 Contractor.

3.2 CUTTING AND PATCHING

A. Refer to Division 1, General Requirements, Cutting and Patching.

3.3 BUILDING ACCESS

A. Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.4 EQUIPMENT ACCESS

A. Install all piping, conduit, and accessories to permit access to equipment for maintenance and service. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Access doors in general construction are to be furnished by the Fire Protection Contractor and installed by the General Contractor.

B. Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not require access panels.

3.5 COORDINATION

A. Coordinate all work with other contractors prior to installation. Any work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

B. Verify that all devices are compatible for the type of construction and surfaces on which they will be used.

3.6 IDENTIFICATION

A. Identify equipment in mechanical equipment rooms with engraved name plates as specified in Part 2 - Products. Equipment shall be designated with the contract drawings designation and description. Example: FP-1 Fire Pump.

B. Identify interior piping not less than once every 25 feet, not less than once in each room, adjacent to each access door or panel, and on both sides of the partition where exposed piping passes through walls or floors. Use approved pipe marking label systems, or provide snap-around type pipe markers as specified in Part 2 - Products.

C. Identify all valves, fire department connections, anti-freeze systems and risers with signs per NFPA rulings. Brass valve tags are also required per Products Section.

D. Provide hydraulic design information sign of permanently marked weatherproof metal or rigid plastic engraved nameplate material. Secure with brass or corrosion resistant chain. Information to include location of the design areas, discharge densities, required flow and residual pressure at the base of riser, hose stream demand and sprinkler demand.

E. Provide a framed valve chart in the main mechanical equipment room or at the fire pump (where applicable). Chart shall include valve size, location and function.

F. Provide additional valve chart and CD in close out documentation.

3.7 LUBRICATION

A. Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is operated for any reason. Once the equipment has been run, maintain lubrication in accordance with the manufacturer's instructions until the work is accepted by the Owner. Maintain a log of all lubricants used and frequency of lubrication; include this information in the Operating and Maintenance Manuals at the completion of the project.

3.8 SLEEVES

A. Provide galvanized sheet metal sleeves for fire rated pipe penetrations through interior and exterior walls to provide a backing for sealant or fire stopping. Patch wall around sleeve to match adjacent wall construction and finish. Grout area around sleeve in masonry construction. In finished spaces where pipe penetration through wall is exposed to view, sheet metal sleeve shall be installed flush with face of wall. In existing poured concrete walls where penetration is core drilled, pipe sleeve is not required. Grout holes directly around steel pipe.

B. Pipe sleeves are not required in interior non-rated gypsum board, plaster or wood partitions and sleeves are not required in existing poured concrete walls where penetrations are core drilled.

C. Pipe sleeves in new poured concrete construction shall be schedule 40 galvanized steel pipe (sized to allow insulated pipe to run thru sleeve), cast in place.

D. In all piping floor penetrations, fire rated and non-fire rated, top of sleeve shall extend 3/4 inch above the adjacent finished floor. In existing floor penetrations, core drill sleeve opening large enough to insert schedule 40 galvanized steel pipe sleeve and grout area around sleeve with hydraulic setting, non-shrink grout. If the pipe penetrating the sleeve is supported by a pipe clamp resting on the sleeve, weld a collar or struts to the sleeve that will transfer weight to existing floor structure.

E. For pipe penetrations through beams insert a schedule 80 steel pipe sleeve to provide a backing for sealant or fire stopping.

F. Plastic floor sleeves that are a component of a fire rated assembly will not be accepted.

3.9 SEALING AND FIRE STOPPING

A. Fire And/Or Smoke Rated Penetrations:

1. Install approved product in accordance with the manufacturer's instructions where a pipe penetrates a fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the insulation and vapor barrier.
2. Where fire stop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Fire stop mortar alone is not adequate to support substantial weight.

B. Non-Rated Partitions:

1. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.

END OF SECTION

SECTION 21 05 29

HANGERS AND SUPPORTS FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

A. This section includes specifications for supports of all fire protection equipment and materials as well as piping system anchors. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Work
- 1.3 Reference
- 1.4 Reference Standards
- 1.5 Quality Assurance
- 1.6 Description
- 1.7 Shop Drawings
- 1.8 Design Criteria

PART 2 - Products
- 2.1 Manufacturers
- 2.2 Structural Supports
- 2.3 Pipe Hangers and Supports

PART 3 - Execution
- 3.1 Installation
- 3.2 Hanger and Support Spacing
- 3.3 Riser Clamps
- 3.4 Anchors

1.2 RELATED WORK

A. Division 3 - Concrete.

B. Section 21 10 00 - Water-Based Fire-Suppression Systems

C. Section 21 30 00 - Fire Pumps

1.3 REFERENCE

A. Applicable provisions of Division 1 shall govern work under this section.

1.4 REFERENCE STANDARDS

A. MSS SP-58

B. MSS SP-69

C. NFPA 13 Installation of Sprinkler Systems (Latest prevailing edition).

D. NFPA 14 Installation of Standpipe and Hose Systems (Latest prevailing edition).

E. NFPA 20 Installation of centrifugal fire pumps (Latest prevailing edition).

F. UL Underwriters' Laboratories Listed.

G. FM Factory Mutual Approved

1.5 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

1.6 DESCRIPTION

A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for building piping.

B. Do not hang any mechanical item directly from a metal deck or run piping so its rests on the bottom chord of any truss or joist.

C. Fasteners depending on soft lead for holding power or requiring explosive powder actuation will not be accepted.

D. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.

1.7 SHOP DRAWINGS

A. Schedule of all hanger and support devices indicating attachment methods and type of device for each pipe size and type of service. Provide details on the working drawings submitted for approval with all pertinent information listed.

1.8 DESIGN CRITERIA

A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless noted otherwise.

B. Materials and application of pipe hangers and supports shall be in accordance with NFPA rulings and be UL/FM listed and approved.

C. Piping connected to pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3 support distance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Anvil, B-Line, Pate, or engineer approved equal.

2.2 STRUCTURAL SUPPORTS

A. Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the drawings.

2.3 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2" through 3"
   1. Carbon steel, adjustable swivel ring with 3/8" min. UL/FM approved hanger rods. B-Line B3170NF, Anvil 69 or 70.
   2. Carbon steel, adjustable clevis, standard, with UL/FM approved size hanger rods. B-Line B3100, Anvil 260.

B. Hangers for Pipe Sizes 4" through 8"
   1. Carbon steel adjustable swivel ring with ½" min. UL/FM approved hanger rods. B-Line B3170NF, Anvil 69 or 70.
   2. Carbon steel, adjustable clevis, standard with UL/FM approved size hanger rods. B-Line B3100, Anvil 260.

C. Multiple or Trapeze Hangers

1. Manufactured steel channel system with manufacturers slotted interlocking pipe clamps with screw/nut securing and threaded hanger rods or steel channels with welded spacers and threaded hanger rods.

D. Wall Support
1. Carbon steel welded bracket with hanger. B-Line 3060 Series, Anvil 190 Series.
2. Steel channels with pipe clamps.

E. Vertical Support
1. Carbon steel riser clamp. B-Line B3373, Anvil 261 for above floor use.

F. Floor Support
1. Carbon steel pipe saddle, stand and bolted floor flange. B-Line B3088T/B3093.

G. Copper Pipe Supports
1. All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or polyvinylchloride coated. Where steel channels are used, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series, Anvil PS 1400 series.

H. Pipe Hanger Rods
1. Steel Hanger Rods
a. Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.
b. Size rods for individual hangers and trapeze support as indicated in the following schedule.

Pipe Size	Diam. Of Rod
Up to and Including 3"	3/8" or 9.5mm min.
4", 5",6" and 8"	½" or 12.7mm min.

I. Beam Clamps
1. MSS SP-69 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a retaining ring and threaded rod of 3/8, 1/2, and 5/8 inch diameter. Furnish with a hardened steel cup point set screw. B-Line B3036L/B3034, Anvil 86/92.
2. MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1-1/2 inch diameter. B-Line B3054, Anvil 228.

J. Concrete Inserts
1. Poured In Place
a. MSS SP-69 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity. B-Line B2505, Anvil 281.
b. MSS SP-69 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. B-Line B3014N, Anvil 282.

K. Drilled Fasteners
1. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

L. Continuous Concrete Insert Channels
1. Steel inserts with an industry standard pre-galvanized finish, nominally 1-5/8 inch by 1-3/8 inch deep by length to suit the application, designed to be nailed to concrete forms and provide a linear slot for attaching other support devices. Installed channels to provide a load rating of 2000 pounds per foot in concrete. Manufacturer's standard

brackets, inserts, and accessories designed to be used with channel inserts may be used. Select insert length to accommodate all pipe sizes in the area.

M. Anchors
   1. Use welding steel shapes, plates, and bars to secure piping to the structure.

N. Equipment Stands
   1. Use structural steel members welded to and supported by pipe supports. Clean, prime and coat with three coat rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere coatings.

O. Corrosive Atmosphere Coatings
   1. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123, 1.5 ounces/square foot of surface each side. Mechanical galvanize threaded products, ASTM B695 Class 50, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.
   2. Corrosive atmospheres include the following locations:
      a. Exterior locations
      b. Parking Ramps
      c. Chemical storage and hazardous waste storage rooms
      d. Locker rooms

PART 3 - EXECUTION

3.1 INSTALLATION

A. Size, apply and install supports and anchors in compliance with manufacturers recommendations.

B. Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

C. Coordinate hanger and support installation to properly group piping of all trades.

D. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior approval.

E. Perform welding in accordance with standards of the American Welding Society.

3.2 HANGER AND SUPPORT SPACING

A. Use hangers with minimum vertical adjustment.

B. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

C. Support riser piping independently of connected horizontal piping.

D. Adjust hangers to obtain the slope specified in the piping section of these specifications.

E. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Max. Horiz. Spacing	Max. Vert. Spacing
Copper	3/4" through 1"	8'-0"	10'-0"
Copper	1-1/4" through 1-1/2"	10'-0"	10'-0"
Copper	2" through 3"	12'-0"	10'-0"
Steel	1" through 1-1/4"	12'-0"	15'-0"

Steel	1-1/2" through 8"	15'-0"	15'-0"

F. Unsupported length from the last hanger and an end sprinkler shall be as follows:

1" piping	Not greater than 36"
1-1/4" piping	Not greater than 48"
1-1/2" piping or larger.	Not greater than 60"

3.3 RISER CLAMPS

A. Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor. Use method of securing the vertical risers to the building structure below in stairwell locations.

3.4 ANCHORS

A. Install where indicated on the drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

END OF SECTION

SECTION 21 10 00

WATER-BASED FIRE-SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

A. This section contains specifications for fire protection pipe and pipe fittings for this project. Included are the following topics:

PART 1 - GENERAL
- 1.1 SCOPE
- 1.2 Related Work
- 1.3 Reference
- 1.4 Reference Standards
- 1.5 Shop Drawings
- 1.6 Quality Assurance
- 1.7 Delivery, Storage, And Handling
- 1.8 Design Criteria
- 1.9 Welder Qualifications
- 1.10 Electrical Coordination

PART 2 - Products
- 2.1 Fire Protection Piping
- 2.2 Mechanical Grooved Pipe Connections
- 2.3 Sprinkler Heads
- 2.4 Flexible Sprinker Drop Fittings
- 2.5 Flow Switches
- 2.6 Pressure Switches
- 2.7 Local Alarm Horn And Strobe
- 2.8 Pressure Gauges
- 2.9 Valves
- 2.10 Fire Department Connection
- 2.11 Flexible Piping Connections

PART 3 - Execution
- 3.1 General
- 3.2 Preparation
- 3.3 Erection
- 3.4 Copper Pipe Joints
- 3.5 Welded Pipe Joints
- 3.6 Threaded Pipe Joints
- 3.7 Mechanical Grooved Pipe Connections
- 3.8 Mechanically Formed Tee Fittings
- 3.9 Unions and Flanges
- 3.10 Flexible Sprinker Drop Fittings
- 3.11 Installation

1.2 RELATED WORK

A. Section 21 05 00 – Common Work Results for Fire Suppression

B. Section 21 05 29 – Hangers and Supports for Fire-Suppression Piping and Equipment

C. Division 26 - Electrical

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ANSI A21.4

B. ANSI A21.11

C. ANSI A21.51

D. ANSI B16.1 Cast Iron Pipe Flanges and Flanged Fittings

E. ANSI B16.3 Malleable Iron Threaded Fittings

F. ANSI B16.4 Cast Iron Threaded Fittings

G. ANSI B16.5 Pipe Flanges and Flanged Fittings

H. ANSI B16.9 Factory Made Wrought Steel Buttweld Fittings

I. ANSI B16.11 Forged Steel Fittings, Socket Welded and Threaded

J. ANSI B16.18 Cast Bronze Solder Joint Pressure Fittings

K. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

L. ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

M. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

N. ASTM A105 Forgings, Carbon Steel, for Piping Components

O. ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

P. ASTM A135 Electric Resistance Welded Steel Pipe

Q. ASTM A181 Forgings, Carbon Steel for General Purpose Piping

R. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

S. ASTM A536 Ductile Iron Castings

T. ASTM A795 Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use

U. ASTM B88 Seamless Copper Water Tube

V. AWS A5.8 Brazing Filler Metal

W. AWS D10.9 Qualification of Welding Procedures and Welders for Piping and Tubing, Level AR3

X. NFPA 13 Installation of Sprinkler Systems. (Latest prevailing edition)

Y. NFPA 71 Installation, maintenance and use of signaling systems for central station service (Latest prevailing edition)

Z. NFPA 72 Installation, maintenance and use of protective signaling systems (Latest prevailing edition)

AA. UL Underwriters' Laboratories Listing

BB. FM Factory Mutual Approval

1.5 SHOP DRAWINGS

A. Schedule from the contractor indicating the ANSI/ASTM specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.

1.6 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

B. Order all copper and steel pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.

C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.8 DESIGN CRITERIA

A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

B. Construct all piping systems for the highest pressures and temperatures in the respective system but not less than 175 psig.

C. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

D. Where ASTM A53 or A795 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where ASTM A135 grade A pipe is specified, grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

E. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

1.9 WELDER QUALIFICATIONS

A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.

1. The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the Owner's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

1.10 ELECTRICAL COORDINATION

A. All relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment are furnished by the Electrical Contractor, except as specifically noted elsewhere in this division of specifications.

B. Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this Contractor. Should any change in size, horsepower rating or means of control be made to any motor or other electrical equipment after contracts are awarded, Contractor is to immediately notify the Electrical Contractor of this change and pay any costs due to this change.

C. Electrical Contractor will provide all power wiring and the Fire Protection Contractor shall provide all control wiring. Control wiring shall conform to Division 28 requirements for Control Wiring.

D. Furnish wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and indicated to be wired by the Electrical Contractor.

PART 2 - PRODUCTS

2.1 FIRE PROTECTION PIPING

A. Steel Pipe
1. Black steel pipe welded and seamless, Type F, Grade A, ASTM A53; black welded and seamless steel pipe for fire protection use, Type F, ASTM A795; electric resistance welded steel pipe, Grade A, ASTM A135.
   a. Threaded lightwall pipe and plastic pipe are not acceptable.
2. Pipe Wall Thickness
   a. All piping: Schedule 40 for welded, threaded and cut groove joints.
   b. Bulk mains and drain piping 2-1/2” to 8”: Schedule 10 for welded and rolled groove joints
   c. Branch, drain and sensor piping ½” to 2”: Schedule 40 threaded or Type L copper
3. Fittings: 2" and Under - Cast iron threaded fittings, Class 125 or 250, ASTM A126/ANSI B16.4. Malleable iron threaded fittings, Class 150 or 300, ASTM A197/ANSI B16.3. Standard weight seamless carbon steel weld fittings, ASTM A234 grade, ANSI B16.9. Mechanical grooved fittings with EPDM gaskets, ASTM A536 ductile iron, ASTM A47 malleable iron or ASTM A53 fabricated steel.
4. Welding Materials: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
5. Finish: Hot dipped zinc coated (galvanized) finish on piping and fittings shall be used in dry sprinkler or combined pipe systems, preaction systems, piping exposed to weather and piping exposed to corrosive environments where indicated. Thread or cut groove hot dipped zinc coated pipe ends for fitting connections. Indoor dry standpipe systems supplied by a Fire Dept. connection only may be black steel piping and fittings.

B. Copper Pipe
1. Type L copper water tube, H (drawn) temper, ASTM B88; with cast copper pressure fittings, ANSI B16.18; wrought copper pressure fittings, ANSI B16.22; copper phosphorous brazing alloy, AWS A5.8 BCuP.

C. Unions and Flanges
1. 2" and Smaller Steel
   a. ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.
2. 2" and Smaller Copper
   a. ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.
3. 2-1/2" and Larger
   a. ASTM A181 or A105, Class 150, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized

steel. ANSI B16.1 or ANSI B16.5, Class 150 cast iron threaded flanges. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.

4. 2-1/2" and Larger Copper
   a. ANSI B16.24, Class 150 cast bronze flanges with raised face.

2.2 MECHANICAL GROOVED PIPE CONNECTIONS

A. Mechanical grooved pipe couplings and fittings, ASTM F1476, as manufactured by Anvil, Tyco Grinnell, or Victaulic may be used with steel pipe. Mechanical grooved components and assemblies to be rated for minimum 175 psi working pressure unless noted otherwise.

B. All mechanical grooved pipe material including gaskets, couplings, fittings and flange adapters to be from the same manufacturer.

C. Couplings and fittings to be malleable iron, ASTM A47, or ductile iron A536 with painted finish. Fittings used on galvanized steel pipe to have galvanized finish, ASTM A153.

D. Gaskets to be EPDM, ASTM D2000. Gaskets for dry systems to be flush seal design. Heat treated carbon steel oval neck track bolts and nuts, ASTM A-183, with zinc electroplated finish.

E. Flange adapters to be ductile iron, ASTM A536; except at lug type butterfly valves where standard threaded flanges shall be used.

F. Credit for the inherent flexibility of mechanical grooved pipe connections when used for expansion joints or flexible connectors may be allowed upon specific application by the Contractor. Three flexible couplings at first three connection points both upstream and downstream of pumps may be used in lieu of flexible connectors. Request for expansion joints shall be made in writing and shall include service, location, line size, proposed application and supporting calculations for the intended service.

2.3 SPRINKLER HEADS

A. Manufacturer: Sprinkler head model numbers establish type, design, and style of head. Design requirements shall include standard coverage sprinkler heads to minimize reaction time. Products of the following manufacturers determined to be equal by the Architect/Engineer will be accepted: Tyco Fire and Building Products, Victaulic Viking, or engineer approved equal.

B. Fusible link or glass bulb type, cast brass or bronze construction. Provide heads with nominal 1/2" discharge orifice except where greater than normal density requires large orifice.

C. Select fusible link or glass bulb temperature rating to not exceed maximum ambient temperature rating allowed under normal conditions at installed location. Provide ordinary temperature (165 degree) fusible link or glass bulb type except at skylights, sealed display windows, unventilated attics and roof spaces, over cooking equipment, adjacent to diffusers, unit heaters, uninsulated heating pipes or ducts, mechanical rooms, storage rooms, or where otherwise indicated.

D. Provide quantity of spare heads as noted below and 1 wrench for each type of head and each temperature range installed. Provide 6 spare heads per 300 or less installed heads, 12 per 1000 or less and 24 for more than 1000. Provide steel cabinet for storage of heads and wrenches.

E. Quick Response Upright: Tyco Model TY 3121 (TY 3131) brass finish.

F. Quick Response Sidewall: Tyco Model TY 3331 chrome plated finish and escutcheon.

G. Quick Response Concealed Pendants: Tyco Model Royal Flush II TY 3551. Color of plate by architect.

H. Provide guards (Tyco model G1) where mechanical damage is likely and also where indicated on plans.

2.4 FLEXIBLE SPRINKER DROP FITTINGS

A. Manufacturers: FlexHead Industries, Victaulic or Viking.

B. Corrugated Type 304 stainless steel hose with braided Type 304 stainless steel exterior cover, welded stainless steel or zinc plated steel inlet and outlet threaded fittings with EPDM seals. 175 PSI pressure rating. 225 oF temperature rating, 1” minimum internal hose diameter. 40” maximum hose length, straight or angle outlet configuration. Galvanized steel ceiling support bar and brackets selected to match project ceiling support system requirements. UL Listed and FM approved.

2.5 FLOW SWITCHES

A. Vane type waterflow switch with metal enclosure, adjustable pneumatic retard and electrical characteristics compatible with alarm system.

2.6 PRESSURE SWITCHES

A. Pressure actuated switch with field adjustable settings, metal enclosure and electrical characteristics compatible with alarm system.

2.7 LOCAL ALARM HORN AND STROBE

A. Weatherproof electric alarm horn and strobe with red painted metal housing, mounting base; weatherproofing o-ring seal and electrical characteristics compatible with alarm system.

2.8 PRESSURE GAUGES

A. Manufacturer: Ametek/U. S. Gauge Division, Ashcroft, H. O. Trerice, or engineer approved equal.

B. Cast aluminum, stainless steel or brass case of not less than 3.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor bronze bourdon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale. Include bronze 3-way globe valve with plugged outlet for Fire Inspector's test gauge.

2.9 VALVES

A. All valves shall contain less than 15% zinc.

B. Manufacturers: Apollo, Milwaukee, Nibco, Victaulic, Watts or engineer approved equal.

C. Ball Valves
   1. 2" and smaller: Bronze, 2-piece, threaded or sweat ends, standard port, blowout proof stem, chrome plated ball, glass reinforced seats, UL approved @ 250 psi. Watts No. B-6000 UL.

D. Gate Valves
   1. 2" and smaller: Outside screw and yoke gate valves, 175 psig, bronze body, bronze mounted, screwed bonnet, rising stem, solid wedge, with normally open tamper switch with double wire leads.
   2. 2-1/2" and larger: Outside screw and yoke gate valves, 175 psig, cast iron body, bronze mounted, bolted bonnet, rising stem, solid wedge, with normally open tamper switch with double wire leads.

E. Butterfly Valves
   1. 2" and smaller: Bronze body butterfly valve, 175 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, Buna or Viton seat, stainless steel disc and stem.

2. 2" and larger: Cast or ductile iron body butterfly valve, lug style or grooved, 175 psig, geared operator, visible position indicator, normally open tamper switch with double wire leads, EPDM resilient seat, EPDM seals, nickel plated ductile iron disc. Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached. Use cap screws for removal of downstream piping while using the valve for system shutoff.

F. Supervisory/Tamper Switches
1. For O S & Y valve or butterfly valve installations, UL/FM listed/approved, to monitor position of valve, tamper resistant cover screws, single or double SPDT switch contacts, corrosion resistant, for indoor or outdoor use, NEMA 4 & 6P enclosures.

G. Check Valves
1. 3" and smaller: Bronze body, threaded end, Y-pattern, regrindable bronze seat, renewable bronze disc, 175 psig, suitable for installation in a horizontal or vertical line with flow upward.
2. 2-1/2" and larger: Cast or ductile iron body, flanged or grooved ends, bronze trim, bolted cap, renewable bronze seat and disc, 175 psig, suitable for installation in a horizontal or vertical line with flow upward.
3. Provide 1/2" automatic drip drain on inlet of fire dept. connection check valve.

H. Spring Loaded Check Valves
1. 2" and smaller: Bronze body, threaded ends, bronze trim, stainless steel spring, stainless steel center guide pin, 175 psig, teflon seat unless only bronze available.
2. 2-1/2" and larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required, 175 psig.

I. Drain Valves
1. 3/4" min. two or three piece bronze body ball valve; threaded ends, chrome plated bronze ball; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 400 psig WOG, with hose thread outlet and cap.

J. Double Detector Check Valves
1. Manufacturers: Beeco, Cla-Val, Conbraco, Febco, Watts, and Wilkinson.

2.10 FIRE DEPARTMENT CONNECTION

A. Manufacturer: Croker, Elkhart Brass, Potter-Roemer, or engineer approved equal.

B. Flush
1. Polished cast brass chrome plated or ductile iron flush fire department inlet, two-way inlet body, swing clappers, pin-lug swivels and caps with chains, 2-1/2" National Standard female hose thread inlets, 4" outlet, cast brass chrome plated lettered identification backplate.

2.11 FLEXIBLE PIPING CONNECTIONS

A. Suitable for pressure, temperature, and fluid involved; minimum pressure rating for any system is 250 psig at the design temperature of the fluid.

B. Seamless corrugated bronze or type 321 stainless steel flexible hose with type 321 stainless steel braided cover for 2" and smaller. Use threaded, soldered, or flanged connections, as applicable to the piping system. For sizes 2-1/2" and larger, use seamless corrugated type 321 stainless steel flexible hose with type 321 stainless steel braided cover and flanged connections. Flexonics, Mason Industries, Mercer Rubber Co., Metraflex, or engineer approved equal.

PART 3 - EXECUTION

3.1 GENERAL

A. Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized industry practices.

3.2 PREPARATION

A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.3 ERECTION

A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of fire protection piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, ceiling grid layout, light fixtures and grilles before installing piping.

B. Where copper piping is embedded in masonry or concrete, provide protective sleeve covering of elastomeric pipe insulation.

C. Provide 3/32" min. thickness steel nailing plates behind or on either side of piping where the possibility of penetration from nails or drywall screws exists.

D. Maintain piping in clean condition internally during construction.

E. Provide clearance for access to valves and piping specialties.

F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

G. Install piping so that system can be drained. Where possible, slope to main drain valve. Slope dry pipe and preaction systems subject to freezing at minimum 1/4"/10' on mains and 1/2"/10' on branches. Where piping not susceptible to freezing cannot be fully drained, install nipple and cap for drainage of less than 5 gallons or ball valve with hose thread outlet and cap for drainage over 5 gallons. Pipe main drain valve to grade or to air gap sewer receptor.

H. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.

I. Do not route piping within exterior walls.

J. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment.

K. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.4 COPPER PIPE JOINTS

A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation and assemble joint to socket stop. Apply flame to fitting until brazing alloy melts when placed at joint. Wipe excess alloy from joint.

3.5 WELDED PIPE JOINTS

A. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable. "Weldolets" and "Threadolets" may be used only for connections up to one-half (1/2) the diameter of the immediate upstream piping.

3.6 THREADED PIPE JOINTS

A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.7 MECHANICAL GROOVED PIPE CONNECTIONS

A. Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field grooved pipe in accordance with the same specifications using specially designed tools available for the application. Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's specifications.

3.8 MECHANICALLY FORMED TEE FITTINGS

A. The use of mechanically formed tee fittings is not permitted on this project.

3.9 UNIONS AND FLANGES

A. Install a union, flange or grooved coupling combination at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union or grooved coupling combination connections on the equipment side of the valve. Concealed unions, flanges or couplings are not acceptable.

3.10 FLEXIBLE SPRINKER DROP FITTINGS

A. Install in accordance with manufacturer’s installation instructions following minimum bend radii, maximum number of bends and bend distance from end requirements. Piping System Leak Tests

B. Conduct pressure test with test medium of water. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.

C. Test piping in sections or entire system as required by sequence of construction. Do not conceal pipe until it has been successfully tested. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Entire test must be witnessed by the Division's representative.

D. Use clean water and remove air from the piping being tested where possible. Measure and record test pressure at the high point in the system.

E. Test system at 200 psi for 2 hours showing no leakage. Where system design is in excess of 150 psig, test at a pressure 50 psig above system design pressure.

F. All pressure tests are to be documented on NFPA Contractor's Material and Test Certificate forms.

3.11 INSTALLATION

A. Install fire protection system components in accordance with NFPA rulings, listings and manufacturers recommendations. Locate where accessible for servicing and replacement.

B. Sprinkler Heads: Locate sprinkler heads as indicated on fire protection plan and reflected ceiling plan maintaining minimum clearances from obstructions, ceilings and walls. Install sprinkler heads level in locations not subject to spray pattern interference. Provide fire sprinkler head installations below ductwork, soffits, etc.

1. Return bends shall be installed on all wet pipe pendent style sprinkler heads regardless of water source.

C. Switches: Locate flow and pressure switches where indicated and where required to obtain specified zoning to isolate floors and major areas of floors. Provide valved test connection for

flow switch adjacent to flow switch. Pipe to floor drain. Test flow switch to verify proper operation

D. Gauges: Provide a valved pressure gauge in main fire protection riser, at the top of each piping riser, at inlet and outlet of pump and elsewhere as indicated.

E. Valves: Properly align piping before installation of valves. Do not support weight of piping system on valve ends. Mount valves in locations which allow access for operation, servicing and replacement. Install all valves with the stem in the upright or horizontal position. Valves installed with the stems down will not be accepted. Provide a riser shutoff valve and a capped hose thread drain valve at the bottom of each riser. Provide capped hose thread drain valves to allow draining of each portion of piping.

F. Fire Department Connections: Mount on wall where indicated. Support from structure independent of piping. Locate between 2' to 3' above grade. Fill wall penetration with insulation and caulk exterior and interior face of wall opening weathertight.

G. Flexible Piping Connections: Install flexible piping connections on the equipment side of shut-off valves.

END OF SECTION

SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SCOPE

A. This section includes information common to two or more technical plumbing specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Work
- 1.3 Reference
- 1.4 Standards
- 1.5 Lead Free Requirements
- 1.6 Quality Assurance
- 1.7 Continuity of Existing Services
- 1.8 Protection of Finished Surfaces
- 1.9 Sleeves and Openings
- 1.10 Sealing and Firestopping
- 1.11 Codes
- 1.12 Certificates and Inspections
- 1.13 Submittals
- 1.14 Operating and Maintenance Data
- 1.15 Training of Owner Personnel
- 1.16 Record Drawings

PART 2 - Products
- 2.1 Access Panels and Doors
- 2.2 Identification
- 2.3 Bedding and Backfill
- 2.4 Sealing and Firestopping

PART 3 - Execution
- 3.1 Excavation and Backfill
- 3.2 Sheeting, Shoring and Bracing
- 3.3 Dewatering
- 3.4 Rock Excavation
- 3.5 Surface Restoration
- 3.6 Concrete Work
- 3.7 Cutting and Patching
- 3.8 Building Access
- 3.9 Equipment Access
- 3.10 Coordination
- 3.11 Identification
- 3.12 Lubrication
- 3.13 Sleeves
- 3.14 Sealing and Firestopping

1.2 RELATED WORK

A. This section applies to all Division 22 00 00 sections of plumbing.

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 STANDARDS

A. Abbreviations of standards organizations referenced in this and other sections are as follows:
1. ABMA American Boiler Manufacturers Association
2. ACI American Concrete Institute
3. ACPA American Concrete Pipe Association
4. AGA American Gas Association
5. AMCA Air Movement and Control Association
6. ANSI American National Standards Institute
7. ARI Air Conditioning and Refrigeration Institute
8. ASME American Society of Mechanical Engineers
9. ASPE American society of Plumbing Engineers
10. ASSE American Society of Sanitary Engineering
11. ASTM American Society for Testing and Materials
12. AWWA American Water Works Association
13. AWS American Welding Society
14. CISPI Cast Iron Soil Pipe Institute
15. CGA Compressed Gas Association
16. CS Commercial Standards, Products Standards Sections, Office of Eng. Standards Service, NBS
17. EPA Environmental Protection Agency
18. FS Federal Specifications, Superintendent of Documents, U.S. Government Printing Office
19. GAMA Gas Appliance Manufacturers Association
20. IAPMO International Association of Plumbing & Mechanical Officials
21. IEEE Institute of Electrical and Electronics Engineers
22. ISA Instrument Society of America
23. MCA Mechanical Contractors Association
24. MICA Midwest Insulation Contractors Association
25. MSS Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
26. NBS National Bureau of Standards
27. NEC National Electric Code
28. NEMA National Electrical Manufacturers Association
29. NFPA National Fire Protection Association
30. NSF National Sanitation Foundation
31. PDI Plumbing and Drainage Institute
32. SMACNA Sheet Metal and Air Conditioning Contractors' National Association. Inc.
33. STI Steel Tank Institute
34. UL Underwriters Laboratories Inc.

B. Standards referenced in this section:
1. ACI 614 Recommended Practice for Measuring, Mixing and Placing of Concrete
2. ASTM D1557 Standard Test Method for Moisture-Density Relations of Soils
3. ASTM E814 Standard Test Method for Fire Tests of Through-Penetration Fire Stops
4. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
5. D.O.T. Standard Specifications for Road and Bridge Construction, State of Wisconsin, Dept. of Transportation
6. UL1479 Fire Tests of Through-Penetration Firestops
7. UL723 Surface Burning Characteristics of Building Materials

1.5 LEAD FREE REQUIREMENTS

A. All materials that contact potable water shall be lead free. Lead free refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per the Federal Safe Drinking Water Act as amended January 4th 2011 Section1417.

B. This requirement applies to all of the subsequent Plumbing Specification Sections and Plumbing Drawings and supersedes any part or model number that may conflict with this requirement.

1.6 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

B. All products and materials used are to be new, undamaged, clean and in good condition. Existing products and materials are not to be reused unless specifically indicated.

C. The use of a manufacturer's name, model, or catalog number, as scheduled or specified, is for the purpose of establishing the standard of quality and general configuration. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the performance from the system into which these items are placed. Said costs may include, but are not limited to, modifications for:

1. Structural loading
2. Size
3. Maintenance accessibility
4. Electrical or plumbing connections
5. Finish
6. Performance and efficiency
7. Warranty
8. Changes found necessary during the testing, adjusting, and balancing phase of the project

1.7 CONTINUITY OF EXISTING SERVICES

A. Do not interrupt or change existing services without prior written approval from the Owner's Project Representative. When interruption is required, coordinate scheduling of down-time with the Owner to minimize disruption to his activities. Unless specifically stated, all work involved in interrupting or changing existing services is to be done during normal working hours.

1.8 PROTECTION OF FINISHED SURFACES

A. Refer to Division 1, General Requirements, Protection of Finished Construction.

1.9 SLEEVES AND OPENINGS

A. Refer to Division 1, General Requirements, Sleeves and Openings.

1.10 SEALING AND FIRESTOPPING

A. Sealing and firestopping of sleeves/openings between piping, etc. and the sleeve or structural opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.11 CODES

A. Comply with requirements of Wisconsin Administrative Code.

1.12 CERTIFICATES AND INSPECTIONS

A. Refer also to the General Conditions of the Contract, Permits, Regulations, Utilities and Taxes.

B. Obtain and pay for all required State installation inspections except those provided by the Architect/Engineer. Deliver the originals of inspection certificates and test records to the Owner's Project Representative. Include copies of the certificates and test records in the Operating and Maintenance Instructions.

1.13 SUBMITTALS

A. Refer to the General Conditions of the Contract, Submittals.

B. Not more than two weeks after award of contract but before any shop drawings are submitted, contractor to submit the following plumbing system data sheet. List piping material type for each piping service on the project, ASTM number, schedule or pressure class, joint type, manufacturer and model number where appropriate. List valves and specialties for each piping service, fixture and equipment with manufacturer and model number. The approved plumbing system data sheet(s) will be made available to the Owner's Project Representative for their use on this project.

C. PLUMBING SYSTEM DATA SHEET

Item	Pipe Service/Sizes	Manufacturer/Model No.	Remarks
Pipe			
Fittings			
Unions			
Valves:			
Ball			
Butterfly			
Balancing			
Check			
Gate			
Curb Stop			
Other			
Pipe Specialties:			
Thermometers			
Press Gauges			
Strainers			
Building Penetrations			
Hangers & Supports			
Insulation			
Plbg. Specialties:			
Floor/Roof Drains			
Cleanouts			
Water Hammer Arrestors			
Backflow Preventers			
Wall Hydrants			
Hose Bibbs			
Manhole Castings			
Wash Machine Boxes			
Plbg. Fixtures			
Plbg. Equipment			

D. Shop drawing submittals are to be bound, labeled, contain the project manual cover page and a material index list page showing item designation, manufacturer and additional items supplied with the installation. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents. Include wiring diagrams of electrically powered equipment.

E. Submit sufficient quantities of data sheets and shop drawings to allow the following distribution:
   1. Operating and Maintenance Manuals 2 copies
   2. Architect/Engineer 1 copy

1.14 OPERATING AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

B. Assemble material in three-ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment.

C. In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:
   1. Copies of all approved shop drawings.
   2. Records of tests performed a to certify compliance with system requirements
   3. Manufacturer's wiring diagrams for electrically powered equipment
   4. Certificates of inspection by regulatory agencies
   5. Valve schedules
   6. Lubrication instructions, including list/frequency of lubrication
   7. Parts lists for fixtures, equipment, valves and specialties.
   8. Manufacturers installation, operation and maintenance recommendations for fixtures, equipment, valves and specialties.
   9. Warranties
   10. Additional information as indicated in the technical specification sections

1.15 TRAINING OF OWNER PERSONNEL

A. Instruct user agency personnel in the proper operation and maintenance of systems and equipment provided as part of this project. Include not less than 4 hours of instruction, using the Operating and Maintenance manuals during this instruction. Demonstrate startup, operation and shutdown procedures for all equipment. All training to be during normal working hours. Videotape all instructions and provide Owner with copy.

1.16 RECORD DRAWINGS

A. Refer to Division 1, General Requirements, Record Drawings. In addition, submit all record drawings in AutoCAD v. 2000 electronic format and one hard copy for engineer’s review. Contractor to include all addendums, RFIs, construction bulletins, and any modifications made in the field. Contractor to make revisions to Record Documents based on Engineer’s comments and resubmit electronic files and hard copies in accordance with the General Requirements.

PART 2 - PRODUCTS

2.1 ACCESS PANELS AND DOORS

A. Lay-in Ceilings:
   1. Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Section 09500 are sufficient; no additional access provisions are required unless specifically indicated.

B. Plaster/Gypsum Board Walls and Ceilings:
   1. 16 gauge frame with not less than a 20 gauge hinged door panel, prime coated steel for general applications, stainless steel for use in toilets, showers, and similar wet areas, concealed hinges, screwdriver operated cam latch for general applications, key lock for use in public or secured areas, UL listed for use in fire rated partitions if required by the application. Use the largest size access opening possible, consistent with the space and the item needing service; minimum size is 12" by 12".

2.2 IDENTIFICATION

A. Engraved Name Plates:
   1. White letters on a black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting, Setonply Style 2060, W.H. Brady, MSI, or engineer approved equal or equal by W. H. Brady.

B. Adhesive Labels:
   1. Pressure-sensitive, adhesive backed vinyl pipe markers with applicable labeling, ¾" min. size for lettering with flow arrows and conforming to ANSI / ASME A.13-2007 standards. Seton Opti-Code, MSI, W.H. Brady, or engineer approved equal. Clean piping and/or insulation before application.

C. Snap-around pipe markers:
   1. One-piece, preformed, vinyl construction, snap-around or strap-around pipe markers with applicable labeling and flow direction arrows, ¾" min. size for lettering. Provide nylon ties on each end of pipe markers. Seton Setmark, W.H. Brady, MSI, or engineer approved equal.

D. Valve Tags:
   1. Round brass tags with 1/2 inch numbers, 1/4 inch system identification abbreviation, 1-1/4 inch minimum diameter, with brass jack chains, brass "S" hooks around the valve stem, available from Seton, or W. H. Brady, MSI or engineer approved equal.

E. Underground Warning Tape:
   1. Detectable underground warning tape, 5.0 mil overall thickness, 6" width, .0035" thick aluminum foil core with polyethylene jacket bonded to both sides. Color code tape and print caution along with name of buried service in bold letters on face of tape. Seton, W.H. Brady, MSI, or engineer approved equal.

F. Underground Tracer Wire:
   1. All underground non-metallic sewers/mains and water services/mains shall be provided with tracer wire installations. Tracer wire installations shall conform with Section 182.0715(2r) of Wisconsin Statutes and prevailing Department of Safety and Professional Services Chapter 384 requirements. Tracer wire shall be continuous solid copper or steel plastic coated with split bolt or compression-type connectors.

2.3 BEDDING AND BACKFILL

A. Bedding up to a point 12" inches above the top of the pipe shall be thoroughly compacted sand or crushed stone chips meeting the following gradations:

Gradation for Bedding Sand		Gradation for Crushed Stone Chip Bedding	
Sieve Size	% Passing (by Wt)	Sieve Size	% Passing (by Wt)
1 inch	100	1/2 inch	100
No. 16	45 - 80	No. 4	75 - 100
No. 200	2 - 10	No. 100	10 - 25

B. Backfill above the bedding in lawn areas shall be thoroughly compacted excavated material free of large stones, organic, perishable, and frozen materials.

C. Backfill above the bedding under existing and future utilities, paving, sidewalks, curbs, roads and buildings shall be granular materials, pit run sand, gravel, or crushed stone, free from large stones, organic, perishable, and frozen materials.

2.4 SEALING AND FIRESTOPPING

A. Fire and/or smoke rated penetrations:
   1. Manufacturers: 3M, Hilti, Tremco, or engineer approved equal.
   2. All firestopping systems shall be provided by the same manufacturer.

3. Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by the Department of Commerce.
4. Submittals: Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project. For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.
5. Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.
6. Use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop blocks, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

B. Non-rated Penetrations:
1. In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water-stop type wall sleeve. The operating bolts of the mechanical type seal shall be accessible from the interior of the building.
2. At pipe penetrations of non-rated interior partitions, floors and exterior walls, use urethane caulk in annular space between pipe insulation and sleeve. For non-rated gypsum board, plaster or wood partitions where sleeve is not required use urethane caulk in annular space between pipe insulation and wall material

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL

A. Perform all excavation and backfill work necessary to accomplish indicated plumbing systems installation. Excavate to bottom of pipe and structure bedding, 4" in stable soils, 6" in rock or wet trenches and 8" in unstable soil. Finish bottoms of excavations to true, level surface.

B. Tunnel or remove sidewalk and curb in areas of excavation to the nearest joint. Remove pavements, curbs and gutters to neat and straight lines to the limits of removal. Make sawcut lines parallel to existing joints, or parallel or perpendicular to pavement edges to form a neat patch. Carefully remove remaining pavement within the sawcut area. Leave existing base materials between the area disturbed by the work and the sawcut line undisturbed by the sawcutting, pavement removal, or pavement replacement processes.

C. Strip topsoil from area to be excavated, free from subsoil and debris, and store for later respreading.

D. At no time place excavated materials where they will impede surface drainage unless such drainage is being safely rerouted away from the excavation.

E. Excavate whatever materials are encountered as required to place at the elevations shown, all pipe, manholes, and other work. Remove debris and rubbish from excavations before placing bedding and backfill material.

F. Remove surplus excavated materials from site.

G. Verify the locations of any water, drainage, gas, sewer, electric, telephone or steam lines which may be encountered in the excavation. Underpin and support all lines. Cut off service connections encountered which are to be removed at the limits of the excavation and cap.

H. Provide and maintain all fencing, barricades, signs, warning lights, and/or other equipment necessary to keep all excavation pits and trenches and the entire subgrade area safe under all

circumstances and at all times. No excavation shall be left unattended without adequate protection.

I. Elevations shown on the plans are subject to such revisions as may be necessary to fit field conditions. No adjustment in compensation will be made for adjustments up to two (2) feet above or below the grades indicated on the plans.

J. Install lines passing under foundations with minimum of 1-1/2 inch clearance to concrete and insure there is no disturbance of bearing soil.

K. Bed pipe up to a point 12" above the top of the pipe. Take care during bedding, compaction and backfill not to disturb or damage piping.

L. Mechanically compact bedding and backfill to prevent settlement. The initial compacted lift to not exceed 24" compacted to 95% density per Modified Proctor Test (ASTM D-1557). Subsequent lifts under pavements, curbs, walks and structures are not to exceed 12" and be compacted to 95% density per Modified Proctor Test. In all other areas where construction above the excavation is not anticipated within 2 years, mechanically compact backfill in lifts not exceeding 24" to 90% density per Modified Proctor Test. Route the equipment over each lift of the material so that the compaction equipment contacts all areas of the surface of the lift.

3.2 SHEETING, SHORING AND BRACING

A. Provide shoring, sheet piling and bracing in conformance with the Wisconsin Administrative Code to prevent earth from caving or washing into the excavation. Shore and underpin to properly support adjacent or adjoining structures. Abandon in place shoring, sheet piling and underpinning below the top of the pipe, or, if approved in advance by the engineer, maintained in place until other permanent support approved by the engineer is provided.

3.3 DEWATERING

A. Provide, operate and maintain all pumps and other equipment necessary to drain and keep all excavation pits, trenches and the entire subgrade area free from water under all circumstances. Obtain general permit from the Wisconsin Department of Natural Resources district office for discharge of construction dewatering effluent. Obtain well permit from the Wisconsin Department of Natural Resources district office for dewatering wells discharging more than 70 GPM. Comply with permit requirements.

3.4 ROCK EXCAVATION

A. Remove rock encountered in the excavation to a minimum dimension of six (6) inches outside the pipe. Rock excavation includes all hard, solid rock in ledges, bedded deposits and unstratified masses, all natural conglomerate deposits so firmly cemented as to present all the characteristics of solid rock; which material is so hard or so firmly cemented that in the opinion of the Engineer it is not practical to excavate and remove same with a power shovel except after thorough and continuous drilling and blasting. Rock excavation includes rock boulders of 1/2 cubic yard or more in volume.

B. Rock excavation will be computed on the basis of the depth of rock removed and a trench width two (2) feet larger than the outside diameter of the pipe where one (1) pipe is laid in the trench and three (3) feet larger than the combined outside diameter where two (2) pipes are laid in the trench. Include 6" pipe and structure bedding in rock excavation. Include rock excavation shown on the plans in the Base Bid.

3.5 SURFACE RESTORATION

A. Completely restore the surface of all disturbed areas to a like condition of the surface prior to the work. Level off all waste disposal areas and clean up all areas used for the storage of materials or the temporary deposit of excavated earth. Remove all surplus material, tools and equipment.

B. Lawns: Topsoil with 4" of clean, friable, fertile topsoil conforming to D.O.T. Section 625, free from debris, lumps, rocks, roots, plants and seeds. Grade surfaces to match adjacent elevations. Rake smooth, free of lumps and debris. Sod with good quality nursery sod conforming to D.O.T. Section 631, be uniform, dense, free from weeds and consist of approximately 60% Kentucky blue grass and the balance perennial rye, fescue and white clover. Place sod with joints staggered and abutting. Maintain lawn areas for one month after installation. Contractor (user agency) will be responsible for necessary watering and mowing. Do necessary weeding, repair, reseeding or resodding until uniform catch is obtained.

C. Curb and Gutter: Concrete curb and gutter conforming to city requirements and D.O.T. Section 601, Type D or L.

D. Sidewalk and Walkways: Non-reinforced concrete conforming to D.O.T. Section 602, thickness to match existing, cross slope of one-fourth inch per foot, scored into squares approximately equal to width.

E. Bituminous Concrete Pavements: 4" thick crushed stone base course conforming to D.O.T. Section 304 (excluding 304.2.4) and two pass bituminous concrete pavement conforming to D.O.T. Section 407, first course 1-1/2" binder, second course 1-1/2" surface.

3.6 CONCRETE WORK

A. Cast-in-place concrete within the building will be performed by the Division 3 Contractor unless otherwise noted. Provide all layout drawings, anchor bolts, metal shapes, and/or templates required to be cast into concrete or used to form concrete for support or installation of plumbing piping, fixtures, specialties and equipment. Coordinate locations of equipment, pipe penetrations in wet areas, etc. with the Division 3 Contractor.

B. Plumbing related cast-in-place concrete on the exterior of the building to be provided by this Contractor in conformance with requirements of Division 3. This includes piping thrust restraints, pipe supports, hydrant supports, manholes, catch basins, grease traps, septic tanks, distribution boxes, valve pits, meter pits, cleanout cover pads, yard hydrant pads, etc.

3.7 CUTTING AND PATCHING

A. Refer to Division 1, General Requirements, Cutting and Patching.

3.8 BUILDING ACCESS

A. Arrange for the necessary openings in the building to allow for admittance or removal of all apparatus. When the building access was not previously arranged and must be provided by this contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.9 EQUIPMENT ACCESS

A. Install all piping, conduit, and accessories to permit access to equipment for maintenance. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Where access is required in plaster walls or ceilings, furnish the access doors to the General Contractor.

3.10 COORDINATION

A. Coordinate all work with other contractors prior to installation. Any work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

B. Verify that all devices are compatible for the type of construction and surfaces on which they will be used.

3.11 IDENTIFICATION

A. Identify equipment in mechanical equipment rooms. Engraved name plates may be used as specified in Part 2 - Products. Equipment shall be designated with the contract drawings designation and description. Example: SP-1 Sump Pump.

B. Identify interior piping not less than once every 30 feet, not less than once in each room, adjacent to each access door or panel, and on both side of the partition where accessible piping passes through walls or floors. Place flow directional arrows at each pipe identification location.

C. Identify all exterior buried piping for entire length with underground warning tape except for sewer piping which is routed in straight lines between manholes or cleanouts. Place tape 6"-12" below finished grade along entire length of pipe. Extend tape to surface at building entrances, meters, hydrants and valves. Where existing underground warning tape is broken during excavation, replace with new tape identifying appropriate service and securely spliced to ends of existing tape.

D. Identify valves with brass tags bearing a system identification and a valve sequence number. Valve tags are not required at a terminal device unless the valves are greater than ten feet from the device, located in another room or not visible from device. Provide a typewritten valve schedule and pipe identification schedule indicating the valve number and the equipment or areas supplied by each valve and the symbols used for pipe identification; locate schedules in mechanical room and in each Operating and Maintenance manual. Schedule in mechanical room to be framed under clear plastic.

3.12 LUBRICATION

A. Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is operated for any reason. Once the equipment has been run, maintain lubrication in accordance with the manufacturer's instructions until the work is accepted by the Owner. Maintain a log of all lubricants used and frequency of lubrication; include this information in the Operating and Maintenance Manuals at the completion of the project.

3.13 SLEEVES

A. Provide galvanized sheet metal sleeves for pipe penetrations through interior and exterior walls to provide a backing for sealant or firestopping. Patch wall around sleeve to match adjacent wall construction and finish. Grout area around sleeve in masonry construction. In finished spaces where pipe penetration through wall is exposed to view, sheet metal sleeve shall be installed flush with face of wall. In existing poured concrete walls where penetration is core drilled, pipe sleeve is not required.

B. Pipe sleeves are not required in interior non-rated gypsum board, plaster or wood partitions and sleeves are not required in existing poured concrete walls where penetrations are core drilled.

C. Pipe sleeves in new poured concrete construction shall be schedule 40 galvanized steel pipe (sized to allow insulated pipe to run through sleeve), cast in place.

D. In all piping floor penetrations, fire rated and non-fire rated, top of sleeve shall extend 1 inch above the adjacent finished floor. In existing floor penetrations, core drill sleeve opening large enough to insert schedule 40 galvanized steel pipe sleeve and grout area around sleeve with hydraulic setting, non-shrink grout. If the pipe penetrating the sleeve is supported by a pipe clamp resting on the sleeve, weld a collar or struts to the sleeve that will transfer weight to existing floor structure.

E. For floor penetrations through existing floors in mechanical and wet locations listed below, core drill opening and provide 1-1/2” x 1-1/2” x 1/8” galvanized steel angles fastened to floor surrounding the penetration or group of penetrations to prevent water from entering the penetration. Provide urethane caulk between angles and floor and fasten angles to floor a minimum of 8” on center. Seal corners water tight with urethane caulk. Or, core drill sleeve

openings large enough to insert schedule 40 galvanized steel pipe sleeve and grout area around sleeve with hydraulic setting non-shrink grout/cement.

F. Wet locations include:
   1. Parking ramps
   2. Chemical storage and hazardous waste storage rooms

G. For pipe penetrations through beams insert a schedule 80 steel pipe sleeve to provide a backing for sealant or firestopping.

H. Pipe sleeves are not required in cored floor pipe penetrations through existing floors that are not located in mechanical rooms, food service areas or wet locations listed above.

3.14 SEALING AND FIRESTOPPING

A. Fire and/or smoke rated penetrations:
   1. Install approved product in accordance with the manufacturer's instructions where a pipe penetrates a fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the insulation and vapor barrier.
   2. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support substantial weight.

B. Non-rated partitions:
   1. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe and tighten in place, in accordance with manufacturer's instructions.
   2. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.

END OF SECTION

SECTION 22 05 13

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

A. This section includes requirements for single and three phase motors that are used with equipment specified in other sections. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Work
- 1.3 Reference
- 1.4 Reference Standards
- 1.5 Shop Drawings
- 1.6 Operating and Maintenance Instructions
- 1.7 Electrical Coordination
- 1.8 Product Criteria

PART 2 - Products
- 2.1 Single Phase, Single Speed Motors

PART 3 - Execution
- 3.1 Installation

1.2 RELATED WORK

A. Section 22 42 00 - Commercial Plumbing Fixtures.

B. Section 22 30 00 - Plumbing Equipment for equipment requiring motors.

C. Division 26 - Electrical - Electrical for power wiring, starters, and other electrical devices

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators

B. ANSI/NEMA MG-1 Motors and Generators

C. ANSI/NFPA 70 National Electrical Code

1.5 SHOP DRAWINGS

A. Include with the equipment which the motor drives the following motor information: motor manufacturer, voltage, phase, hertz, rpm, full load efficiency, full load power factor, service factor, NEMA design designation, insulation class, and frame type.

1.6 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Include manufacturer's instructions in the manuals with the specific equipment to which they apply.

1.7 ELECTRICAL COORDINATION

A. All relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment are furnished by the Electrical Contractor, except as specifically noted elsewhere in this division of specifications.

B. Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this Contractor. Should any change in size, horsepower rating or means of control be made to any motor or other electrical equipment after contracts are awarded, Contractor is to immediately notify the Electrical Contractor of this change and pay any costs due to this change.

C. Electrical Contractor will provide all power wiring and the Plumbing Contractor shall provide all control wiring. Control wiring shall conform to Division 16 requirements for Control Wiring.

D. Furnish wiring diagrams to Electrical Contractor for all equipment and devices furnished by this Contractor and indicated to be wired by the Electrical Contractor.

E. The A/E must coordinate specified voltages with the Electrical Consultant for the project. The Electrical Contractor will provide all power wiring and the Plumbing Contractor will provide all control wiring. Control wiring shall conform to Division 26 requirements for Control Wiring.

1.8 PRODUCT CRITERIA

A. Motors to conform to all applicable requirements of NEMA, IEEE, ANSI, and NEC standards and shall be listed by U.L. for the service specified.

B. Select motors for conditions in which they will be required to perform; i.e., general purpose, splashproof, explosion proof, standard duty, high torque or any other special type as required by the equipment or motor manufacturer's recommendations.

C. Furnish motors for starting in accordance with utility requirements and compatible with starters as specified.

PART 2 - PRODUCTS

2.1 SINGLE PHASE, SINGLE SPEED MOTORS

A. Use NEMA rated 115 volt, single phase, 60 hertz motors for all motors 1/3 HP and smaller.

B. Use permanent split capacitor or capacitor start, induction run motors equipped with permanently lubricated and sealed ball or sleeve bearings and Class A insulation. Service factor to be not less than 1.35.

PART 3 - EXECUTION

3.1 INSTALLATION

A. When motor will be flexible coupled to the driven device, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Using a dial indicator, check angular misalignment of the two shafts; adjust motor position as necessary so that the angular misalignment of the shafts does not exceed 0.002 inches per inch diameter of the coupling hub. Again using the dial indicator, check the shaft for run-out to assure concentricity of the shafts; adjust as necessary so that run-out does not exceed 0.002 inch.

B. Lubricate all motors requiring lubrication. Record lubrication material used and the frequency of use. Include this in the maintenance manuals.

END OF SECTION

SECTION 22 05 14

PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 SCOPE

A. This section includes specifications for floor drains, roof drains, cleanouts, backflow preventers, water hammer arrestors and other miscellaneous plumbing specialties. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Documents
- 1.3 Reference
- 1.4 Reference Standards
- 1.5 Quality Assurance
- 1.6 Shop Drawings

PART 2 - Products
- 2.1 Floor Drains
- 2.2 Trap Guards
- 2.3 Hub Drains
- 2.4 Roof Drains
- 2.5 Trench Drains
- 2.6 Cleanouts
- 2.7 Water Hammer Arrestors
- 2.8 Backflow Preventers
- 2.9 Wall Hydrants
- 2.10 Hose Bibbs
- 2.11 Manholes and Catch Basins
- 2.12 Safings
- 2.13 Vent Flashings

PART 3 - Execution
- 3.1 Installation

1.2 RELATED DOCUMENTS

A. Section 22 05 23 - General-Duty Valves for Plumbing Piping

B. Section 22 11 00 - Facility Water Distribution

C. Section 22 13 00 - Facility Sanitary Sewerage

D. Section 22 14 00 - Facility Storm Drainage

1.3 REFERENCE

A. Applicable provisions of Division 1 shall govern work under this section.

1.4 REFERENCE STANDARDS

A. ANSI A112.21.1 - Floor Drains.

B. ANSI A112.21.2 - Roof Drains.

C. ANSI A112.26.1/PDI WH-201 - Water Hammer Arrestors.

D. ASSE 1001 - Pipe Applied Atmospheric Type Vacuum Breakers.

E. ASSE 1010 - Water Hammer Arrestors.

F. ASSE 1011 - Hose Connection Vacuum Breakers.

G. ASSE 1012 - Backflow Preventers with Intermediate Atmospheric Vent.

H. ASSE 1013 - Reduced Pressure Principle Backflow Preventers.

I. ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining, Anti-Backflow Type.

J. ASTM C1227 - Standard Specification for Precast Concrete Septic Tanks (latest edition)

K. ASTM C1613 - Standard Specification for Precast Concrete Grease Interceptor Tanks (latest edition)

1.5 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

B. Plumbing products requiring approval by the State of Wisconsin Dept. of Safety and Professional Services must be approved or have pending approval at the time of shop drawing submission.

1.6 SHOP DRAWINGS

A. Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

PART 2 - PRODUCTS

2.1 FLOOR DRAINS

A. Manufacturer: Smith, Sioux Chief, Watts, Zurn, or engineer approved equal.

B. FD-1: 3" min. (2” min. for single shower drains) enameled cast iron two piece body with double drainage flange, weep holes, reversible clamping adjustable collar, adjustable 6" min. round polished nickel bronze strainer with threaded collar, bottom outlet. With the addition of the trap guard diaphragm called out below. Zurn ZN-415.

C. FD 2: 4" enameled heavy duty cast iron two piece body with double drainage flange, weep holes, heavy duty adjustable 9" round coated cast iron tractor grate strainer, with sediment bucket, bottom outlet. With the addition of the trap guard diaphragm called out below. Zurn Z-556-Y

2.2 TRAP GUARDS

A. Manufacturer: ProSet Systems Trap Guard, JR Smith, or engineer approved equal.

B. Flexible elastomeric PVC construction diaphragm trap guard for installation in new and existing floor drains, hub drains, and trench drains; ASSE 1072. Trap guard to prevent trap evaporation and waste backflow. Size as applicable to the drain outlet size, up to 4” size.

2.3 HUB DRAINS

A. Manufacturer: Smith, Sioux Chief, Watts, Zurn, or engineer approved equal.

B. HD-1: 3” min. cast iron hub section up 2” min. above floor level, with full-sized deep seal P-trap. With the addition of the trap guard diaphragm called out above.

C. HD-2: 3” min. enameled cast iron bottom outlet floor drain body with membrane clamp, adjustable collar and 3” high extension adapter (less threads on inlet). With the addition of the trap guard diaphragm called out above.urn Z-415-U (modified). (For use on above grade installations.)

2.4 ROOF DRAINS

A. Manufacturer: Smith, Sioux Chief, Watts, Zurn, or engineer approved equal.

B. RD-1: 4" min. bottom outlet roof drain, enameled cast iron body with flashing collar and gravel stop, cast iron dome strainer, adjustable extension, underdeck clamp, 15” diameter. Zurn ZC-100-C-EA

2.5 TRENCH DRAINS

A. Manufacturer: Aco, Smith, Sioux Chief, Watts, Zurn, or engineer approved equal.

B. TD-1: Modular precast polymer concrete, cast iron or polyester fiberglass trench sections with presloped 4" wide radiused interior waterways, knockouts, endcaps, cast iron frame and slotted ductile iron grate, extra heavy duty rated, stainless steel grate holdowns.

2.6 CLEANOUTS

A. Manufacturer: Smith, Sioux Chief, Watts, Zurn, or engineer approved equal.

B. Interior Concrete Floor Areas: Enameled cast iron body with round or square adjustable scoriated polished nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400- / ZN-1400-T.

C. Interior Ceramic Tile Floor Areas: Enameled cast iron body with square adjustable scoriated nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400-T.

D. Interior Vinyl Tile Floor Areas: Enameled cast iron body with round adjustable scoriated nickel bronze cover, tapered threaded ABS closure plug. Zurn ZN-1400.

E. Interior Carpeted Floor Areas: Enameled cast iron body with round adjustable scoriated nickel bronze cover and secured carpet marker, tapered threaded ABS closure plug. Zurn Z-1400-CM.

F. Interior Finished Wall Areas: Line type cleanout tee with tapered threaded ABS cleanout plug, round polished stainless steel access cover secured with machine screw. Zurn Z-1446-(Note: Screw shall not pass completely through the ABS plug, trim screw as necessary)

G. Interior Exposed Vertical Stacks: Line type cleanout tee with tapered threaded ABS closure plug. Zurn Z-1445.

H. Interior Horizontal Lines: Cast iron hub with tapped ferrule and tapered threaded ABS or PVC closure plug, or no-hub coupling and blind plug.

I. Exterior Paved Areas: Cast iron hub or plug with tapered threaded ABS or PVC closure plug, cast iron frost sleeve and cover set in 24" square by 4" min. thick reinforced concrete pad top or surrounding pavement, crowned for drainage. Neenah R-1976 with non-ferrous securing screw.

J. Exterior Unpaved Areas: Cast iron hub or plug with tapered threaded ABS or PVC closure plug, cast iron or PVC frost sleeve and cover set in 24” square by 4” min. thick reinforced concrete pad top. Neenah R-1976 with non-ferrous securing screw.

2.7 WATER HAMMER ARRESTORS

A. Manufacturer: PPP Industries, Sioux Chief, Watts, or engineer approved equal.

B. ANSI A112.26.1, ASSE 1010; sized in accordance with PDI WH-201, precharged piston type constructed of hard drawn Type K copper, threaded brass adapter, brass piston with o-ring seals, FDA approved silicone lubricant, suitable for operation in temperature range 35 to 150 degrees F, maximum 250 psig working pressure, 1500 psig surge pressure. Watts series 15.

2.8 BACKFLOW PREVENTERS

A. Manufacturers: Beeco, Conbraco, Febco, Watts, or engineer approved equal.

B. Hose Connection Vacuum Breakers: ASSE 1011, brass or bronze construction, EPDM diaphragm and seat, rated for 125 psig and 180 deg F. Watts 8 (interior application).

C. Pipe Applied Atmospheric Type Vacuum Breakers: ASSE 1001, same size as pipe, brass or bronze construction, silicone disc, rated for 125 psig and 160 deg F. Watts 288A.

D. Reduced Pressure Zone Backflow Preventers: ASSE 1013, reduced pressure zone backflow assembly complete with inlet strainer, inlet and outlet ball, or non-rising stem gate isolation valves (Valves to be as specified in Section 22 05 23). Line size for minimum pressure drop. Constructed of bronze or epoxy coated cast iron body with bronze and plastic internal parts, stainless steel springs, non-threaded vent outlet, 4 test cocks, rated for 175 psig and 210 deg F, with air gap apparatus on drain. Watts series 919-S-QT-AG/919-S-NRS-AG (Watts 009 is not considered an equal).

2.9 WALL HYDRANTS

A. Manufacturer: Smith, Watts, Woodford, Zurn, or engineer approved equal.

B. WH-1: Freezeproof automatic draining wall hydrant with exposed chrome plated bronze wall plate, 3/4" inlet, 3/4" hose thread ASSE 1019-93 backflow preventer outlet, copper or bronze casing, loose key operator. Woodford model 65 series

2.10 HOSE BIBBS

A. HB-1: Bronze or brass construction hose faucet/valve (cold only), hose thread spout, hose rack, with ASSE 1011 backflow preventer outlet, 3/4” size. Plumbing Innovations Model PI-1011.

B. HB-2: Bronze or brass construction hose faucet/valve (hot and cold), hose thread spout, hose rack, with ASSE 1011 backflow preventer outlet, 3/4” size. Plumbing Innovations Model PI-1012.

2.11 MANHOLES AND CATCH BASINS

A. Precast reinforced concrete manhole sections, 48" diameter minimum manholes, 36" diameter minimum catch basins, ASTM C478. Construct base of 6" thick precast reinforced concrete or 8" thick cast in place concrete. Construct top of precast reinforced concrete eccentric cone and adjusting rings or 6" thick reinforced concrete slab with concentric opening.

B. Seal between sections with rubber ring gaskets, ASTM C443, or plastic preformed gasket material. Seal pipe penetrations with flexible watertight rubber gasketed seals.

C. Steps to be constructed of cast iron or polypropylene coated steel reinforcing rod.

D. Frame and cover or grate to be cast iron, ASTM A48, Class 35B, of style indicated, with minimum 24" diameter manhole opening, 20" diameter catch basin opening and pickhole. Provide gasketed self-sealing covers on sanitary manholes.

2.12 SAFINGS

A. Manufacturers: Noble, Oatey, Semco, or engineer approved equal.

B. Chlorinated polyethylene sheeting, 40 mils thick, ASTM D4068, joined with CPE solvent; or 3 lb./sq. ft. sheet lead.

2.13 VENT FLASHINGS

A. Manufacturers: F.J. Moore Manufacturing Co. or engineer approved equal.

B. Flashing boot of material compatible with roofing membrane with base flange for adhering to membrane and stainless steel drawband for securing to vent pipe.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Coordinate location and setting of plumbing specialties with adjacent construction. Install in accordance with manufacturers recommendations.

B. Set floor drains, roof drains, trench drains and cleanouts level and plumb adjusted to finished floor elevation, roof elevation or finished wall location. Locate where serviceable. Allow minimum of 18" clearance around cleanouts for rodding. Lubricate threaded cleanout plugs with graphite and oil, teflon tape or waterproof grease. Install trap primer connections where indicated. Provide deep seal traps on floor drains and hub drains installed in mechanical rooms, penthouses or rooms with excessive positive or negative pressure.

C. Floor drains and hub drains installed in public restrooms, locker rooms, seldom used rooms, and areas with minute drainage flow shall have installations of combination trap evaporation/backflow preventer diaphragm installations.

D. Install water hammer arrestors where indicated and at quick closing valve installations.

E. Install backflow preventers in accordance with Wis. Dept. of Safety and Professional Services requirements maintaining minimum clearance distances for servicing and testing. Provide indirect waste piping with air gap installation from relief opening to above hub drain or floor drain.

F. Where backflow preventers requiring Dept. of Safety and Professional Services registration are installed, provide initial registration, testing and report filing required by Dept. of Safety and Professional Services. List the name and address of the building that the backflow preventer installations occur in..

G. Mount wall hydrants recessed in exterior wall construction with valve plug extended beyond interior side of building insulation. Slope to drain to exterior. Install so discharge is 18” min. above finished grade. Set wall box in grout or caulk and fill exterior wall penetration with insulation.

H. Mount hose bibbs securely fastened to wall where indicated. Provide water hammer arrestor in line to hose bibb.

I. Excavate for manholes and catch basins setting precast bases on granular backfill and pouring cast in place bases on undisturbed soil. Seal joints between base, sections, collars and castings with gasketing material for tightly packed waterproof seals. Adjust casting to match finished grade. Form interior shelves with concrete grout for smooth flowlines conforming to the shape and slope of the sewer. Place piping into manholes providing full support of piping on exterior bedding and insuring pipe seals are properly installed and waterproof. Valve manholes and other manholes intended to remain dry must be made waterproof and are subject to infiltration testing. Where an entering sewer is 2 feet or more above the springline of a leaving sewer, provide outside drop connection encased in concrete. Where existing pipe penetrations are being removed or capped, fill opening with non-shrink Portland cement grout plug. Backfill and compact soil around manhole or catch basin.

J. Install safing at floor drains above grade. Extend 12" beyond drains in all directions. Install on concrete floor that is smooth and free of debris. Seal all joints and connect to drain body clamp. Safing is subject to standing water leak test. (Note: spray-on and brush applied liquid safing is not acceptable).

K. Flash vent penetrations through roof. Turn down top of lead flashings into vent pipe. Tighten drawband of membrane boot to vent pipe. Adhere base flashing to deck or membrane. Provide waterproof patch around penetration on existing roofs.

END OF SECTION

SECTION 22 05 15

PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SCOPE

A. This section contains specifications for plumbing piping specialties for all piping systems. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Work
- 1.3 Reference
- 1.4 Reference Standards
- 1.5 Quality Assurance
- 1.6 Shop Drawings
- 1.7 Design Criteria

PART 2 - Products
- 2.1 Thermometers
- 2.2 Thermometer Sockets
- 2.3 Pressure Gauges
- 2.4 Strainers
- 2.5 Inline Flowmeter
- 2.6 Flexible Piping Connections

PART 3 - Execution
- 3.1 Thermometers
- 3.2 Thermometer Sockets
- 3.3 Pressure Gauges
- 3.4 Strainers
- 3.5 Inline Flowmeter
- 3.6 Flexible Piping Connections

1.2 RELATED WORK

A. Section 22 07 00 - Plumbing Insulation

B. Section 22 11 00 - Facility Water Distribution

C. Section 22 13 00 - Facility Sanitary Sewerage

D. Section 22 14 00 - Facility Storm Drainage

E. Section 22 05 23 - General-Duty Valves for Plumbing Piping

F. Section 22 30 00 - Plumbing Equipment

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ASTM B650 Electrodeposited Engineering Chromium Coatings on Ferrous Substrates

1.5 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.

1.6 SHOP DRAWINGS

A. Required for all items in this section. Include materials of construction, dimensional data, ratings/capacities/ranges, approvals, test data, pressure drop data where appropriate, and identification as referenced in this section and/or on the drawings.

1.7 DESIGN CRITERIA

A. All piping specialties are to be rated for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

PART 2 - PRODUCTS

2.1 THERMOMETERS

A. Ametek/U. S. Gauge, Ashcroft, H. O. Trerice, Wika, or engineer approved equal.

B. Stem Type: Cast aluminum case, nine inch scale, clear acrylic window. adjustable angle brass stem with stem of sufficient length so the end of the stem is near the middle of a pipe without reducing the thickness of any insulation, red indicating fluid, black lettering against a white background, with scale ranges as follows:

Service	Hot Water	Cold Water
Scale Range, deg F	30 – 180	30 - 180
Increment, deg F	2	2

2.2 THERMOMETER SOCKETS

A. Brass with threaded connections suitable for thermometer stems and temperature control sensing elements in pipeline. Furnish with extension necks for insulated piping systems.

2.3 PRESSURE GAUGES

A. Ametek/U. S. Gauge, Ashcroft, H. O. Trerice, Wika, or engineer approved equal.

B. Cast aluminum case of not less than 4.5 inches in diameter, double strength glass window, black lettering on a white background, phosphor bronze bourdon tube with bronze bushings, recalibration from the front of the dial, 99% accuracy over the middle half of the scale, 98.5% accuracy over the remainder of the scale, with scale range as follows:

Service	Hot Water	Cold Water
Scale Range, psig	0-100	0-100
Increment, psig	2	2

C. Pressure Snubbers: Bronze construction, 300 psig working pressure, 1/4" size.

D. Gauge Valves: Use ball valves as specified in Section 22 05 23 - General-Duty Valves for Plumbing Piping.

2.4 STRAINERS

A. Armstrong, Sarco, Watts, or engineer approved equal.

B. Y type; cast bronze body, ASTM B62; 20 mesh stainless steel screens; bolted or threaded screen retainer tapped for a blowoff valve; sweat, threaded or flanged body rated at not less than 150 psi WOG.

C. Y type; cast iron body, ASTM A126; 20 mesh stainless steel screens; bolted or threaded screen retainer tapped for a blowoff valve; threaded or flanged ends; rated at not less than 150 psi WOG.

2.5 INLINE FLOWMETER

A. Hedland EZ-VIEW H600 Series, Omega EZ-VIEW FL-9000 Series or FL-500 Series, Lake Monitor Style B, or engineer approved equal.

B. Polysulfone, T300 series stainless steel spring, Buna-N flow indicator ring, Buna-N O-rings, suitable for use on potable water. Maximum pressure rating of 325 psig and maximum temperature rating of 250°F.

C. Select appropriate scale for application/location.

2.6 FLEXIBLE PIPING CONNECTIONS

A. Suitable for pressure, temperature, and fluid involved; minimum pressure rating for any system is 250 psig at the design temperature of the fluid.

B. Seamless corrugated bronze or type 321 stainless steel flexible hose with type 321 stainless steel braided cover for 2" and smaller. Use threaded, soldered, or flanged connections, as applicable to the piping system. For sizes 2-1/2" and larger, use seamless corrugated type 321 stainless steel flexible hose with type 321 stainless steel braided cover and flanged connections. Flexonics, Mason Industries, Mercer Rubber Co., Metraflex, or engineer approved equal.

PART 3 - EXECUTION

3.1 THERMOMETERS

A. Stem Type: Install in piping systems as indicated on the drawings and/or details using a separable socket in each location.

3.2 THERMOMETER SOCKETS

A. Install at each point where a thermometer or temperature control sensing element is located in a pipeline.

3.3 PRESSURE GAUGES

A. Install in locations where indicated on the drawings and/or details, with scale range appropriate to the system operating pressures.

B. Pressure Snubbers: Install in gauge piping for all gauges used on water services.

C. Gauge Valves: Install at each gauge location as close to the main as possible and at each location where a gauge tapping is indicated.

3.4 STRAINERS

A. Install all strainers where indicated allowing sufficient space for the screens to be removed. Install a ball valve in the tapped screen retainer.

3.5 INLINE FLOWMETER

A. Install per manufacturer’s recommendations.

B. Install at each balance valve and where indicated on the drawings.

C. Set balancing valve to appropriate position to achieve flowrate on meter.

3.6 FLEXIBLE PIPING CONNECTIONS

A. Install flexible piping connections on the equipment side of shut-off valves.

END OF SECTION

SECTION 22 05 23

GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SCOPE

A. This section includes valve specifications for all Plumbing systems except where indicated under Related Work. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Work
- 1.3 Reference
- 1.4 Quality Assurance
- 1.5 Submittals
- 1.6 Design Criteria

PART 2 - Products
- 2.1 Water System Valves
- 2.2 Waste System Valves
- 2.3 Specialty Valves and Valve Accessories

PART 3 - Execution
- 3.1 General
- 3.2 Shut-Off Valves
- 3.3 Balancing Valves
- 3.4 Drain Valves
- 3.5 Spring Loaded Check Valves
- 3.6 Swing Check Valves
- 3.7 Pressure Reducing Valves
- 3.8 Safety Relief Valves

1.2 RELATED WORK

A. Section 22 05 14 - Plumbing Specialties

B. Section 22 30 00 - Plumbing Equipment

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

1.5 SUBMITTALS

A. Schedule of all valves indicating type of service, dimensions, materials of construction, and pressure/temperature ratings for all valves to be used on the project. Temperature ratings specified are for continuous operation.

1.6 DESIGN CRITERIA

A. ANSI Z21.22 - Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.

B. ASSE 1003 - Water Pressure Reducing Valves for Domestic Water Supply Systems.

C. Where valve types (ball, butterfly, etc.) are specified for individual plumbing services (i.e. domestic water, gas, etc.), each valve type shall be of the same manufacturer unless prior written approval is obtained from the Owner.

D. Valves to be line size unless specifically noted otherwise.

PART 2 - PRODUCTS

2.1 WATER SYSTEM VALVES

A. All water system valves to be rated at not less than 125 water working pressure at 240 degrees F unless noted otherwise. All valves shall contain less than 15% zinc.

B. Ball Valves
1. 3" and smaller: Two piece bronze body; sweat or threaded ends, stainless steel ball and stem; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 600 psig WOG. Provide valve stem extensions for valves installed in all piping with insulation. Apollo 70-240, Milwaukee BA150S, Nibco S-580-70-66, Watts B6001-SS, or engineer approved equal.

C. Butterfly Valves
1. 2-1/2" and larger: Cast or ductile iron body; stainless steel shaft; bronze, copper or teflon bushings; EPDM resilient seat; EPDM seals; bronze, aluminum-bronze, EPDM encapsulated ductile iron or stainless steel disc. 200 psig WOG through 12", 150 psig WOG through 24". Valve assembly to be bubble tight to 175 psig with no downstream flange/pipe attached. Use tapped lug type valves with stud bolts or cap screws, or grooved end connection valves, permitting removal of downstream piping while using the valve for system shutoff. Apollo, Kitz, Milwaukee M or C Series, Nibco LD2000/LC2860, Watts BF-03, or engineer approved equal.
2. Provide 10 position locking lever handle actuators for valves 6" and smaller. Provide worm gear operators with external position indication for valves 8" and larger.

D. Gate Valves
1. 2" and smaller: Bronze body, bronze trim, soldered ends, solid wedge, rising stem, union bonnet, malleable iron hand wheel, suitable for 300 psi WOG. Apollo, Kitz, Milwaukee, Nibco S134, Watts, or engineer approved equal.
2. 2-1/2" and larger: Iron body, bronze trim, bolted bonnet, O.S. & Y., solid wedge, flanged, suitable for 200 psi WOG. Apollo, Kitz, Milwaukee F2885, Nibco F617-O, Watts, or engineer approved equal.

E. Swing Check Valves
1. 3" and smaller: Bronze body, sweat ends, Y-pattern, regrindable bronze seat, renewable bronze disc, Class 125, suitable for installation in a horizontal or vertical line with flow upward. Apollo, Kitz, Milwaukee, Nibco, Watts, or engineer approved equal.
2. 4" and larger: Cast iron body, flanged ends, bronze trim, bolted cap, renewable bronze seat and disc, Class 125, non-asbestos gasket, suitable for installation in a horizontal or vertical line with flow upward. Apollo, Kitz, Milwaukee, Nibco, Watts or engineered approved equal.

F. Spring Loaded Check Valves
1. 2" and smaller: Bronze body, sweat or threaded ends, bronze trim, stainless steel spring, stainless steel center guide pin, Class 125, teflon seat unless only bronze available. Apollo, Kitz, Milwaukee, Nibco S480Y, Watts, or engineer approved equal.
2. 2-1/2" and larger: Cast or ductile iron body, wafer or globe type, bronze trim, bronze or EPDM seat, stainless steel spring, stainless steel stem if stem is required, Class 125. Apollo, Kitz, Milwaukee 1800 series, Nibco W910 or F910, Watts, or engineer approved equal .

G. Balance Valves

1. 2" and smaller: Two or three piece bronze body ball valve, sweat or threaded ends, chrome plated brass ball, glass filled teflon seat, threaded packing nut, with adjustable memory stop position indicator and extended handle stem, suitable for 400 psig water working pressure at 240 degrees F. Watts B-6000/B-6001 BS, Apollo, Kitz, Milwaukee, or Nibco, or engineer approved equal.

H. Drain Valves

1. 3/4 inch ball valve with integral threaded hose adapter, sweat or threaded inlet connections, with threaded cap and chain on hose threads, Watts B-6000-CC/B-6001-CC series, Apollo, Kitz, Milwaukee, Nibco, or engineer approved equal.

2.2 WASTE SYSTEM VALVES

1. Gate Valves
   a. 2" and smaller: Bronze body, bronze trim, threaded ends, solid wedge, rising stem, union bonnet, malleable iron hand wheel, suitable for 300 psi WOG. Apollo, Milwaukee, Nibco, Watts, or engineer approved equal.
   b. 2-1/2" and larger: Iron body, bronze trim, bolted bonnet, O.S. & Y., solid wedge, flanged, suitable for 200 psi WOG. Apollo, Kitz, Milwaukee, Nibco, Watts, or engineer approved equal.
2. Ball Valves
   a. 3" and smaller: Three piece bronze body; sweat or threaded ends, chrome plated bronze ball; glass filled teflon seat; teflon packing and threaded packing nut; blowout-proof stem; 400 psig WOG. Apollo, Kitz, Milwaukee, Nibco, Watts, or engineer approved equal.
3. Swing Check Valves
   a. 1-1/2" and smaller: Bronze body, threaded ends, Y-pattern, regrindable bronze seat, renewable bronze disc, Class 125, suitable for installation in a horizontal or vertical line with flow upward. Apollo, Kitz, Milwaukee, Nibco, Watts, or engineer approved equal.
   b. 2" and larger: Cast iron body, flanged ends, bronze trim, bolted cap, renewable bronze seat and disc, Class 125, non-asbestos gasket, outside lever and weight or spring, suitable for installation in a horizontal or vertical line with flow upward. Apollo, Kitz, Milwaukee, Nibco, Watts, or engineer approved equal.

2.3 SPECIALTY VALVES AND VALVE ACCESSORIES

A. Gauge Valves

1. Use 1/4" ball valves. Needle valves and gauge cocks will not be accepted.

B. Water Pressure Reducing Valves

1. Bronze body, diaphragm operated, with an integral thermal expansion bypass valve, inlet union, stainless steel strainer, renewable monel or stainless steel seat and adjustable reduced pressure range, 300 psig at 160 degrees F. Pre-set for the scheduled pressure. A. W. Cash, Conbraco, Watts, Wilkins, or engineer approved equal.

C. Safety Relief Valves

1. Bronze body, temperature and pressure actuated, stainless steel stem and spring, thermostat with non-metallic coating, test lever, suitable for 125 psig water working pressure at 240 degrees F, sized for full BTUH input and operating pressure of equipment, with valve capacity on metal label. For equipment less than or equal to 200,000 BTUH input, provide AGA, UL or ASME listed and labeled valve. Provide ASME listed and labeled valve for larger equipment. Bell & Gossett, A. W. Cash, Conbraco, Watts, Wilkins. Temperature and pressure relief valve shall be sized per AGA rating for BTUH input, Re: COMM 82.40(5)(d).

PART 3 - EXECUTION

3.1 GENERAL

A. Properly align piping before installation of valves. Install and test valves in strict accordance with valve manufacturer's installation recommendations. Do not support weight of piping system on valve ends.

B. Mount valves in locations which allow access for operation, servicing and replacement.

C. Provide valve handle extensions for all valves installed in insulated piping.

D. Install all valves with the stem in the upright or horizontal position. If possible, install butterfly valves with the stem in the horizontal position. Valves installed with the stems down will not be accepted.

E. Prior to flushing of piping systems, place all valves in the full-open position.

3.2 SHUT-OFF VALVES

A. Install shut-off valves at each piece of equipment, at each branch take-off from mains for isolation or repair and elsewhere as indicated.

3.3 BALANCING VALVES

A. Install where indicated on the drawings and details for balancing of flow in pumped hot water recirculation piping systems.

B. Upon project completion, adjust each valve and set position stop. Balance system to minimum flow in return piping branches needed to maintain even supply water temperature throughout building.

3.4 DRAIN VALVES

A. Provide drain valves for complete drainage of all systems. Locations of drain valves include low points of piping systems, downstream of riser isolation valves, equipment locations specified or detailed, other locations required for drainage of systems and elsewhere as indicated.

3.5 SPRING LOADED CHECK VALVES

A. Install a spring loaded check valve in each circulating pump discharge line, each clearwater sump pump discharge line and elsewhere as indicated.

3.6 SWING CHECK VALVES

A. Install swing check valves in recirculation branch lines and elsewhere as indicated.

3.7 PRESSURE REDUCING VALVES

A. Provide ball valve and strainer at inlet and ball valve at outlet. Install pressure gauges to indicate inlet and outlet pressure at each pressure reducing valve.

3.8 SAFETY RELIEF VALVES

A. Install relief valves on all pressure vessels and elsewhere as indicated. Inlet and outlet piping connecting to valves must be the same size as valve connections or larger. Pipe discharge to drain where indicated or to floor.

END OF SECTION

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

A. This section includes specifications for supports of all plumbing equipment and materials as well as piping system anchors. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Work
- 1.3 Reference
- 1.4 Reference Standards
- 1.5 Quality Assurance
- 1.6 Description
- 1.7 Shop Drawings
- 1.8 Design Criteria

PART 2 - Products
- 2.1 Manufacturers
- 2.2 Structural Supports
- 2.3 Pipe Hangers and Supports
- 2.4 Anchors
- 2.5 Equipment Stands
- 2.6 Corrosive Atmosphere Coatings

PART 3 - Execution
- 3.1 Installation
- 3.2 Hanger and Support Spacing
- 3.3 Vertical Support
- 3.4 Concrete Inserts and Continuous Insert Channels
- 3.5 Anchors

1.2 RELATED WORK

A. Section 03 - Concrete formwork and cast-in-place concrete for equipment pads.

B. Section 22 07 00 - Plumbing Insulation for insulation protection at support devices.

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. MSS SP-58

B. MSS SP-69

1.5 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

1.6 DESCRIPTION

A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for building piping.

B. Do not hang any mechanical item directly from a metal deck or run piping so its rests on the bottom chord of any truss or joist.

C. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.

D. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.

E. Protect insulation at all hanger points; see Related Work above.

1.7 SHOP DRAWINGS

A. Schedule of all hanger and support devices indicating attachment methods and type of device for each pipe size and type of service.

1.8 DESIGN CRITERIA

A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless noted otherwise.

B. Piping connected to pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3 support distance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Anvil, Cooper B-Line, Pate, or engineer approved equal.

2.2 STRUCTURAL SUPPORTS

A. Provide all supporting steel required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspended or floor supported tanks and equipment. All of this steel may not be specifically indicated on the drawings.

2.3 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2" Through 2"
   1. Carbon steel, adjustable swivel ring. Cooper B-Line B3170NF, Anvil 69 or 70.
   2. Carbon steel, adjustable clevis, standard. Cooper B-Line B3100, Anvil 260.

B. Hangers for Pipe Sizes 2" and Larger
   1. Carbon steel, adjustable clevis, standard. Cooper B-Line B3100, Anvil 260.

C. Multiple or Trapeze Hangers
   1. Steel channels with welded spacers and hanger rods.

D. Wall Support
   1. Carbon steel welded bracket with hanger. Cooper B-Line 3068 Series, Anvil 194 Series.
   2. Perforated, epoxy painted finish, 16-12 gauge, min., steel channels securely anchored to wall structure, with interlocking, split-type, bolt secured, galvanized pipe/tubing clamps. Cooper B-Line type S channel with B-2000 series clamps, Anvil type PS 200 H with PS 1200 clamps. When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping

and avoid contact with the channel or clamp, equal to Cooper B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, Cooper B-Line BVT series, Anvil PS 1400 series.

E. Vertical Support
   1. Carbon steel riser clamp. Cooper B-Line B3373, Anvil 261 for above floor use.

F. Copper Pipe Supports
   1. All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper plated or polyvinylchloride coated. Where steel channels are used, provide isolation collar between supports/clamps/fasteners and copper piping.

G. Pipe Hanger Rods
   1. Steel Hanger Rods
      a. Threaded both ends, threaded one end, or continuous threaded, complete with adjusting and lock nuts.
      b. Size rods for individual hangers and trapeze support as indicated in the following schedule.
      c. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

Maximum Load (Lbs.) (650°F Maximum Temp.)	Rod Diameter (inches)
610	3/8
1130	1/2
1810	5/8
2710	3/4
3770	7/8
4960	1
8000	1-1/4

H. Beam Clamps
   1. MSS SP-69 Types 19 & 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick with a retaining ring and threaded rod of 3/8, 1/2, and 5/8 inch diameter. Furnish with a hardened steel cup point set screw. Cooper B-Line B3036L/B3034, Anvil 86/92.
   2. MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1-1/2 inch diameter. Cooper B-Line B3054, Anvil 228.

I. Concrete Inserts
   1. Poured In Place
      a. MSS SP-69 Type 18 wedge type to be constructed of a black carbon steel body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. Wedge design to allow the insert to be held by concrete in compression to maximize the load carrying capacity. Cooper B-Line B2505, Anvil 281.
      b. MSS SP-69 Type 18 universal type to be constructed of black malleable iron body with a removable malleable iron nut that accepts threaded rod to 7/8 inch diameter. Cooper B-Line B3014N, Anvil 282.
   2. Drilled Fasteners
      a. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead, or engineer approved equal.
   3. Continuous Concrete Insert Channels
      a. Steel inserts with an industry standard pre-galvanized finish, nominally 1-5/8 inch wide by 1-3/8 inch deep by length to suit the application, designed to be nailed to concrete forms and provide a linear slot for attaching other support devices. Installed channels to provide a load rating of 2000 pounds per foot in concrete. Manufacturer's standard brackets, inserts, and accessories designed to be used

with the channel inserts may be used. Select insert length to accommodate all pipe in the area.

2.4 ANCHORS

A. Use welding steel shapes, plates, and bars to secure piping to the structure.

2.5 EQUIPMENT STANDS

A. Use structural steel members welded to and supported by pipe supports. Clean, prime and coat with three coat rust inhibiting alkyd paint or one coat epoxy mastic. Where exposed to weather, treat with corrosive atmosphere coatings.

2.6 CORROSIVE ATMOSPHERE COATINGS

A. Factory coat supports and anchors used in corrosive atmospheres with hot dip galvanizing after fabrication, ASTM A123, 1.5 ounces/square foot of surface each side. Mechanical galvanize threaded products, ASTM B695 Class 50, 2.0 mil coating. Field cuts and damaged finishes to be field covered with zinc rich paint of comparable thickness to factory coating.

B. Corrosive atmospheres include the following locations:
   1. Exterior locations
   2. Chemical storage and hazardous waste storage rooms
   3. Locker rooms

PART 3 - EXECUTION

3.1 INSTALLATION

A. Size, apply and install supports and anchors in compliance with manufacturers recommendations.

B. Install supports to provide for free expansion of the piping system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

C. Coordinate hanger and support installation to properly group piping of all trades.

D. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes or continuous insert channels for the supporting steel. Where continuous insert channels are used, pipe supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for prior approval.

E. Size and install hangers and supports, except for riser clamps, for installation on the exterior of piping insulation. Where a vapor barrier is not required, hangers may be installed either on the exterior of pipe insulation or directly on piping.

F. Perform welding in accordance with standards of the American Welding Society.

3.2 HANGER AND SUPPORT SPACING

A. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

B. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.

C. Use hangers with 1-1/2 inch minimum vertical adjustment.

D. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

E. Support riser piping independently of connected horizontal piping.

F. Adjust hangers to obtain the slope specified in the piping section of these specifications.

G. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Max. Horiz. Spacing	Max. Vert. Spacing
Cast Iron	2" and larger	5'-0"	15'-0"
Copper	1/2" through 3/4"	5'-0"	10'-0"
Copper	1" through 1-1/4"	6'-0"	10'-0"
Copper	1-1/2" through 2-1/2"	8'-0"	10'-0"
Copper	3"	10'-0"	10'-0"
Copper	4" and larger	12'-0"	10'-0"
Ductile Iron	All	10'-0"	20'-0"
Steel	1/2" through 1-1/4"	7'-0"	15'-0"
Steel	1-1/2" through 6"	10'-0"	15'-0"

3.3 VERTICAL SUPPORT

A. Support vertical piping with clamps secured to the piping and resting on the building structure.

3.4 CONCRETE INSERTS AND CONTINUOUS INSERT CHANNELS

A. Select size based on the manufacturer's stated load capacity and weight of material that will be supported. Locate continuous insert channels on 6'-0" maximum centers and 2'-0" from corners. Furnish inserts to the General Contractor for placement in concrete formwork. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inch size. Where concrete slabs form finished ceiling, provide inserts that are flush with the slab surface.

3.5 ANCHORS

A. Install where indicated on the drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 - GENERAL

1.1 SCOPE

A. This section includes insulation specifications for plumbing piping and equipment. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Work
- 1.3 Reference
- 1.4 Reference Standards
- 1.5 Quality Assurance
- 1.6 Description
- 1.7 Definitions
- 1.8 Shop Drawings

PART 2 - Products
- 2.1 Materials
- 2.2 Insulation and Jackets
- 2.3 Accessories

PART 3 - Execution
- 3.1 Installation
- 3.2 Piping, Valve, and Fitting Insulation
- 3.3 Equipment Insulation

1.2 RELATED WORK

A. Section 22 05 00 - Common Work Results for Plumbing

B. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment

C. Section 22 11 00 - Facility Water Distribution

D. Section 22 13 00 - Facility Sanitary Sewerage

E. Section 22 14 00 - Facility Storm Drainage

F. Section 22 30 00 - Plumbing Equipment

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate

B. ASTM C165 Test Method for Compressive Properties of Thermal Insulations

C. ASTM C177 Heat Flux and Thermal Transmission Properties

D. ASTM C195 Mineral Fiber Thermal Insulation Cement

E. ASTM C240 Cellular Glass Insulation Block

F. ASTM C302 Density of Preformed Pipe Insulation

G. ASTM C303 Density of Preformed Block Insulation

H.	ASTM C449	Mineral Fiber Hydraulic Setting Thermal Insulation Cement
I.	ASTM C518	Heat Flux and Thermal Transmission Properties
J.	ASTM C533	Calcium Silicate Block and Pipe Thermal Insulation
K.	ASTM C534	Preformed Flexible Elastomeric Thermal Insulation
L.	ASTM C547	Mineral Fiber Preformed Pipe Insulation
M.	ASTM C552	Cellular Glass Block and Pipe Thermal Insulation
N.	ASTM C553	Mineral Fiber Blanket and Felt Insulation
O.	ASTM C578	Preformed, Block Type Cellular Polystyrene Thermal Insulation
P.	ASTM C591	Preformed Rigid Cellular Polyurethane Thermal Insulation
Q.	ASTM C610	Expanded Perlite Block and Thermal Pipe Insulation
R.	ASTM C612	Mineral Fiber Block and Board Thermal Insulation
S.	ASTM C921	Properties of Jacketing Materials for Thermal Insulation
T.	ASTM C1136	Flexible Low Permeance Vapor Retarders for Thermal Insulation
U.	ASTM E84	Surface Burning Characteristics of Building Materials
V.	MICA	National Commercial & Industrial Insulation Standards
W.	NFPA 225	Surface Burning Characteristics of Building Materials
X.	UL 723	Surface Burning Characteristics of Building Materials

1.5 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.

1.6 DESCRIPTION

A. Furnish and install all insulating materials and accessories as specified or as required for a complete installation. The following types of insulation are specified in this section:
   1. Pipe Insulation
   2. Equipment Insulation

B. Install all insulation in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions. Exceptions to these standards will only be accepted where specifically modified in these specifications, or where prior written approval has been obtained from the Owner’s Project Representative.

1.7 DEFINITIONS

A. Concealed: shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.

1.8 SHOP DRAWINGS

A. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials or accessories containing asbestos will not be accepted.

B. Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:
   1. Insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke developed rating no higher than 50.

2.2 INSULATION AND JACKETS

A. Manufacturers: Armstrong, Certainteed Manson, K-FLEX USA, Knauf, Owens-Corning, Johns-Mansville, or engineer approved equal.

B. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.

C. Rigid Fiberglass Insulation
   1. Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.
   2. White kraft reinforced foil vapor barrier all service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

D. Elastomeric Insulation
   1. Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75 degrees F, minimum compressive strength of 4.5 psi at 25% deformation, maximum water vapor transmission of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.

E. Jacket material shall be the same as jacket for adjacent insulation.

F. PVC Fitting Covers and Jackets
   1. White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be 0.02 inch (20 mil). Zeston 2000 or engineer approved equal.

G. Metal Jackets
   1. 0.016 inch thick aluminum or 0.010 inch thick stainless steel with safety edge.

H. Insulation Inserts and Pipe Shields
   1. Manufacturers: B-Line, Pipe Shields, Value Engineered Products, or engineer approved equal.
   2. Construct inserts with calcium silicate, minimum 140 psi compressive strength. Piping 12” and larger, supplement with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum 180 degree coverage on bottom of supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.
   3. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to pre-engineered, pre-manufactured product described above. On low temperature systems, extruded polystyrene may be substituted for calcium silicate provided insert and

shield length and gauge are increased to compensate for lower insulation compressive strength.

4. Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1”x 6” block for piping through 2-1/2” and three 1” x 6” blocks for piping through 4”. Submit shield schedule to demonstrate equivalency to pre-engineered/pre-manufactured product described above.
5. Wood blocks will not be accepted.

2.3 ACCESSORIES

A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.

B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.

C. Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be 0.015 inch for aluminum and 0.010 inch for stainless steel.

D. Tack fasteners to be stainless steel ring grooved shank tacks.

E. Staples to be clinch style.

F. Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.

G. Finishing cement to be ASTM C449.

H. Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz/sq. yd.

I. Bedding compounds to be non-shrinking and permanently flexible.

J. Vapor barrier coatings to be non-flammable, fire resistant, polymeric resin.

K. Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install insulation, jackets and accessories in accordance with manufacturers instructions and under ambient temperatures and conditions recommended by manufacturer. Surfaces to be insulated must be clean and dry.

B. Do not insulate systems or equipment which are specified to be pressure tested or inspected, until testing, inspection and any necessary repairs have been successfully completed.

C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Cover and seal exposed fiberglass insulation when insulation is terminated, no raw fiberglass insulation is allowed. Provide neat and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates. Install with longitudinal joints facing wall or ceiling.

D. Seal off raw ends of insulation and butt joints with vapor barrier mastic at intervals of not more than 20 feet on piping requiring a vapor barrier.

E. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.

F. Use full-length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.

G. Insulation shall be continuous through sleeves and openings. Vapor barriers shall be maintained continuous through all penetrations.

H. Provide a complete vapor barrier for insulation on the following systems:
   1. Cold water (potable and non-potable)
   2. Storm Water
   3. Equipment piping with a surface temperature below 65 degrees F

3.2 PIPING, VALVE, AND FITTING INSULATION

A. General
   1. Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2” lap on jacket seams and 2” tape on butt joints, firmly cemented with lap adhesive. Additionally secure with staples along seams and butt joints. Coat staples with vapor barrier mastic on systems requiring vapor barrier.
   2. Water supply piping insulation shall be continuous throughout the building and installed adjacent to and within building walls to a point directly behind the fixture that is being supplied.
   3. Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation. Where a vapor barrier is not required, hangers and supports may be attached directly to piping with insulation completely covering hanger or support and jacket sealed at support rod penetration. Where riser clamps are required to be attached directly to piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.

B. Insulation Inserts and Pipe Shields
   1. Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4” and smaller copper piping provided 12” long 22 gauge pipe shields are used.

C. Fittings and Valves
   1. Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation of the same thickness as adjoining insulation. Cover insulation with fabric reinforcing and mastic or where temperatures do not exceed 150 degrees, PVC fitting covers. Secure PVC fitting covers with tack fasteners and 1-1/2” band of mastic over ends, throat, seams or penetrations. On systems requiring vapor barrier, use vapor barrier mastic.

D. Elastomeric
   1. Where practical, slip insulation on piping during pipe installation when pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. Apply full bed of adhesive to both surfaces or use factory-applied self-seal seams.

E. Pipe Insulation Schedule
   1. Provide insulation on new and existing remodeled piping as indicated in the following schedule:

		Insulation Thickness by Pipe Size				
Service	**Types**	**1" and Smaller**	**1-1/4" to 2"**	**2-1/2" to 4"**	**5” to 6”**	**8" and Larger**
Hot Water Supply	Rigid Fiberglass	1"	1"	1.5"	1.5"	1.5"
Hot Water Circulating	Rigid Fiberglass	1"	1"	1.5"		
Cold Water	Rigid Fiberglass	0.5"	0.5"	1"	1"	1"
Tempered Water	Rigid Fiberglass	1"	1"	1.5"		
Horizontal Storm Piping and 4'-0"	Rigid Fiberglass	0.5"	0.5"	0.5"	0.5"	1"

of vertical piping thereafter						
Roof Drain bodies	Rigid Fiberglass	0.5"	0.5"	0.5"	0.5"	1"
Clearwater Waste	Rigid Fiberglass	0.5"	0.5"	0.5"	0.5"	1"
Copper and steel embedded in masonry walls	Elastomeric	0.5"	0.5"	0.5"	0.5"	0.5"

F. The following piping and fittings are not to be insulated:
   1. Chrome plated exposed supplies and stops (except where specifically noted).
   2. Water hammer arrestors.
   3. Piping unions and flanges for systems not requiring a vapor barrier.

3.3 EQUIPMENT INSULATION

A. Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.

B. Semi-Rigid Fiberglass
   1. Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place. Fill all joints, seams and depressions with insulating cement to a smooth, even surface. Cover with reinforcing fabric and 2 coats of mastic. Use vapor barrier mastic on systems requiring a vapor barrier.

C. Elastomeric/Polyolefin
   1. Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints. Place insulation with edge joints firmly butted pressing to surface for full adhesion. Seal seams and joints vapor tight.
   2. Equipment Insulation Schedule; provide equipment insulation as follows:

Equipment	**Insulation Type**	**Thickness**	**Remarks**
Water Meter	Elastomeric	0.5”	Sheet type, fabricated for ease of removal and replacement when service is required.

END OF SECTION

SECTION 22 10 13

FACILITY FUEL PIPING

PART 1 - GENERAL

1.1 SCOPE

A. This section contains specifications for fuel pipe and fuel pipe fittings for this project. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Work
- 1.3 Reference
- 1.4 Reference Standards
- 1.5 Quality Assurance
- 1.6 Shop Drawings
- 1.7 Quality Assurance
- 1.8 Delivery, Storage, and Handling
- 1.9 Design Criteria
- 1.10 Welder Qualifications
- 1.11 Natural Gas Service

PART 2 - Products
- 2.1 Fuel Oil (Supply, Return, Fill, Vent and Gauge)
- 2.2 Lube Oil Systems
- 2.3 Natural Gas
- 2.4 Vents and Relief Valves
- 2.5 Unions and Flanges

PART 3 - Execution
- 3.1 Preparation
- 3.2 Erection
- 3.3 Welded Pipe Joints
- 3.4 Threaded Pipe Joints
- 3.5 Fuel Oil (Supply, Return, Fill, Vent, and Gauge)
- 3.6 Lube Oil Systems
- 3.7 Natural Gas
- 3.8 Vents and Relief Valves
- 3.9 Unions and Flanges
- 3.10 Piping System Leak Tests

1.2 RELATED WORK

A. Section 22 05 14 - Plumbing Specialties

B. Section 22 05 19 - Meters and Gages for Plumbing Piping

C. Section 22 05 23 - General-Duty Valves for Plumbing Piping

D. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment

E. Section 22 07 00 - Plumbing Insulation.

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ANSI B16.3 Malleable Iron Threaded Fittings

B. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

C. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

D. ANSI B31.9 Pipe Material Requirements

1.5 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC – General Conditions of the Contract, Equals and Substitutions.

1.6 SHOP DRAWINGS

A. Refer to Division 1, General Conditions, Submittals.

B. Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

C. Type E or S Steel Pipe

1. Mill certification papers, also known as material test reports, for the pipe furnished for this project, in English. Heat numbers on these papers to match the heat numbers stenciled on the pipe. Chemical analysis indicated on the mill certification papers to meet or exceed the requirements of the referenced ASTM specification.

1.7 QUALITY ASSURANCE

A. Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM specification.

B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

B. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place.

C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.9 DESIGN CRITERIA

A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

B. Construct all piping for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in occupied spaces and ventilation plenum spaces, including plenum ceilings.

D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

E. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

1.10 WELDER QUALIFICATIONS

A. Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code and/or the National Certified Pipe Welding Bureau.

B. Before any polyethylene fusion welding is performed, Contractor to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.

C. The A/E or DSF reserves the right to test the work of any welder employed on the project, at the Contractor's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

1.11 NATURAL GAS SERVICE

A. All charges for the gas service as shown on the plans, including the connection from the main in the street or other location to the gas meter, shall be paid by this Contractor, including setting of gas meter(s) and all work performed by the gas company.

PART 2 - PRODUCTS

2.1 NATURAL GAS

A. Below Ground: Thermoplastic polyethylene gas pressure pipe, tubing and fittings, PE 2406/3406/3408, SDR 11.5 maximum, ASTM D2513; with butt-weld ASTM D3261 or socket-type polyethylene heat fusion fittings.

B. 2" and Smaller: ASTM A53, type E or S, standard weight (schedule 40) black steel pipe with ASTM A197/ANSI B16.3 class 150 black malleable iron threaded fittings or ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.

C. 2-1/2" and Larger: ASTM A53, type E or S, standard weight black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.

2.2 VENTS AND RELIEF VALVES

A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

2.3 UNIONS AND FLANGES

A. 2" and Smaller: ASTM A197/ANSI B16.39 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 psi.

B. 2-1/2" and Larger: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding and of a pressure class compatible with that specified for valves, piping specialties and fittings of the respective piping service. Flanges smaller than 2-1/2" may be used as needed for connecting to equipment and piping specialties. Use raised face flanges ANSI B16.5 for mating with other

raised face flanges on equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.

PART 3 - EXECUTION

3.1 PREPARATION

A. Remove all foreign material from interior and exterior of pipe and fittings.

3.2 ERECTION

A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

B. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

C. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.

D. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable. "Weldolets" and "Threadolets" may be used only for connections up to one-half (1/2) the diameter of the immediate upstream piping.

E. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment

F. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

3.3 WELDED PIPE JOINTS

A. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable.

B. Electrodes shall be Lincoln, or approved equal, with coating and diameter as recommended by the manufacturer for the type and thickness of work being done.

3.4 THREADED PIPE JOINTS

A. Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.5 NATURAL GAS

A. Install in accordance with NFPA 54 and 58. Pitch horizontal piping down 1" in 60 feet in the direction of flow. Install a 4" minimum depth dirt leg at the bottom of each vertical run and at each appliance. When installing mains and branches, cap gas tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main. Teflon tape is acceptable for use on natural gas lines.

B. Do not install gas pipe in a ventilation air plenum.

C. Bury exterior underground piping a minimum of 24" below grade.

D. All joints in underground polyethylene gas pipe must be made by qualified personnel proficient in the joining methods of ASTM D2513 thermoplastic gas pressure pipe and polyethylene fittings. Do not install polyethylene gas pipe inside buildings.

E. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least five feet above grade.

F. Install a shut off valve at each appliance. Provide a valved connection at the main for equipment and appliances furnished by others.

G. Piping through a roof shall be run through an approved roof penetration with flashing and counter flashing.

H. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.

I. Clean all welded piping before all regulators and control valves. Test by placing target cloth over piping and blow with compressed air. Clean piping until target cloth is clean and free of debris.

J. Install gas meter in accordance with all local utility requirements.

3.6 VENTS AND RELIEF VALVES

A. Install vent and relief valve discharge lines as indicated on the drawings, as detailed, and as specified for each specific valve or piping specialty item. In no event is a termination to occur less than six feet above a roof line.

3.7 UNIONS AND FLANGES

A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

3.8 PIPING SYSTEM LEAK TESTS

A. Verify that the piping system being tested is fully connected to all components and that all equipment is properly installed, wired, and ready for operation. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.

B. Provide all piping, fittings, blind flanges, and equipment to perform the testing.

C. Conduct pressure test with test medium of air or water unless specifically indicated. Minimum test time is indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by the Division's representative. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.

D. Do not insulate pipe until it has been successfully tested.

E. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

F. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or

valve packing shall show no evidence of leaking. After testing is complete, slowly release the pressure in a safe manner.

G. Measure natural gas system test pressure with a water manometer or an equivalent device calibrated in increments not greater than 0.1 inch water column. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

H. Conduct fuel oil system test so as not to impose a pressure of more than 10 psig on the tank. Instead of a pressure test, suction lines may be tested under a vacuum of not less than 20 inches of mercury maintained for at least one hour.

System	Pressure	Medium	Duration
Natural gas	100 psig	Air	24 hr

I. On piping that can not be tested because of connection to an active line, provide temporary blind flanges and hydrostatically test new section of piping. After completion of test, remove temporary flanges and make final connections to piping. Die penetrate test pass weld or x-ray the piping that was not hydrostatically tested up to the active system.

END OF SECTION

SECTION 22 11 00

FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 SCOPE

A. This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics

PART 1 - General
- 1.1 Scope
- 1.2 Related Work
- 1.3 Reference
- 1.4 Reference Standards
- 1.5 Shop Drawings
- 1.6 Quality Assurance
- 1.7 Delivery, Storage, and Handling
- 1.8 Design Criteria
- 1.9 Welder Qualifications

PART 2 - Products
- 2.1 Domestic Water
- 2.2 Dielectric Unions and Flanges
- 2.3 Unions and Flanges
- 2.4 Mechanical Grooved Pipe Connections

PART 3 - Execution
- 3.1 General
- 3.2 Preparation
- 3.3 Erection
- 3.4 Copper Pipe Joints
- 3.5 Mechanical Grooved Pipe Connections
- 3.6 Mechanically Formed Tee Fittings
- 3.7 Domestic Water
- 3.8 Dielectric Unions and Flanges
- 3.9 Unions and Flanges
- 3.10 Piping System Leak Tests

1.2 RELATED WORK

A. 22 05 14 - Plumbing Specialties

B. 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ANSI A21.4

B. ANSI A21.11

C. ANSI A21.51

D. ANSI B16.3 Malleable Iron Threaded Fittings

E. ANSI B16.4 Cast Iron Threaded Fittings

F. ANSI B16.5 Pipe Flanges and Flanged Fittings

G. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

H. ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

I. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

J. ASTM A105 Forgings, Carbon Steel, for Piping Components

K. ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

L. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

M. ASTM B32 Solder Metal

N. ASTM B88 Seamless Copper Water Tube

O. ASTM B280 Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

P. ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

Q. AWS A5.8 Brazing Filler Metal

R. AWWA C104 Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water

S. AWWA C105 Polyethylene Encasement for Ductile Iron Piping for Water

T. AWWA C110 Ductile Iron and Gray Iron Fittings, 3 In. Through 48 In., for Water and Other Liquids

U. AWWA C111 Rubber Gasket Joints for Ductile Iron and Gray Iron Pressure Pipe and Fittings

V. AWWA C151 Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds for Water or Other Liquids

W. AWWA C153 Ductile Iron Compact Fittings, 3 In. Through 48 In., for Water and Other Liquids

X. AWWA C600 Installation of Ductile Iron Water Mains and Their Appurtenances

Y. AWWA C651 Disinfecting Water Mains

1.5 SHOP DRAWINGS

A. Schedule from the contractor indicating the ASTM or AWWA specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.

B. Statement from manufacturer on his letterhead that pipe furnished meets the ASTM or AWWA specification contained in this section.

1.6 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

B. Order all copper, cast iron, steel, PVC and polyethylene pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.

C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the State.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.8 DESIGN CRITERIA

A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, AWWA or CISPI specifications as listed in this specification.

B. Construct all piping for the highest pressures and temperatures in the respective system.

C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings.

D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

E. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

F. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

1.9 WELDER QUALIFICATIONS

A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.

B. The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the State's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER

A. Above Ground

1. Type L copper water tube, H (drawn) temper, ASTM B88; wrought copper pressure fittings, ANSI B16.22; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosporous brazing alloy, AWS A5.8 BCuP. Copper mechanical grooved fittings and couplings on roll grooved pipe may be used in lieu of soldered fittings.
2. Ductile iron pipe, thickness Class 53, AWWA C151/C115; with standard thickness cement mortar lining, AWWA C104; ductile iron mechanical grooved cement mortar lined fittings and couplings on cut grooved pipe, Class 350 12" and below, Class 250 above 12", AWWA C606; ductile iron or gray iron flanged cement mortar lined fittings,

Class 250, AWWA C110; rubber gasket joints with non-toxic gasket lubricant, AWWA C111.

B. Underground To Interior Building Entrance Piping 3” And Larger:
   1. Ductile iron as specified above with factory threaded and machined flanges.

2.2 DIELECTRIC UNIONS AND FLANGES

A. Watts Regulator Company, Lochinvar, Wilkins or EPCO Sales, Inc., dielectric unions 2" and smaller; dielectric flanges 2" and larger; with iron female pipe thread to copper solder joint or brass female pipe thread end connections, non-asbestos gaskets, having a pressure rating of not less than 175 psig at 180 degrees.

2.3 UNIONS AND FLANGES

A. Unions, flanges and gasket materials to have a pressure rating of not less than 150 psig at 180 degrees. Gasket material for flanges and flanged fittings shall be teflon type. Treated paper gaskets are not acceptable.

B. 2" and Smaller Steel
   1. ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping.

C. 2" and Smaller Copper
   1. ANSI B16.18 cast bronze union coupling or ANSI B15.24 Class 150 cast bronze flanges.

D. 2-1/2" and Larger Steel
   1. ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding neck, or slip-on pattern on black steel and threaded only on galvanized steel. Use raised face flanges ANSI B16.5 for mating with other raised face flanges or equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face teflon gaskets for mating with other flat face flanges on equipment. Gaskets shall be teflon type.

E. 2-1/2" and Larger Copper
   1. ANSI B15.24 Class 150 cast bronze flanges with full face teflon gaskets.

2.4 MECHANICAL GROOVED PIPE CONNECTIONS

A. Mechanical grooved pipe couplings and fittings, ASTM F1476, as manufactured by Victaulic, Grinnell, or Gruvlok may be used with cut groove galvanized steel pipe, cut groove ductile iron pipe or roll groove copper pipe where noted. Mechanical grooved components and assemblies to be rated for minimum 250 psi working pressure.

B. All mechanical grooved pipe material including gaskets, couplings, fittings and flange adapters to be from the same manufacturer.

C. Couplings to be malleable iron, ASTM A47, or ductile iron ASTM A536 with painted finish. Reducing couplings are not acceptable.

D. Fittings used on galvanized steel pipe to be malleable iron, ASTM A47, or ductile iron A536, with galvanized finish, ASTM A153. Fittings used on ductile iron pipe to be cement mortar lined ductile iron with coal tar coating, ASTM A536; conforming to requirements of AWWA C110/C153 and AWWA C606. Fittings used on copper pipe to be copper.

E. Gaskets to be EPDM, ASTM D2000. Gaskets for hot water systems and dry pipe systems to be flush seal design. Heat treated carbon steel oval neck track bolts and nuts, ASTM A183, with zinc electroplated finish ASTM B633.

F. Flange adapters to be ductile iron, ASTM A536; except at lug type butterfly valves where standard threaded flanges shall be used.

G. Credit for the inherent flexibility of mechanical grooved pipe connections when used for expansion joints or flexible connectors may be allowed upon specific application by the Contractor. Three flexible couplings at first three connection points both upstream and downstream of pumps may be used in lieu of flexible connectors. Request for expansion joints shall be made in writing and shall include service, location, line size, proposed application and supporting calculations for the intended service.

PART 3 - EXECUTION

3.1 GENERAL

A. Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized industry practices.

3.2 PREPARATION

A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.3 ERECTION

A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

B. Where copper piping is embedded in masonry, provide protective sleeve covering of elastomeric pipe insulation.

C. Maintain piping in clean condition internally during construction.

D. Provide clearance for installation of insulation, access to valves and piping specialties.

E. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

F. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment

G. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.4 COPPER PIPE JOINTS

A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

3.5 MECHANICAL GROOVED PIPE CONNECTIONS

A. Use pipe factory grooved in accordance with the coupling manufacturer's specifications or field grooved pipe in accordance with the same specifications using specially designed tools specially designed for the application. Lubricate pipe and coupling gasket, align pipe, and secure joint in accordance with the coupling manufacturer's specifications.

3.6 MECHANICALLY FORMED TEE FITTINGS

A. The use of mechanically formed tee fittings is not permitted on this project.

3.7 DOMESTIC WATER

A. Maintain piping system in clean condition during installation. Remove dirt and debris from assembly of piping as work progresses. Cap open pipe ends where left unattended or subject to contamination.

B. Install interior water piping with drain valves where indicated and at low points of system to allow complete drainage. Install shutoff valves where indicated and at the base of risers to allow isolation of portions of system for repair. Do not install water piping within exterior walls.

C. Prior to use, isolate and fill system with potable water. Allow to stand 24 hours. Flush each outlet proceeding from the service entrance to the furthest outlet for minimum of 1 minute and until water appears clear. Fill system with a solution of water and chlorine containing at least 50 parts per million of chlorine and allow to stand for 24 hours. Alternately a solution containing at least 200 parts per million of chlorine may be used and allowed to stand for 3 hours. Flush system with potable water until chlorine concentration is no higher than source water level.

D. Wait 24 hours after final flushing. Take samples of water for lab testing. The number and location of samples shall be representative of the system size and configuration and are subject to approval by Engineer. Test shall show the absence of coliform bacteria. If test fails, repeat disinfection and testing procedures until no coliform bacteria are detected. Submit test report indicating date and time of test along with test results.

3.8 DIELECTRIC UNIONS AND FLANGES

A. Install dielectric unions or flanges at each point where a copper-to-steel pipe connection is required in domestic water systems.

3.9 UNIONS AND FLANGES

A. Install a union or flange at each connection to each piece of equipment and at other items which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

3.10 PIPING SYSTEM LEAK TESTS

A. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.

B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints. Backfill underground water mains prior to testing with the exception of thrust restrained valves which may be exposed to isolate potential leaks.

C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

D. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.

E. Entire test must be witnessed by the owner's representative. All pressure tests are to be documented on forms to be provided by the contractor.

System	Test Medium	Final Test Pressure	Final Test Duration
*Below Ground	Water	200 psig	2 hr

Domestic Water			
Above Ground Domestic Water	Water	100 psig	8 hr

Leakage on exterior mains 3" and larger may not exceed leakage calculated as follows:

GPH Allowable Leakage = [(Feet of Pipe)(Inches Dia. of Pipe)(Test Pressure)^5]/[133,200]

END OF SECTION

SECTION 22 13 00

FACILITY SANITARY SEWERAGE

PART 1 - GENERAL

1.1 SCOPE

A. This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Work
- 1.3 Reference
- 1.4 Reference Standards
- 1.5 Shop Drawings
- 1.6 Quality Assurance
- 1.7 Delivery, Storage, and Handling
- 1.8 Design Criteria
- 1.9 Welder Qualifications

PART 2 - Products
- 2.1 Sanitary Waste and Vent

PART 3 - Execution
- 3.1 General
- 3.2 Preparation
- 3.3 Erection
- 3.4 Copper Pipe Joints
- 3.5 Welded Pipe Joints
- 3.6 Threaded Pipe Joints
- 3.7 Solvent Welded Pipe Joints
- 3.8 Mechanical Hubless Pipe Connections
- 3.9 Push-On Gasketed Pipe Connections
- 3.10 Mechanically Formed Tee Fittings
- 3.11 Sanitary Waste and Vent
- 3.12 Piping System Leak Tests

1.2 RELATED WORK

A. 22 05 14 - Plumbing Specialties

B. 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ANSI A21.4

B. ANSI A21.11

C. ANSI A21.51

D. ANSI B16.3 Malleable Iron Threaded Fittings

E. ANSI B16.4 Cast Iron Threaded Fittings

F. ANSI B16.5 Pipe Flanges and Flanged Fittings

G. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

H. ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

I. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

J. ASTM A74 Standard Specifications for Hub and Spigot Cast Iron Soil Pipe and Fittings

K. ASTM A105 Forgings, Carbon Steel, for Piping Components

L. ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

M. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

N. ASTM A861 High Silicon Iron Pipe and Fittings

O. ASTM A888 Standard Specifications for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications (Latest Edition)

P. ASTM B32 Solder Metal

Q. ASTM B306 Copper Drainage Tube (DWV)

R. ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

S. ASTM C76 Reinforced Concrete Culvert, Storm Drain and Sanitary Pipe

T. ASTM C564 Standard Specifications for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

U. ASTM C1540 Standard Specification For Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe And Fittings

V. ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe

W. ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)

X. ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

Y. ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

Z. ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings

AA. ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

BB. ASTM D2774 Recommended Practice for Underground Installation of Thermoplastic Pressure Piping

CC. ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings

DD. ASTM D3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

EE. ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

FF. ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

GG. ASTM D3222 Unmodified Poly Vinylidene Fluoride (PVDF) Molding Extrusion and Coating Materials

HH. ASTM D3311 Drain, Waste and Vent (DWV) Plastic Fitting Patterns

II. AWS A5.8 Brazing Filler Metal

JJ. CISPI 301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications (Latest Edition)

1.5 SHOP DRAWINGS

A. Schedule from the contractor indicating the ASTM, or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.

B. Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, or CISPI specification contained in this section.

1.6 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

B. Order all copper, cast iron, steel, PVC and polyethylene pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.

C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the State.

1.7 DELIVERY, STORAGE, AND HANDLING

1. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.
2. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.
3. Offsite storage agreements will not relieve the contractor from using proper storage techniques.
4. Storage and protection methods must allow inspection to verify products.

1.8 DESIGN CRITERIA

1. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, or CISPI specifications as listed in this specification.
2. Construct all piping for the highest pressures and temperatures in the respective system.
3. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings.
4. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.
5. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.
6. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

1.9 WELDER QUALIFICATIONS

1. Welding procedures, welders, and welding operators for all building service piping to be in accordance with certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.
2. Before any polyethylene fusion welding is performed, Contractor to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.

3. The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the State's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

PART 2 - PRODUCTS

2.1 SANITARY WASTE AND VENT

A. Interior Above Ground
1. Hubless cast iron soil pipe and fittings, CISPI Standard 301 and ASTM A888; joints shall conform to the requirements of ASTM Standard C-1540 and shall be heavy duty type 304, minimum 28 gauge, stainless steel shielded couplings. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be manufactured by AB&I, Charlotte, or Tyler. Approved coupling manufacturers: Husky SD 4000, Clamp-All 80 or engineer approved equal.
2. Type M copper water tube, H (drawn) temper, ASTM B88; with cast copper drainage fittings (DWV), ANSI B16.23; wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP.

B. Interior Below Ground
1. Cast iron soil pipe and fittings, hub and spigot, service weight, CISPI Standard 301, ASTM A888, and ASTM A74, with neoprene rubber compression gaskets, ASTM C564 and CISPI HSN 85. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be manufactured by AB&I, Charlotte, or Tyler.
2. PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

C. Exterior Below Ground 10" and Smaller
1. Non-reinforced concrete sewer, storm drain and culvert pipe, Class III, ASTM C14; rubber gasket joints, ASTM C443; bell and spigot ends with opposing shoulder or confined O-ring seal configuration, ASTM C302.

D. Exterior Below Ground 15" and Smaller
1. Cast iron soil pipe and fittings, CISPI Standard 301, ASTM A888, and ASTM A74; with neoprene rubber compression gaskets, ASTM C564 and CISPI HSN 85. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be manufactured by AB&I, Charlotte, or Tyler.
2. PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.
3. Type PSM PVC sewer pipe and socket fittings, SDR 35, Class 12454-B (PVC 1120), ASTM D3034; primer, ASTM F656; solvent cement, ASTM 2564; or integral bell and flexible elastomeric seal, ASTM D3212.

PART 3 - EXECUTION

3.1 GENERAL

A. Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized industry practices.

3.2 PREPARATION

A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.3 ERECTION

A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

B. Where copper piping is embedded in masonry, provide protective sleeve covering of elastomeric pipe insulation.

C. Install underground warning tape 6"-12" below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.

D. Maintain piping in clean condition internally during construction.

E. Provide clearance for installation of insulation, access to valves and piping specialties.

F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

G. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment

H. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.4 COPPER PIPE JOINTS

A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

3.5 WELDED PIPE JOINTS

A. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.

3.6 THREADED PIPE JOINTS

A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.7 SOLVENT WELDED PIPE JOINTS

A. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.

B. Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2 the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4-5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set. Reference manufacturers recommendations for initial set time before handling and for full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by the Owner's Project Representative.

3.8 MECHANICAL HUBLESS PIPE CONNECTIONS

A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturers recommended torque.

3.9 PUSH-ON GASKETED PIPE CONNECTIONS

A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Insure pipe is supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

3.10 MECHANICALLY FORMED TEE FITTINGS

A. The use of mechanically formed tee fittings is not permitted on this project.

3.11 SANITARY WASTE AND VENT

A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at minimum slope of 1/4" per foot where possible and in no case less than 1/8" per foot for piping 3" and larger.

B. Install exterior piping below predicted frost level and not less than 5' bury depth to top of pipe wherever possible. Where piping is located above predicted frost level, provide frost protection in accordance with SPS 382.30(11)(c).

C. Flush piping inlets (floor drains, hub drains, mop basins, fixtures, etc.) with high flow of water at completion of project to demonstrate full flow capacity. Remove blockages and make necessary repairs where flow is found to be impeded.

3.12 PIPING SYSTEM LEAK TESTS

A. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.

B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints.

C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

D. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.

E. Entire test must be witnessed by the owner's representative. All pressure tests are to be documented on forms by contractor.

System	Medium	Final Test Pressure	Final Test Duration
Sanitary Waste and Vent	Water	10' water	2 hr

END OF SECTION

SECTION 22 14 00

FACILITY STORM DRAINAGE

PART 1 - GENERAL

1.1 SCOPE

A. This section contains specifications for plumbing pipe and pipe fittings for this project. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Work
- 1.3 Reference
- 1.4 Reference Standards
- 1.5 Shop Drawings
- 1.6 Quality Assurance
- 1.7 Delivery, Storage, and Handling
- 1.8 Design Criteria
- 1.9 Welder Qualifications

PART 2 - Products
- 2.1 Storm and Clearwater Waste and Vent
- 2.2 Subsoil Drain

PART 3 - Execution
- 3.1 General
- 3.2 Preparation
- 3.3 Erection
- 3.4 Copper Pipe Joints
- 3.5 Welded Pipe Joints
- 3.6 Threaded Pipe Joints
- 3.7 Solvent Welded Pipe Joints
- 3.8 Mechanical Hubless Pipe Connections
- 3.9 Push-On Gasketed Pipe Connections
- 3.10 Mechanically Formed Tee Fittings
- 3.11 Storm and Clearwater Waste and Vent
- 3.12 Subsoil Drain
- 3.13 Piping System Leak Tests

1.2 RELATED WORK

A. 22 05 14 - Plumbing Specialties

B. 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ANSI A21.4

B. ANSI A21.11

C. ANSI A21.51

D. ANSI B16.3 Malleable Iron Threaded Fittings

E. ANSI B16.4 Cast Iron Threaded Fittings

F. ANSI B16.5 Pipe Flanges and Flanged Fittings

G. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings

H. ANSI B16.29 Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV

I. ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless

J. ASTM A74 Standard Specifications for Hub and Spigot Cast Iron Soil Pipe and Fittings

K. ASTM A105 Forgings, Carbon Steel, for Piping Components

L. ASTM A126 Gray Cast Iron Castings for Valves, Flanges, and Pipe Fittings

M. ASTM A234 Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

N. ASTM A861 High Silicon Iron Pipe and Fittings

O. ASTM A888 Standard Specifications for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications (2005 Edition)

P. ASTM B32 Solder Metal

Q. ASTM B88 Seamless Copper Water Tube

R. ASTM B306 Copper Drainage Tube (DWV)

S. ASTM B813 Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube

T. ASTM C76 Reinforced Concrete Culvert, Storm Drain and Sanitary Pipe

U. ASTM C443 Joints for Circular Concrete Pipe Sewer and Culvert Pipe Using Rubber Gaskets

V. ASTM C564 Standard Specifications for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

W. ASTM C1540 Standard Specification For Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe And Fittings

X. ASTM D1785 Poly Vinyl Chloride (PVC) Plastic Pipe

Y. ASTM D2321 Underground Installation of Flexible Thermoplastic Sewer Pipe

Z. ASTM D2241 Poly Vinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series)

AA. ASTM D2464 Threaded Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 80

BB. ASTM D2466 Poly Vinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40

CC. ASTM D2513 Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

DD. ASTM D2564 Solvent Cements for Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

EE. ASTM D2665 Poly Vinyl Chloride (PVC) Plastic Drain, Waste and Vent Pipe and Fittings

FF. ASTM D2729 Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

GG. ASTM D2855 Making Solvent Cemented Joints with Poly Vinyl Chloride (PVC) Pipe and Fittings

HH. ASTM D3034 Type PSM Poly Vinyl Chloride (PVC) Sewer Pipe and Fittings

II. ASTM D3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

JJ. ASTM D3212 Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

KK. ASTM D3311 Drain, Waste and Vent (DWV) Plastic Fitting Patterns

LL. ASTM D4101 Propylene Plastic Injection and Extrusion Materials

MM. ASTM F405 Corrugated Polyethylene (PE) Tubing and Fittings

NN. ASTM F656 Primers for Use in Solvent Cement Joints of Poly Vinyl Chloride (PVC) Plastic Pipe and Fittings

OO. CISPI 301 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications

1.5 SHOP DRAWINGS

A. Schedule from the contractor indicating the ASTM, AWWA or CISPI specification number of the pipe being proposed along with its type and grade if known at the time of submittal, and sufficient information to indicate the type and rating of fittings for each service.

B. Statement from manufacturer on his letterhead that pipe furnished meets the ASTM, AWWA or CISPI specification contained in this section.

1.6 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

B. Order all copper, cast iron, steel, PVC and polyethylene pipe with each length marked with the name or trademark of the manufacturer and type of pipe; with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier.

C. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the State.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

B. Cover pipe to prevent corrosion or deterioration while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.8 DESIGN CRITERIA

A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM, AWWA or CISPI specifications as listed in this specification.

B. Construct all piping for the highest pressures and temperatures in the respective system.

C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in ventilation plenum spaces, including plenum ceilings.

D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

E. Where ASTM A53 type F pipe is specified, grade A type E or S, or grade B type E or S may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

F. Where ASTM B88, type L H (drawn) temper copper tubing is specified, ASTM B88, type K H (drawn) temper copper tubing may be substituted at Contractor's option.

1.9 WELDER QUALIFICATIONS

A. Welding procedures, welders, and welding operators for all building service piping to be in accordance with certified welding procedures of the National Certified Pipe Welding Bureau and Section 927.5 of ASME B31.9 Building Services Piping or AWS 10.9 Qualification of Welding Procedures and Welders for Piping and Tubing. Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section 927.6 of ASME B31.9 Building Services Piping.

B. Before any polyethylene fusion welding is performed, Contractor to submit certification that the welders to be used on this project have successfully demonstrated proper welding procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.

C. The Architect or Engineer reserves the right to test the work of any welder employed on the project, at the State's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project and all defective welds replaced.

PART 2 - PRODUCTS

2.1 STORM AND CLEARWATER WASTE AND VENT

A. Interior Above Ground
1. Hubless cast iron soil pipe and fittings, CISPI Standard 301 and ASTM A888; joints shall conform to the requirements of ASTM Standard C-1540 and shall be heavy duty type 304, minimum 28 gauge, stainless steel shielded couplings. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be manufactured by AB&I, Charlotte, or Tyler. Approved coupling manufacturers: Husky SD 4000, Clamp-All 80 or engineer approved equal.
2. Type M copper water tube, H (drawn) temper, ASTM B88; with cast copper drainage fittings (DWV), ANSI B16.23; wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP.
3. Copper drainage tube (DWV), ASTM B306; with cast copper drainage fittings (DWV), ANSI B16.23; wrought copper drainage fittings (DWV), ANSI B16.29; lead free (<.2%) solder, ASTM B32; flux, ASTM B813; copper phosphorous brazing alloy, AWS A5.8 BCuP.

B. Interior Below Ground 15" and Smaller
1. Cast iron soil pipe and fittings, hub and spigot, service weight, CISPI Standard 301, ASTM A 888, and ASTM A74; with neoprene rubber compression gaskets, ASTM C564 and CISPI HSN 85. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be manufactured by AB&I, Charlotte, or Tyler.
2. PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

C. Exterior Below Ground 10" and Smaller
1. Non-reinforced concrete sewer, storm drain and culvert pipe, Class III, ASTM C14; rubber gasket joints, ASTM C443; bell and spigot or tongue and groove ends.

D. Exterior Below Ground 15" and Smaller
1. Cast iron soil pipe and fittings, hub and spigot, service weight, CISPI Standard 301, ASTM A 888, and ASTM A74; with neoprene compression rubber gaskets, ASTM C564 and CISPI HSN 85. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be manufactured by AB&I, Charlotte, or Tyler.
2. PVC plastic pipe, Schedule 40, Class 12454-B (PVC 1120), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM 2564.

3. Type PSM PVC sewer pipe and fittings, SDR 35, Class 12454-B (PVC 1120), ASTM D3034; primer, ASTM F656; solvent cement, ASTM 2564; or integral bell and flexible elastomeric seal, ASTM D3212.

2.2 SUBSOIL DRAIN

A. PVC sewer pipe and fittings, perforated, Class 12454-B (PVC 1120), ASTM D2729; primer, ASTM F656; solvent cement, ASTM 2564; with polypropylene fabric filter cover.

PART 3 - EXECUTION

3.1 GENERAL

A. Install pipe and fittings in accordance with reference standards, manufacturers recommendations and recognized industry practices.

3.2 PREPARATION

A. Cut pipe ends square. Ream ends of piping to remove burrs. Clean scale and dirt from interior and exterior of each section of pipe and fitting prior to assembly.

3.3 ERECTION

A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. Coordinate locations of plumbing piping with piping, ductwork, conduit and equipment of other trades to allow sufficient clearances. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

B. Where copper piping is embedded in masonry, provide protective sleeve covering of elastomeric pipe insulation.

C. Install underground warning tape 6"-12" below finished grade above all exterior below ground piping. Where existing underground warning tape is encountered, repair and replace.

D. Maintain piping in clean condition internally during construction.

E. Provide clearance for installation of insulation, access to valves and piping specialties.

F. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

G. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment

H. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Provide access to valves and specialties for maintenance. Make connections to all equipment, fixtures and systems installed by others where same requires the piping services indicated in this section.

3.4 COPPER PIPE JOINTS

A. Remove all slivers and burrs remaining from the cutting operation by reaming and filing both pipe surfaces. Clean fitting and tube with metal brush, emery cloth or sandpaper. Remove residue from the cleaning operation, apply flux and assemble joint to socket stop. Apply flame to fitting until solder melts when placed at joint. Remove flame and feed solder into joint until full penetration of cup and ring of solder appears. Wipe excess solder and flux from joint.

3.5 WELDED PIPE JOINTS

A. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.

3.6 THREADED PIPE JOINTS

A. Use a thread lubricant or teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.7 SOLVENT WELDED PIPE JOINTS

A. Install in accordance with ASTM D2855 "Making Solvent Cemented Joints With PVC Pipe and Fittings". Saw cut piping square and smooth. Tube cutters may be used if they are fitted with wheels designed for use with PVC/CPVC pipe that do not leave a raised bead on pipe exterior. Support and restrain pipe during cutting to prevent nicks and scratches. Bevel ends 10-15 degrees and deburr interior. Remove dust, drips, moisture, grease and other superfluous materials from pipe interior and exterior. Check dry fit of pipe and fittings. Reject materials which are out of round or do not fit within close tolerance. Use heavy body solvent cement for large diameter fittings.

B. Maintain pipe, fittings, primer and cement between 40 and 100 degrees during application and curing. Apply primer and solvent using separate daubers (3" and smaller piping only) or clean natural bristle brushes about 1/2 the size of the pipe diameter. Apply primer to the fitting socket and pipe surface with a scrubbing motion. Check for penetration and reapply as needed to dissolve surface to a depth of 4-5 thousandths. Apply solvent cement to the fitting socket and pipe in an amount greater than needed to fill any gap. While both surfaces are wet, insert pipe into socket fitting with a quarter turn to the bottom of the socket. Solvent cement application and insertion must be completed in less than 1 minute. Minimum of 2 installers is required on piping 4" and larger. Hold joint for 30 seconds or until set. Reference manufacturers recommendations for initial set time before handling and for full curing time before pressure testing. Cold weather solvent/cement may be utilized only under unusual circumstances and when specifically approved by the Owner’s Project Representative.

3.8 MECHANICAL HUBLESS PIPE CONNECTIONS

A. Place the gasket on the end of one pipe or fitting and the clamp assembly on the end of the other pipe or fitting. Firmly seat the pipe or fitting ends against the integrally molded shoulder inside the neoprene gasket. Slide the clamp assembly into position over the gasket. Tighten fasteners to manufacturers recommended torque.

3.9 PUSH-ON GASKETED PIPE CONNECTIONS

A. Clean pipe end, bell, gasket seat and gasket of dirt or debris. Coat end of pipe and gasket with gasket lubricant. Insure pipe is supported off the ground so lubricant does not pick up dirt. Push spigot end into gasket bell with levered pipe joining tool recommended by pipe manufacturer. Large diameter exterior mains may be joined by pushing end of pipe section with backhoe against wood blocking over pipe end. Insert to fully seated position or to reference mark on pipe.

3.10 MECHANICALLY FORMED TEE FITTINGS

A. The use of mechanically formed tee fittings is not permitted on this project.

3.11 STORM AND CLEARWATER WASTE AND VENT

A. Verify invert elevations and building elevations prior to installation. Install exterior piping pitched to drain at indicated elevations and slope. Install interior piping pitched to drain at

minimum slope of 1/8" per foot where possible and in no case less than 1/16" per foot for piping 3" and larger.

B. Install exterior piping below predicted frost level and not less than 5' bury depth to top of pipe wherever possible. Where piping is located above predicted frost level, provide frost protection in accordance with SPS 382.30(11)(c).

3.12 SUBSOIL DRAIN

A. Verify invert elevations and building elevations prior to installation. Install piping sloped to drain to locations indicated. Where subsoil drains are required to penetrate foundation work, sleeve subsoil drains or use nonperforated sections of piping and place prior to foundation work.

B. Secure joints and piping where corrugated polyethylene is used to prevent movement during laying and backfill. Route piping in straight lines. Plug dead ends of pipe with pipe caps or concrete plugs. Extend filter fabric cover over all piping and fittings with fabric cover joints overlapping and banded.

C. Bed piping on and backfill around subsoil drains with pea gravel or No. 2 coarse aggregate (DOT 501.3.6.4.5) to a level 12" above or as indicated.

3.13 PIPING SYSTEM LEAK TESTS

A. Isolate or remove components from system which are not rated for test pressure. Test piping in sections or entire system as required by sequence of construction. Do not insulate or conceal pipe until it has been successfully tested.

B. If required for the additional pressure load under test, provide temporary restraints at fittings or expansion joints.

C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

D. Inspect system for leaks. Where leaks occur, repair the area with new materials and repeat the test; caulking will not be acceptable.

E. Entire test must be witnessed by the Division's representative. All pressure tests are to be documented on forms provided by the contractor.

System	Test Medium	Final Test Pressure	Final Test Duration
Storm and Clearwater Waste & Vent	Water	10' water	2 hr

END OF SECTION

SECTION 22 30 00

PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SCOPE

A. This section includes specifications for water heaters, water softeners, pumps and other equipment used for plumbing applications. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Documents
- 1.3 Reference
- 1.4 Quality Assurance
- 1.5 Shop Drawings

PART 2 - Products
- 2.1 Water Heaters
- 2.2 Sumps
- 2.3 Pumps
- 2.4 Expansion Tanks

PART 3 - Execution
- 3.1 Installation

1.2 RELATED DOCUMENTS

A. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment

B. Section 22 05 15 - Piping Specialties

C. Section 22 05 23 - General-Duty Valves for Plumbing Piping

D. Section 22 07 00 - Plumbing Insulation

E. Division 26 - Electrical

1.3 REFERENCE

A. Applicable provisions of Division 1 shall govern work under this section.

1.4 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - the General Conditions of the Contract, Article 7 Equals and Substitutions.

B. Plumbing products requiring approval by the State of Wisconsin Dept. of Safety and Professional Services must be approved or have pending approval at the time of shop drawing submission.

1.5 SHOP DRAWINGS

A. Include data concerning dimensions, capacities, materials of construction, ratings, certifications, weights, pump curves with net positive suction head requirements, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

PART 2 - PRODUCTS

2.1 WATER HEATERS

A. Power Vented Gas Fired Water Heater

1. Manufacturers: A.O. Smith, Bock, Bradford White, HTP or engineer approved equal.
2. Type: Natural gas modulating burner 5:1 turndown water heater. Design to be AGA certified with 3 year commercial tank and parts warranty.
   Efficiency: >50 gallons or >75,000 Btu/h 93% Min. Efficiency
   (Q/800+110√V) Maximum Standby Loss
   Q=Input Btu/h, V=Volume Gallons
3. Tank: 316L stainless steel tank. The primary condensing heat exchanger shall be constructed of 90/10 cupronickel. The secondary heat exchanger shall be constructed of 800H stainless steel and 90/10 cupronickel.
4. Tank insulation shall be 2" thick water blown foam. Insulation shall be enclosed in a plastic jacket. All components shall be located on the front of the heater for easy service access. All related hardware shall be constructed of stainless steel studs with brass nuts. All water connection nipples shall be constructed of stainless steel and attached to the side of the tank. Multi Fit models shall have additional top mounted piping connections to increase installation flexibility. The top and bottom of the tank shall be smooth.
5. The heaters shall be ETL listed and will exceed the minimum efficiency requirements of ASHRAE 90.1b-1992. All heaters shall be approved in accordance with ANSI Z 21.10.3. All heaters will be supplied with a factory installed ASME rated temperature and pressure relief valve, a low water cutoff, a high temperature switch, an upper hot water sensor, a lower cold water sensor, and a condensate trap assembly ready for easy connection to a field supplied condensate drain
6. The heater shall have an integrated digital controller device with integral diagnostics, LED fault and temperature settings for establishing set point and temperature differential. Ignition shall be direct spark and take place at a speed pre-set for the burner blower. The control shall utilize an algorithm to fully adjust the burner modulating firing rate while maintaining the desired temperature. In Sanitizer models, the controller is set to provide 184°F operating temperature with an adjustable 2°F differential to maintain temperature for sanitation purposes. The pre-mix stainless steel burner uses a 120 volt motor with pulse wave modulation control to change the fan speed, thus the combustion air volume of fuel and air through the burner to establish a continuous BTU input range equal to the water heating set point requirement. The digital LED control display shall provide means, via push buttons, for adjustments of operating temperatures, differential adjustment, ECO reset, service mode, and real time status mode. The control shall have low voltage inputs to accept a 0-10 volt from a building management system or outdoor sensor to alter the set point of the water heater. The unit will also have line voltage outputs for connection to a condensate pump and alarm output that will alert user of fault in the water heater for service. In addition, there shall be provided a computer connection for history, including all fault codes and hours of operation above 50% input, below 50% input, as well as real time status reporting of all operations. The burner assembly shall be mounted so as to be easily removed as an integral unit for ease of service.
7. Vent: Schedule 40 PVC with DWV solvent weld fittings with weatherproof screened outlet tee or elbow as recommended by manufacturer.

2.2 SUMPS

A. Fiberglass sump basin constructed of 25-30% fiberglass and 70-75% polyester resin with no fillers; minimum design safety factor of four; complete with tapped top flange; side hub fittings; bolted galvanized steel gasketed cover with inspection access plate, access plate with discharge pipe flange for each pump and control and vent flange where required. Minimum sump wall thickness as follows:

Wall Thickness (Inches)							
Diameter	24	30	36	42	48	60	72
Max. 10' Depth	3/16	1/4	1/4	1/4	5/16	5/16	3/8
Max. 15' Depth	1/4	5/16	5/16	5/16	3/8	3/8	7/16

B. Precast reinforced concrete manhole sections, ASTM C478. Construct base of 6" thick precast reinforced concrete or 8" thick cast in place concrete. Construct top of precast reinforced

concrete or 6" thick reinforced concrete slab. Seal between sections with rubber ring gaskets, ASTM C443, or plastic preformed gasket material. Seal pipe penetrations with flexible watertight rubber gasketed seals. Provide bolted galvanized steel or aluminum gasketed cover with inspection access plate, access plate with discharge pipe flange for each pump and control and vent flange where required.

2.3 PUMPS

A. Sump Pumps
   1. Manufacturer: Aurora/Hydromatic, Little Giant, Paco, Weil, Zoeller, or engineer approved equal.
   2. Type: Submersible pumps constructed of epoxy coated cast iron shell, cast iron volute, two vane enclosed semi-open non-clog cast iron, bronze or thermoplastic impeller, stainless steel shaft, stainless steel fasteners, upper and lower ball bearings, oil lubricated or factory sealed grease lubricated, and ceramic mechanical seal.
   3. Motor: Hermetically sealed, capacitor start, with built-in thermal overload protection sized for non-overloading over the entire pump curve.
   4. Controls
      a. Triple (Pump On, Off, High level alarm) float switch, UL listed.
      b. NEMA 1 indoor alarm panel with warning light, horn, silence switch, test switch and high level alarm switch, UL listed.
   5. Accessories
      a. 20’ power cord.
      b. NEMA 4 junction box.
      c. Discharge check valve, fullport ball valve and union for each pump.

B. In-Line System Lubricated Centrifugal Pumps
   1. Manufacturer: Bell and Gossett, Grundfos, Taco, or engineer approved equal.
   2. Type: Horizontal single stage close coupled system lubricated in-line pumps, 125 psig maximum working pressure at operating temperature of 225 deg F. continuous. The manufacturer shall certify all pump ratings. All pumps to operate without excessive noise or vibration.
   3. Casing: Bronze or stainless steel; flanged suction and discharge connection.
   4. Impeller: Bronze, stainless steel or thermoplastic, keyed to the shaft, single suction enclosed type, hydraulically and dynamically balanced.
   5. Bearings: System lubricated carbon sleeve bearings.
   6. Shaft: Stainless steel or ceramic.
   7. Seal: stainless steel can isolate rotor and stator.
   8. Motor: Provide pump with impedance protected motor sized for non-overloading over the entire pump curve. Furnish each pump and motor with a nameplate giving the manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current.

2.4 EXPANSION TANKS

A. Manufacturer: Amtrol, Bell and Gossett, Wessels, or engineer approved equal.

B. Vertical steel precharged hydro-pneumatic expansion tank, 125 psi ASME labeled construction, complete with replaceable flexible butyl rubber bladder, system connection fitting, Schrader type air charge fitting, steel base ring stand, factory prime and enamel painted exterior finish, ASME relief valve. Materials exposed to water to be NSF or FDA approved for potable water service.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plumbing equipment where indicated in accordance with manufacturer's recommendations. Coordinate equipment location with piping, ductwork, conduit and equipment

of other trades to allow sufficient clearances. Locate equipment and arrange plumbing piping to provide access space for servicing all components.

B. Set commercial water heaters on concrete housekeeping pads. Adjust and level equipment.

C. Connect equipment to water and drain piping using unions or flanges and isolation valves.

D. Size temperature & pressure relief valves per CSA rating and pipe temperature and pressure relief valves to floor drain or floor as indicated.

E. Startup and test equipment adjusting operating and safety controls for proper operation.

F. Excavate for basins. Furnish and install a minimum of 6" of granular backfill for a sub base to install the 6" thick concrete pad as detailed that extends a minimum of 1 foot beyond the basin. Include hold down anchors per manufacturer's recommendations.

G. Seal joints per manufacturer's instructions. Place piping into basins providing full support of piping on exterior bedding and insuring pipe seals are properly installed and waterproof. Backfill excavation with granular fill. Compact as specified. Furnish & install 6" thick concrete pad around rim & cover that extends a minimum of 1 foot beyond frame. Pad and casting to match finished grade. Electrical dontractor to coordinate with plumbing contractor the installation of sensors and wiring. Provide OSHA required warning signage for concealed spaces.

H. Lubricate pumps before startup. Adjust pumps for rated flow. Clean and blowdown strainers after 8 hours of operation.

I. Provide a pressure gauge on the suction side and discharge side of all circulating pumps.

J. Adjust compression tank precharge to scheduled minimum operating pressure prior to connecting to system.

END OF SECTION

SECTION 22 42 00

COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SCOPE

A. This section includes specifications for plumbing fixtures, faucets and trim. Included are the following topics:

PART 1 - General
- 1.1 Scope
- 1.2 Related Work
- 1.3 Reference
- 1.4 Quality Assurance
- 1.5 Shop Drawings
- 1.6 Design Criteria

PART 2 - Products
- 2.1 Plumbing Fixtures
- 2.2 Water Closets
- 2.3 Urinals
- 2.4 Lavatories
- 2.5 Sinks
- 2.6 Mop Basins
- 2.7 Showers
- 2.8 Electric Water Coolers
- 2.9 Emergency Eyewash Fountains and Showers

PART 3 - Execution
- 3.1 Installation

1.2 RELATED WORK

A. Section 22 05 14 - Plumbing Specialties

B. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment

C. Section 22 11 00 - Facility Water Distribution

D. Section 22 13 00 - Facility Sanitary Sewerage

E. Section 22 14 00 - Facility Storm Drainage

1.3 REFERENCE

A. Applicable provisions of Division 1 shall govern work under this section.

1.4 QUALITY ASSURANCE

A. Substitution of Materials: Refer to Section GC - General Conditions of the Contract, Equals and Substitutions.

B. Plumbing products requiring approval by the State of Wisconsin Dept. of Safety and Professional Services must be approved or have pending approval at the time of shop drawing submission.

1.5 SHOP DRAWINGS

A. Include data concerning sizes, utility sizes, rough in-dimensions, capacities, materials of construction, ratings, weights, trim, finishes, manufacturer's installation requirements, manufacturer's performance limitations, and appropriate identification.

1.6 DESIGN CRITERIA

A. ANSI A112.6.1M-88 - Supports for Off-the Floor Plumbing Fixtures for Public Use.

B. ANSI A112.18.1-94 - Finished and Rough Brass Plumbing Fixture Fittings.

C. ANSI A112.19.1-90 - Enameled Cast Iron Plumbing Fixtures.

D. ANSI A112.19.2M-82 - Vitreous China Plumbing Fixtures.

E. ANSI A112.19.5-79(R1990) - Trim for Water Closet Bowls, Tanks and Urinals.

F. ARI-1010-94 - Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers.

G. ASSE 1011-93 - Hose Connection Vacuum Breakers.

H. ASSE 1014-90 - Handheld Showers.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. Manufacturers: Fixture descriptions establish fixture type, quality, materials, features and size. Products of the following manufacturers determined to be equal by the Architect/Engineer will be accepted.

1. Water Closets - American Standard, Kohler, Sloan, Zurn, or engineer approved equal.
2. Water Closet Seats - Bemis, Beneke, Centoco, Olsonite or engineer approved equal.
3. Urinals - American Standard, Kohler, Sloan, Zurn, or engineer approved equal.
4. Lavatories - American Standard, Kohler, Sloan, Zurn, or engineer approved equal.
5. Faucets - Chicago Faucet, Kohler, Speakman, Symmons, T&S Brass, Zurn, or engineer approved equal.
6. Drains - Chicago Faucet, Kohler, McGuire, Zurn, or engineer approved equal.
7. Stops and Supplies - Chicago Faucet Co., T&S Brass, Kohler, McGuire, Zurn, or engineer approved equal. (Heavy Duty Type Only)
8. Flush Valves - Coyne & Delany, Hydrotek, Sloan Royal, Zurn AV, or engineer approved equal.
9. Traps - Kohler, McGuire, Dearborn, Zurn, or engineer approved equal (17 gauge cast brass minimum)
10. Trap Wrap – McGuire, Zurn, or engineer approved equal
11. Carriers and Supports - Josam, Smith, Wade, Watts Drainage, Zurn, or engineer approved equal.
12. Sinks - American Standard, Elkay, Just, Kohler, or engineer approved equal.
13. Mop Basins - Fiat, Mustee, Stern-Williams, or engineer approved equal.
14. Showers - Leonard, Powers, Speakman, Symmons, or engineer approved equal.
15. Electric Water Coolers - Elkay, Halsey Taylor, Haws, Filtrine, Oasis, Sunroc, or engineer approved equal.
16. Emergency Eyewash Fountains and Showers - Bradley, Encon, Chicago Faucet Co., Guardian, Haws, Speakman, or engineer approved equal.

2.2 WATER CLOSETS

A. WC-1 - Wall hung back outlet white vitreous china siphon jet water closet with elongated bowl, 1-1/2" top spud, 2-1/4” passageway and 1.6 gallon flush, barrier free adjusted for 16-1/2" bowl height. Flush valve handle 10” above rim.

1. Fixture: Kohler Kingston K-4325.
2. Flush Valve: Zurn Z6000AV-WS1.
3. Seat: Bemis 1655-SS/C white solid plastic open front.
4. Carrier: Smith commercial grade adjusted for 15" bowl height.

2.3 URINALS

A. UR-1 - Wall mount white vitreous china washout urinal with 3/4" top inlet spud, 2" outlet, removable strainer and 1 gallon flush. Battery powered, side mount sensor operated flush valve.
1. Fixture: Kohler Bardon K-4960-ET.
2. Flush Valve: Zurn ZER6003AV-WS1-CPM.
3. Carrier: Smith commercial grade adjusted for 24" lip height.

B. UR-2 - Same as UR-1, barrier free adjusted for 16" lip height. Flush valve handle to be ADA compliant.

2.4 LAVATORIES

A. L-1 - Self-rimming counter mount white vitreous china lavatory with 4" on center faucet openings.
1. Fixture: Kohler Pennington K-2196.
2. Faucet: Chicago Faucet No.802-336CP. Self closing.
3. Drain: Kohler K-13885 perforated strainer and 1-1/4" offset tailpiece.
4. Trap: 1-1/4"x1-1/2" 17 ga. cast brass trap and tubular wall bend. With C.O. plug.
5. Supplies & Stops: Chicago Faucet No. 1006-CP.

2.5 SINKS

A. S-1 - Counter mounted 18 ga type 304 stainless steel single compartment sink with 3 faucet openings 4" on center.
1. Fixture: Just SL-1921.
2. Faucet: Chicago Faucet No. 201ACP.
3. Drain: Just JB-99
4. Trap: 1-1/2"x1-1/2" 17 ga. cast brass trap and tubular wall bend, With C.O. plug.
5. Supplies & Stops: Chicago Faucet No. 1006-CP w/ 1/2" riser, length as necessary.

2.6 MOP BASINS

A. MB-1 - Floor mounted precast terrazzo mop basin, 24"x24", with 3" drain, stainless steel strainer and stainless steel curb caps.
1. Fixture: Fiat TSB-100.
2. Faucet: Chicago Faucet No.897RCF with Watts 8BC vacuum breaker.
3. Hose: Fiat 832-AA.
4. Stops: (Integral with faucet)

2.7 SHOWERS

A. SH-1.-.Pressure balanced shower valve with ceramic valving, inlet checks, inlet stops, adjustable temperature limit stop and volume control, Lever handle operated. With lever operated diverter valve, stationary shower head and hand-held adjustable head with 42" slide bar , 69" hose, in-line vacuum breaker and supply elbow. ADA compliable.
1. Fixture: Speakman SM-3060-IS

2.8 ELECTRIC WATER COOLERS

A. EWC-1 - In-wall sensor operated bottle filling station with single refrigerated oval fountain barrier free electric water cooler with stainless steel basin, self-closing front push button, wall hanger and 1-1/4" tailpiece, rated for 8 GPH at 80 degree inlet water, 90 degree ambient and 50 degree leaving water, 260 watts, 120/60/1. Mount at 36" spout height. Shall include the

WaterSentry Plus 3000-gallon capacity filter, certified to NSF/ANSI 42 and 53, with visual monitor to indicate when replacement is necessary.

1. Fixture: Elkay EZH2O w/LRPBGRNM8K | LZWS-SFGRN8K
2. Trap: 1-1/4”x1-1/4” PVC trap.
3. Stop/Supply: Chicago Faucet Co. 1006-CP or ½" ball valve with ½" riser (concealed).
4. Filters: Two (2) 3 PK Replacement Filters 51300C

2.9 EMERGENCY EYEWASH FOUNTAINS AND SHOWERS

A. EEW-1 - Wall mounted emergency eyewash with plastic bowl, eye and face wash fittings, 1/2" ball valve with push flag operator, dome strainer and wall bracket.

1. Fixture: Bradley S19-224FW.
2. Trap: 1-1/4"x1-1/4" 17 ga. cast brass trap with tubular wall return.
3. Mixing Valve: Bradley #19-2000RSW with recessed stainless steel cabinet and plexiglass window in door.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install plumbing fixtures in accordance with manufacturers instructions. Set level and plumb. Secure in place to counters, floors and walls providing solid bearing and secure mounting. Bolt fixture carriers to floor and wall. Secure rough-in fixture piping to prevent movement of exposed piping.

B. Install each fixture with trap easily removable for servicing and cleaning. Install fixture stops in readily accessible location for servicing.

C. Install barrier free fixtures in compliance with IBC 1108, 3408, and Federal ADA Accessibility Guidelines. Install barrier free lavatory traps parallel and adjacent to wall and supplies and stops elevated to 27" above floor to avoid contact by wheelchair users.

D. Provide unions at water connections to drinking fountains and electric water coolers.

E. Each fixture shall have a stop valve installation to control the fixture. Stop valves shall be heavy duty type with brass stems and screwed or sweat inlet connections. Compression type inlets are not acceptable.

F. Cover pipe penetrations with escutcheons. Exposed traps, stops, piping and escutcheons to be chrome plated brass, same items in concealed locations may be of rough brass finish.

G. Set floor mounted water closets, floor mounted service sinks; counter mounted lavs and sinks; lav and sink faucets and drains with full setting bed of flexible non-staining plumber's putty. Cover exposed water closet bolts with bolt covers.

H. Set mop basins to floor and wall with grout or silicone sealant.

I. Seal openings between walls, floors and fixtures with mildew-resistant silicone sealant same color as fixture.

J. Test fixtures to demonstrate proper operation. Replace malfunctioning units or components. Adjust valves for intended water flow rate to fixtures without splashing, noise or overflow. Adjust self-closing lavatory faucets to 15 second cycle. Adjust shower valve temperature limit stops to 110 degree maximum outlet temperature.

K. Protect fixtures during construction. At completion clean plumbing fixtures and trim using manufacturer's recommended cleaning methods and materials.

END OF SECTION

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 SCOPE

A. This section includes information common to two or more technical specification sections or items that are of a general nature, not conveniently fitting into other technical sections. Included are the following topics:

B. PART 1 - GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Protection of Finished Surfaces
7. Sleeves and Openings
8. Sealing and Firestopping
9. Submittals
10. Operating and Maintenance Data
11. Off Site Storage
12. Request and Certification for Payment
13. Certificates and Inspections
14. Operating and Maintenance Instructions
15. Training of Owner Personnel
16. Record Drawings

C. PART 2 - PRODUCTS

1. Access Panels and Doors
2. Identification
3. Sealing and Firestopping

D. PART 3 - EXECUTION

1. Excavation and Backfill
2. Concrete Work
3. Cutting and Patching
4. Building Access
5. Equipment Access
6. Coordination
7. Identification
8. Lubrication
9. Sleeves
10. Sealing and Firestopping
11. Owner Training

1.2 RELATED WORK

A. Applicable provisions of Division 1 govern work under this section.
B. Section 23 05 13 - Common Motor Requirements for HVAC.
C. Section 23 33 00 - Air Duct Accessories.

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. Abbreviations of standards organizations referenced in other sections are as follows:

1.	AABC	Associated Air Balance Council
2.	ADC	Air Diffusion Council
3.	AGA	American Gas Association
4.	AMCA	Air Movement and Control Association
5.	ANSI	American National Standards Institute
6.	ARI	Air-Conditioning and Refrigeration Institute
7.	ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
8.	ASME	American Society of Mechanical Engineers
9.	ASTM	American Society for Testing and Materials
10.	AWS	American Welding Society
11.	CGA	Compressed Gas Association
12.	EPA	Environmental Protection Agency
13.	GAMA	Gas Appliance Manufacturers Association
14.	IEEE	Institute of Electrical and Electronics Engineers
15.	ISA	Instrument Society of America
16.	MCA	Mechanical Contractors Association
17.	MICA	Midwest Insulation Contractors Association
18.	MSS	Manufacturer's Standardization Society of the Valve & Fitting Industry, Inc.
19.	NBS	National Bureau of Standards
20.	NEBB	National Environmental Balancing Bureau
21.	NEC	National Electric Code
22.	NEMA	National Electrical Manufacturers Association
23.	NFPA	National Fire Protection Association
24.	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association. Inc.
25.	UL	Underwriters Laboratories Inc.
26.	ASTM E814	Standard Test Method for Fire Tests of Through-Penetration Fire Stops
27.	ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
28.	UL1479	Fire Tests of Through-Penetration Firestops
29.	UL723	Surface Burning Characteristics of Building Materials

1.5 QUALITY ASSURANCE

A. Refer to Division 1, General Conditions, Equals and Substitutions.

B. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the contract documents, the contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the performance from the system into which these items are placed. This may include changes found necessary during the testing, adjusting, and balancing phase of the project.

1.6 PROTECTION OF FINISHED SURFACES

A. Refer to Division 1, General Requirements, Protection of Finished Surfaces.

B. Furnish one can of touch-up paint for each different color factory finish which is to be the final finished surface of the product. Deliver touch-up paint with other "loose and detachable parts" as covered in the General Requirements.

1.7 SLEEVES AND OPENINGS

A. Refer to Division 1, General Requirements, Sleeves and Openings.

1.8 SEALING AND FIRESTOPPING

A. Sealing and firestopping of sleeves/openings between ductwork, piping, etc. and the sleeve, structural or partition opening shall be the responsibility of the contractor whose work penetrates the opening. The contractor responsible shall hire individuals skilled in such work to do the sealing and fireproofing. These individuals hired shall normally and routinely be employed in the sealing and fireproofing occupation.

1.9 SUBMITTALS

A. Refer to Division 1, General Conditions, Submittals.

B. Submit for all equipment and systems as indicated in the respective specification sections, marking each submittal with that specification section number. Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents.

C. Before submitting electrically powered equipment, verify that the electrical power and control requirements for the equipment are in agreement with the motor starter schedule on the electrical drawings. Include a statement on the shop drawing transmittal to the architect/engineer that the equipment submitted and the motor starter schedule are in agreement or indicate any discrepancies. See related comments in Section 23 05 13 in Part 1 under Electrical Coordination.

D. Include wiring diagrams of electrically powered equipment.

E. Submit sufficient quantities of shop drawings to allow the following distribution:

1. Operating and Maintenance Manuals 2 copies
2. Testing, Adjusting and Balancing Contractor 1 copy
3. A/E 1 copy

F. Not more than two weeks after award of contract but before any shop drawings are submitted, the contractor shall submit the following piping system data sheet for each piping service on the project. The approved piping system data sheet(s) will be made available to the Project Representative for their use on this project.

Item	Pipe Size	[List each piping service]	Remarks
Pipe	2" & smaller	Gas	
	2.5" - 4"	Gas	
Fittings	2" & smaller	Gas	
	2.5" & larger	Gas	
Nipples			
Branch takeoffs	2" & smaller	Gas	
D=main, d=branch	2.5" & larger	Gas	
Shut-off valves	2" & smaller	Gas	
	2.5” & larger	Gas	
Hangers	Type, mfr & figure no.		
Hanger accessories			
Pipe identification			

1.10 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.11 OFF SITE STORAGE

A. Prior approval by the project representative and the A/E will be needed.

B. Generally, ductwork, metal for making ductwork, duct lining, sleeves, pipe/pipe fittings and similar rough-in material will not be accepted for off site storage. For material that can be stored off site, no material will be accepted for off site storage unless shop drawings for that material have been approved.

1.12 REQUEST AND CERTIFICATION FOR PAYMENT

A. Within 10 days after Notice to Proceed, the successful bidder will submit to the Project Representative in a form prescribed below and by the General Conditions of the Contract - Scheduling and Coordination of Work, Reports, Records and Data, Payments to Contractor, a cost breakdown of the proposed values for work performed which, if approved by the owner's representative, will become the basis for construction progress and monthly payments. The cost breakdown items shall reflect actual work progress stages as closely as feasible.

B. In addition, if payment is requested for approved off-site stored material, then that material shall be listed as a line item in the request and certification for payment cost breakdown.

1.13 CERTIFICATES AND INSPECTIONS

A. Refer also to Division 1, General Conditions, Permits, Regulations, Utilities and Taxes.

B. Obtain and pay for all required State installation inspections except those provided by the Architect/Engineer in accordance with WI Administrative Code Section ILHR 50.12. Deliver originals of these certificates to the A/E. Include copies of the certificates in the Operating and Maintenance Instructions.

1.14 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Refer to Division 1, General Requirements, Operating and Maintenance Instructions.

B. Assemble material in three ring or post binders, using an index at the front of each volume and tabs for each system or type of equipment. In addition to the data indicated in the General Requirements, include the following information:

1. Copies of all approved shop drawings.
2. Manufacturer's wiring diagrams for electrically powered equipment
3. Records of tests performed to certify compliance with system requirements
4. Certificates of inspection by regulatory agencies
5. Temperature control record drawings and control sequences
6. Parts lists for manufactured equipment
7. Valve schedules
8. Lubrication instructions, including list/frequency of lubrication done during construction
9. Warranties
10. Additional information as indicated in the technical specification sections

1.15 TRAINING OF OWNER PERSONNEL

A. Instruct the Owner's personnel in the proper operation and maintenance of systems and equipment provided as part of this project; video tape all training sessions. Include not

less than 8 hours of instruction, using the Operating and Maintenance manuals during this instruction. Demonstrate startup and shutdown procedures for all equipment. All training to be during normal working hours.

1.16 RECORD DRAWINGS

A. Refer to Division 1, General Requirements, Record Drawings.

B. In addition to the data indicated in the General Requirements, maintain temperature control record drawings on originals prepared by the installing contractor/subcontractor. Include copies of these record drawings with the Operating and Maintenance Manuals.

PART 2 PRODUCTS

2.1 ACCESS PANELS AND DOORS

A. LAY-IN CEILINGS:

1. Removable lay-in ceiling tiles in 2 X 2 foot or 2 X 4 foot configuration provided under Section 09500 are sufficient; no additional access provisions are required unless specifically indicated.

2.2 IDENTIFICATION

A. STENCILS:

1. Not less than 1 inch high letters/numbers for marking pipe and equipment.

B. SNAP-ON PIPE MARKERS:

1. Cylindrical self-coiling plastic sheet that snaps over piping insulation and is held tightly in place without the use of adhesive, tape or straps. Not less than 1 inch high letters/numbers and flow direction arrows for piping marking. W. H. Brady, Seton, Marking Services, or equal.

C. ENGRAVED NAME PLATES:

1. White letters on a black background, 1/16 inch thick plastic laminate, beveled edges, screw mounting, Setonply Style 2060 by Seton Name Plate Company or Emedolite- Style EIP by EMED Co., or equal by Marking Services, or W. H. Brady.

D. VALVE TAGS:

1. Round brass tags with 1/2 inch numbers, 1/4 inch system identification abbreviation, 1-1/4 inch minimum diameter, with brass jack chains or brass "S" hooks around the valve stem, available from EMED Co., Seton Name Plate Company, Marking Services, or W. H. Brady.

2.3 SEALING AND FIRESTOPPING

A. FIRE AND/OR SMOKE RATED PENETRATIONS:

1. Manufacturers:

a) 3M, Hilti, Rectorseal, STI/SpecSeal, Tremco, or approved equal.
b) All firestopping systems shall be provided by the same manufacturer.

2. Submittals:

a) Contractor shall submit product data for each firestop system. Submittals shall include product characteristics, performance and limitation criteria, test data, MSDS sheets, installation details and procedures for each method of installation applicable to this project.

For non-standard conditions where no UL tested system exists, submit manufacturer's drawings for UL system with known performance for which an engineering judgment can be based upon.

3. Product:

a) Fire stop systems shall be UL listed or tested by an independent testing laboratory approved by the Department of Commerce.

b) Use a product that has a rating not less than the rating of the wall or floor being penetrated. Reference architectural drawings for identification of fire and/or smoke rated walls and floors.

c) Contractor shall use firestop putty, caulk sealant, intumescent wrapstrips, intumescent firestop collars, firestop blocks, firestop mortar or a combination of these products to provide a UL listed system for each application required for this project. Provide mineral wool backing where specified in manufacturer's application detail.

B. NON-RATED PENETRATIONS:

1. Pipe Penetrations Through Below Grade Walls:

a) In exterior wall openings below grade, use a modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the uninsulated pipe and the cored opening or a water-stop type wall sleeve.

2. Pipe Penetrations:

a) At pipe penetrations of non-rated interior partitions, floors and exterior walls above grade, use urethane caulk in annular space between pipe insulation and sleeve. For non-rated drywall, plaster or wood partitions where sleeve is not required use urethane caulk in annular space between pipe insulation and wall material.

3. Duct Penetrations:

a) Annular space between duct (with or without insulation) and the non-rated partition or floor opening shall not be larger than 2". Where existing openings have an annular space larger than 2", the space shall be patched to match existing construction to within 2" around the duct.

4. Where shown or specified, pack annular space with fiberglass batt insulation or mineral wool insulation. Provide 4" sheet metal escutcheon around duct on both sides of partition or floor to cover annular space.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

A. Perform all excavation and backfill work to accomplish indicated mechanical systems installation in accordance with Division 31 - Earthwork. Blasting will not be allowed without written permission of the Architect/Engineer and the Owner.

B. Install lines passing under foundations with minimum of 1-1/2 inch clearance to concrete and insure there is no disturbance of bearing soil.

3.2 CONCRETE WORK

A. All cast-in-place concrete will be performed by the Division 3 Contractor unless otherwise noted. Provide all layout drawings, anchor bolts, metal shapes, and/or

templates required to be cast into concrete or used to form concrete for support of mechanical equipment.

3.3 CUTTING AND PATCHING

A. Refer to Division 1, General Requirements, Cutting and Patching.

3.4 BUILDING ACCESS

A. Arrange for the necessary openings in the building to allow for admittance of all apparatus. When the building access was not previously arranged and must be provided by this contractor, restore any opening to its original condition after the apparatus has been brought into the building.

3.5 EQUIPMENT ACCESS

A. Install all piping, conduit, ductwork, and accessories to permit access to equipment for maintenance and service. Coordinate the exact location of wall and ceiling access panels and doors with the General Contractor, making sure that access is available for all equipment and specialties. Access doors in general construction are to be furnished by the Mechanical Contractor and installed by the General Contractor.

B. Provide color coded thumb tacks or screws, depending on the surface, for use in accessible ceilings which do not require access panels.

3.6 COORDINATION

A. Verify that all devices are compatible for the surfaces on which they will be used. This includes, but is not limited to, diffusers, register, grilles, and recessed or semi-recessed heating and/or cooling terminal units installed in/on architectural surfaces.

B. Coordinate all work with other contractors prior to installation. Any installed work that is not coordinated and that interferes with other contractor's work shall be removed or relocated at the installing contractor's expense.

C. Cooperate with the test and balance agency in ensuring Section 23 05 93 specification compliance. Verify system completion to the test and balance agency (flushing, pressure testing, chemical treatment, filling of liquid systems, proper pressurization and air venting of hydronic systems, clean filters, clean strainers, duct and pipe systems cleaned, controls adjusted and calibrated, controls cycled through their sequences, etc.), ready for testing, adjusting and balancing work. Install dampers, shutoff and balancing valves, flow measuring devices, gauges, temperature controls, etc., required for functional and balanced systems. Demonstrate the starting, interlocking and control features of each system so the test and balance agency can perform its work.

3.7 IDENTIFICATION

A. Identify equipment in mechanical equipment rooms by stenciling equipment number and service with one coat of black enamel against a light background or white enamel against a dark background. Use a primer where necessary for proper paint adhesion. Do not label equipment such as cabinet heaters and ceiling fans in occupied spaces.

B. Where stenciling is not appropriate for equipment identification, engraved name plates may be used.

1. Identify piping not less than once every 30 feet, not less than once in each room, adjacent to each access door or panel, and on both side of the partition where exposed piping passes through walls, floors or roofs. Place flow directional arrows at each pipe identification location. Use one coat of black enamel against

a light background or white enamel against a dark background for stenciling, or provide snap-on pipe markers as specified in Part 2 – Products.

2. Identify valves with brass tags bearing a system identification and a valve sequence number. Valve tags are not required at a terminal device unless the valves are greater than ten feet from the device or located in another room not visible from the terminal unit. Provide a typewritten valve schedule indicating the valve number and the equipment or areas supplied by each valve; locate schedules in each mechanical room and in each Operating and Maintenance manual. Schedules in mechanical rooms to be framed under clear plastic.

3. Use engraved name plates to identify control equipment.

4. Label fire, smoke and combination fire smoke dampers on the exterior surface of ductwork directly adjacent to access doors using a minimum of 0.5 inch height lettering reading, “SMOKE DAMPER” or “FIRE DAMPER”. Smoke and combination fire smoke dampers shall also include a second line listing the individual damper tag. The tags must be coordinated with the mechanical schedules. Utilize stencils or manufactured labels. All other forms of identification are unacceptable. All labels shall be clearly visible from the ceiling access point.

3.8 LUBRICATION

A. Lubricate all bearings with lubricant as recommended by the manufacturer before the equipment is operated for any reason. Once the equipment has been run, maintain lubrication in accordance with the manufacturer's instructions until the work is accepted by the owner’s representative. Maintain a log of all lubricants used and frequency of lubrication; include this information in the Operating and Maintenance Manuals at the completion of the project.

3.9 SLEEVES

A. PIPE SLEEVES:

1. Provide galvanized sheet metal sleeves for pipe penetrations through interior and exterior walls to provide a backing for sealant or firestopping. Patch wall around sleeve to match adjacent wall construction and finish. Grout area around sleeve in masonry construction. In finished spaces where pipe penetration through wall is exposed to view, sheet metal sleeve shall be installed flush with face of wall.

2. Pipe sleeves are not required in interior non-rated drywall, plaster or wood partitions and sleeves are not required in existing poured concrete walls where penetrations are core drilled.

3. Pipe sleeves in new poured concrete construction shall be schedule 40 steel pipe (sized to allow insulated pipe to run through sleeve), cast in place.

4. Extend the top of sleeve 1 inch above the adjacent floor in piping floor penetrations located in the mechanical rooms and wet locations listed below. In finished areas sleeves shall be flush with rough floor.

B. DUCT SLEEVES:

1. Duct sleeves are not required in non-rated partitions or floors.

2. Provide sleeve required for fire dampers in fire-rated partitions and floors. Reference fire damper details on drawings.

3. For duct penetrations through mechanical room floors and wet locations listed below, provide 1-1/2”x 1-1/2” x 1/8” galvanized steel angles fastened to floor around the perimeter of the duct opening to prevent water from getting to floor

opening. Provide urethane caulk between angles and floor and fasten angles to floor 8” on center. Seal corners water tight with urethane caulk.

3.10 SEALING AND FIRESTOPPING

A. FIRE AND/OR SMOKE RATED PENETRATIONS:

1. Install approved product in accordance with the manufacturer's instructions where pipes penetrate a fire/smoke rated surface. When pipe is insulated, use a product which maintains the integrity of the insulation and vapor barrier.

2. Where firestop mortar is used to infill large fire-rated floor openings that could be required to support weight, provide permanent structural forming. Firestop mortar alone is not adequate to support any substantial weight.

B. NON-RATED PARTITIONS:

1. In exterior wall openings below grade, assemble rubber links of mechanical seal to the proper size for the pipe and tighten in place, in accordance with manufacturer's instructions.

2. At all interior partitions and exterior walls, pipe penetrations are required to be sealed. Apply sealant to both sides of the penetration in such a manner that the annular space between the pipe sleeve or cored opening and the pipe or insulation is completely blocked.

3. Duct penetrations through non-rated partitions shall require sheet metal escutcheons with fiberglass or mineral wool insulation fill for spaces that include laboratories, clean rooms, animal rooms, kitchens, cart wash rooms, janitor closets, cart wash rooms, toilet rooms, mechanical rooms, conference rooms, private consultation rooms, and where noted on drawings elsewhere.

3.11 OWNER TRAINING

A. All training provided for the owner will be videotaped and then transferred onto a DVD, flash drive or other media with 3 copies given to owner.

END OF SECTION 23 05 00

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section includes requirements for single and three phase motors that are used with equipment specified in other sections. Included are the following topics:

B. PART 1 – GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Shop Drawings
7. Operating and Maintenance Data
8. Electrical Coordination
9. Product Criteria

C. PART 2 – PRODUCTS

1. Three Phase, Single Speed Motors
2. Single Phase, Single Speed Motors
3. Motors Used on Variable Frequency Drives

D. PART 3 – EXECUTION

1. Installation

1.2 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.
B. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC
C. Section 23 05 14 - Variable Frequency Drives
D. Division 26 00 00 - Electrical

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ANSI/IEEE 112 Test Procedure for Polyphase Induction Motors and Generators
B. ANSI/NEMA MG-1 Motors and Generators
C. ANSI/NFPA 70 National Electrical Code

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions.

1.6 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Include with the equipment which the motor drives the following motor information: motor manufacturer, horsepower, voltage, phase, hertz, rpm, full load efficiency. Include project wiring diagrams prepared by the contractor specifically for this work.

1.7 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.8 ELECTRICAL COORDINATION

A. All starters, overload relay heater coils, disconnect switches and fuses, relays, wire, conduit, pushbuttons, pilot lights, and other devices required for the control of motors or electrical equipment are furnished and installed by the Electrical Contractor, except as specifically noted elsewhere in this division of specifications.

B. Electrical drawings and/or specifications show number and horsepower rating of all motors furnished by this Contractor, together with their actuating devices if these devices are furnished by the Electrical Contractor. Should any discrepancy in size, horsepower rating, electrical characteristics or means of control be found for any motor or other electrical equipment after contracts are awarded, Contractor is to immediately notify the architect/engineer of such discrepancy. Costs involved in any changes required due to equipment substitutions initiated by this contractor will be the responsibility of this contractor. See related comments in Section 23 05 00 - Common Work Results for HVAC, under Shop Drawings.

1.9 PRODUCT CRITERIA

A. Motors to conform to all applicable requirements of NEMA, IEEE, ANSI, and NEC standards and shall be listed by U.L. for the service specified.

B. Select motors for conditions in which they will be required to perform; i.e., general purpose, splashproof, explosion proof, standard duty, high torque or any other special type as required by the equipment or motor manufacturer's recommendations.

C. Furnish motors for starting in accordance with utility requirements and compatible with starters as specified.

P A R T 2 - P R O D U C T S

2.1 THREE PHASE, SINGLE SPEED MOTORS

A. Use NEMA rated 230, 460 volt, three phase, 60 hertz motors for all motors ½ HP and larger unless specifically indicated.

B. Use NEMA general purpose, continuous duty, Design B , normal starting torque, T-frame or U-frame motors with Class B or better insulation unless the manufacturer of the equipment on which the motor is being used has different requirements. Use open drip-proof motors unless totally enclosed fan-cooled, totally enclosed non-ventilated, explosion-proof, or encapsulated motors are specified in the equipment sections.

C. Use grease lubricated anti-friction ball bearings with housings equipped with plugged/capped provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at the end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

D. For motors on fans, furnish epoxy sealed or coated motor windings and protect rotor and stator surfaces with epoxy enamel. Double shield bearings; use waterproof non-washing grease.

E. All open drip-proof motors to have a 1.15 service factor. Other motor types may have minimum 1.0 service factors.

F. All motors 1 HP and larger, except specially wound motors and inline pump motors 56 frame and smaller, to be premium efficiency design with full load efficiencies which meet or exceed the values listed below when tested in accordance with NEMA MG 1.

FULL LOAD NOMINAL MOTOR EFFICIENCY BY MOTOR SIZE AND SPEED

MOTOR HP	-----Open Drip-Proof Motors------ -------Nominal Motor Speed------- 1200 rpm	1800 rpm	3600 rpm
1	82.5	85.5	77.0
1-1/2	86.5	86.5	84.0
2	87.5	86.5	85.5
3	88.5	89.5	85.5

MOTOR HP	----Totally Enclosed Fan-Cooled---- -------Nominal Motor Speed------ 1200 rpm	1800 rpm	3600 rpm
1	82.5	85.5	77.0
1-1/2	87.5	86.5	84.0
2	88.5	86.5	85.5
3	89.5	89.5	86.5

2.2 SINGLE PHASE, SINGLE SPEED MOTORS

A. Use NEMA rated 115 volt, single phase, 60 hertz motors for all motors 1/3 HP and smaller.

B. Use permanent split capacitor or capacitor start, induction run motors equipped with permanently lubricated and sealed ball or sleeve bearings and Class A insulation. Service factor to be not less than 1.35.

2.3 MOTORS USED ON VARIABLE FREQUENCY DRIVES

A. In addition to the requirements specified above, the motor must be suitable for use with the drive specified in Section 23 05 14, including but not limited to motor cooling. Motor shall comply with NEMA MG1 Part 31 to provide windings capable to withstand up to 1600 peak Volts with a rise time of 0.1 µs. Provide bearing protection grounding rings to bleed current from the motor shaft to the motor casing. Manufacturers: Aegis SGR,Inpro/Seal CDR, or equal.

P A R T 3 - E X E C U T I O N

3.1 INSTALLATION

A. Mount motors on a rigid base designed to accept a motor, using shims if required under each mounting foot to get a secure installation.

B. When motor will be flexible coupled to the driven device, mount coupling to the shafts in accordance with the coupling manufacturer's recommendations. Using a dial indicator, check angular misalignment of the two shafts; adjust motor position as necessary so that the angular misalignment of the shafts does not exceed 0.002 inches per inch diameter of the coupling hub. Again using the dial indicator, check the shaft for run-out to assure concentricity of the shafts; adjust as necessary so that run-out does not exceed 0.002 inch.

C. When motor will be connected to the driven device by means of a belt drive, mount sheaves on the appropriate shafts in accordance with the manufacturer's instructions. Use

a straight edge to check alignment of the sheaves; reposition sheaves as necessary so that the straight edge contacts both sheave faces squarely. After sheaves are aligned, loosen the adjustable motor base so that the belt(s) can be added and tighten the base so that the belt tension is in accordance with the drive manufacturer's recommendations. Frequently recheck belt tension and adjust if necessary during the first day of operation and again after 80 hours of operation.

D. Verify the proper rotation of each three-phase motor as it is being wired or before the motor is energized for any reason.

E. Lubricate all motors requiring lubrication. Record lubrication material used and the frequency of use. Include this information in the maintenance manuals.

END OF SECTION 23 05 13

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section includes specifications for supports of all HVAC equipment and materials as well as piping system anchors. Included are the following topics:

B. PART 1 – GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Description
7. Drawings
8. Design Criteria

C. PART 2 – PRODUCTS

1. Pipe Hanger and Support Manufacturers
2. Structural Supports
3. Pipe Hangers and Supports
4. Beam Clamps
5. Concrete Inserts
6. Anchors
7. Roof Mounted Supports
8. Equipment Curbs
9. Pipe Penetrations through Roof

D. PART 3 – EXECUTION

1. Installation
2. Hanger and Support Spacing
3. Vertical Riser Clamps
4. Anchors
5. Roof Mounted Supports
6. Equipment Curbs
7. Pipe Penetration through Roof

1.2 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.
B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
C. Section 23 07 00 - HVAC Insulation

1.3 REFERENCE

A. Applicable provisions of Division 1 shall govern work under this section.

1.4 REFERENCE STANDARDS

A. MSS SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture.
B. MSS SP-59 Pipe Hangers and Supports - Selection and Application.

1.5 QUALITY ASSURANCE

A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.6 DESCRIPTION

A. Provide all supporting devices as required for the installation of mechanical equipment and materials. All supports and installation procedures are to conform to the latest requirements of the ANSI Code for pressure piping.

B. Do not hang any mechanical item directly from a metal deck or run piping so it rests on the bottom chord of any truss or joist.

C. Support apparatus and material under all conditions of operation, variations in installed and operating weight of equipment and piping, to prevent excess stress, and allow for proper expansion and contraction.

D. Protect insulation at all hanger points; see Related Work above.

1.7 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Schedule of all hanger and support devices indicating shields, attachment methods, and type of device for each pipe size and type of service. Reference section 23 05 00.

1.8 DESIGN CRITERIA

A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless noted otherwise.

B. Piping connected to base mounted pumps, compressors, or other rotating or reciprocating equipment is to have vibration isolation supports for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Standard pipe hangers/supports as specified in this section are required beyond the 100 pipe diameter/3 support distance.

C. Piping flexible connections and vibration isolation supports are required for piping connected to coils that are in a fan assembly where the entire assembly is mounted on vibration supports; the vibration isolation supports are required for a distance of one hundred pipe diameters or three supports away from the equipment, whichever is greater. Piping flexible connection and vibration isolation supports are not required when the fan section is separately and independently isolated by means of vibration supports and duct flexible connections. Standard pipe hangers/supports as specified in this section are required when there are no vibration isolation devices in the piping and beyond the 100 pipe diameter/3 support distance.

D. Piping supported by laying on the bottom chord of joists or trusses will not be accepted.

E. Fasteners depending on soft lead for holding power or requiring powder actuation will not be accepted.

F. Allow sufficient space between adjacent pipes and ducts for insulation, valve operation, routine maintenance, etc.

P A R T 2 - P R O D U C T S

2.1 PIPE HANGER AND SUPPORT MANUFACTURERS

A. Anvil, B-Line, Fee and Mason, Kindorf, Michigan Hanger, Unistrut, or approved equal. Anvil figure numbers are listed below; equivalent material by other manufacturers is acceptable.

2.2 STRUCTURAL SUPPORTS

A. Provide all supporting steel required for the installation of mechanical equipment and materials, whether or not it is specifically indicated or sized, including angles, channels, beams, etc. to suspend or floor support tanks and equipment.

2.3 PIPE HANGERS AND SUPPORTS

A. HANGERS FOR STEEL PIPE SIZES 1/2" THROUGH 2":

1. Carbon steel, adjustable, clevis, black finish. Anvil figure 65 or 260.

B. HANGERS FOR STEEL PIPE SIZES 2-1/2" AND OVER:

1. Carbon steel, adjustable, clevis, black finish. Anvil figure 260.

2. Adjustable steel yoke, cast iron roll, double hanger. Anvil figure 181.

C. MULTIPLE OR TRAPEZE HANGERS:

1. Steel channels with welded spacers and hanger rods if calculations are submitted.

D. WALL SUPPORT:

1. Welded steel bracket with hanger. B-Line 3068 Series, Anvil 194 Series.

2. Perforated epoxy painted finish, 16-12 gauge min., steel channels securely anchored to wall structure with interlocking, split type, bolt secured, galvanized pipe/tubing clamps. B-Line type S channel with B-2000 series clamps, Anvil type AS200 H with AS 1200 clamps. When copper piping is being supported, provide flexible elastomeric/thermoplastic isolation cushion material to completely encircle the piping and avoid contact with the channel or clamp, equal to B-Line B1999 Vibra Cushion or provide manufacturers clamp and cushion assemblies, B-Line BVT series, Anvil cushion clamp assembly.

E. VERTICAL RISER SUPPORT:

1. Carbon steel riser clamp, copper plated when used with copper pipe. Anvil figure 261 for steel pipe, figure CT121 for copper pipe.

F. FLOOR SUPPORT FOR PIPE SIZES THROUGH 4":

1. Cast iron adjustable pipe saddle, locknut nipple, floor flange, and concrete pier or steel support.

G. COPPER PIPE SUPPORT:

1. Carbon steel ring, adjustable, copper plated or polyvinylchloride coated.

H. INSULATION PROTECTION SHIELDS:

1. Galvanized carbon steel of not less than 18 gauge for use on insulated pipe 2-1/2 inch and larger. Minimum shield length is 12 inches. Equal to Anvil figure 167.

I. STEEL HANGER RODS:

1. Threaded both ends, threaded one end, or continuous threaded, black finish.

2. Size rods for individual hangers and trapeze support as indicated in the following schedule.

3. Total weight of equipment, including valves, fittings, pipe, pipe content, and insulation, are not to exceed the limits indicated.

Maximum Load (Lbs.) (650°F Maximum Temp.)	Rod Diameter (inches)
610	3/8

1130	1/2
1810	5/8
2710	3/4

4. Provide rods complete with adjusting and lock nuts.

2.4 BEAM CLAMPS

A. MSS SP-69 Type 23 malleable black iron clamp for attachment to beam flange to 0.62 inches thick for single threaded rods of 3/8, 1/2, and 5/8 inch diameter, for use with pipe sizes 4 inch and less. Furnish with a hardened steel cup point set screw. Anvil figure 86.

B. MSS SP-69 Type 28 or Type 29 forged steel jaw type clamp with a tie rod to lock clamp in place, suitable for rod sizes to 1-1/2 inch diameter but limited in application to pipe sizes 8 inch and less without prior approval. Anvil figure 228.

2.5 CONCRETE INSERTS

A. Carbon steel expansion anchors, vibration resistant, with ASTM B633 zinc plating. Use drill bit of same manufacturer as anchor. Hilti, Rawl, Redhead.

2.6 ANCHORS

A. Use welding steel shapes, plates, and bars to secure piping to the structure.

2.7 ROOF MOUNTED SUPPORTS

A. HEIGHT OF SUPPORTS:

1. Based on the length of the longest main support member, the height of the support member above the roof deck to be as follows:

Length of Longest Support Member (inches)	Min. Height of Support Above Finished Roof .
Up to 36”	18 inches
37” and Over	36 inches

B. SUPPORTS 18” OR LESS IN HEIGHT:

1. Prefabricated Metal Sleeper Curb:

Constructed of not less than 18 gauge galvanized steel reinforced so it is structurally capable of supporting the intended load with no penetrations through the curb flashing, inside and outside corner sections that are mitered and continuously welded, filled with 3 pound density rigid fiberglass insulation, integral deck mounting flange, nominal two inch wood nailer, galvanized steel counter flashing with metal receiver cap Attach a galvanized steel channel track for securing pipe or duct roller and roller support. Do not use built-in metal base flashings or cants.

2. Wood Build Sleeper Curb:

Constructed of wood blocking anchored to the deck. The curb must be structurally capable of supporting the intended load with no penetrations through the curb flashing. Galvanized steel counter flashing with metal receiver cap. Attach a steel channel track for securing pipe or duct roller support. Do not use built-in metal base flashings or cants.

3. Use galvanized structural steel members supported by pipe supports and use pipe or duct rollers fastened to the structural member. Pipe supports to be secured to the roof structure and sealed per pipe penetrations through roof specifications as specified in this section.

C. SUPPORTS 36” OR MORE IN HEIGHT:

1. Roof Support Stand/Equipment Roof Support Stand:

2. Use galvanized structural steel members supported by pipe supports and use pipe or duct rollers fastened to the structural member. Pipe supports to be secured to the roof structure and sealed per pipe penetrations through roof specifications as specified in this section

2.8 EQUIPMENT CURBS

A. Prefabricated Metal Curb:

1. Constructed of not less than 18 gauge galvanized steel reinforced so it is structurally capable of supporting the intended load with no penetrations through the curb flashing, inside and outside corner sections that are mitered and continuously welded, filled with 3 pound density rigid fiberglass insulation, integral deck mounting flange, nominal two inch wood nailer, galvanized steel counter flashing. Do not use built-in metal base flashings or cants. Use 18 inch high equipment curbs where the curb completely surrounds the perimeter of the equipment and there is no roof exposed to the weather.

B. Wood Build Sleeper Curb:

1. Constructed of wood blocking and anchored to the deck. The curb must be structurally capable of supporting the intended load with no penetrations through the curb flashing. Galvanized steel counter flashing. Do not use built-in metal base flashings or cants. Use 18 inch high equipment curbs where the curb completely surrounds the perimeter of the equipment and there is no roof exposed to the weather.

2.9 PIPE PENETRATIONS THROUGH ROOF

A. Multiple Pipe Penetrations:

1. Refer to acceptable Equipment Curb types listed above for curb specifications. An 8” high (minimum) curb height is required. The coping cap shall be constructed from laminated acrylic clad thermoplastic (ABS) with graduated step boots to accommodate various size pipes, stainless steel fastening screws for cover, stainless steel band clamps for securing boots around the pipe, and stainless steel band clamp or mechanical locking seal for securing boots around the ABS coping cap flanges.

2. Single Pipe Penetrations:

3. A stack flashing penetration may be utilized for single pipe penetrations through built up roofs and single ply membrane roofs. Utilize high temperature sealant for all high temperature applications. This includes but is not limited to steam condensate vent piping, steam safety relief piping, and flues.

4. A single pre-manufactured boot may be utilized for single pipe penetrations through single ply membrane roofs only.

P A R T 3 - E X E C U T I O N

3.1 3.1 INSTALLATION

A. Install supports to provide for free expansion of the piping and duct system. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

B. Piping shall be supported independently from ductwork and all other trades.

C. Where piping can be conveniently grouped to allow the use of trapeze type supports, use standard structural shapes for the supporting steel.

D. Perform all welding in accordance with standards of the American Welding Society. Clean surfaces of loose scale, rust, paint or other foreign matter and properly align before welding. Use wire brush on welds after welding. Welds shall show uniform section, smoothness of weld metal and freedom from porosity and clinkers. Where necessary to achieve smooth connections, joints shall be dressed smooth.

3.2 HANGER AND SUPPORT SPACING

A. Place a hanger within 12 inches of each horizontal elbow, valve, strainer, or similar piping specialty item.

B. Where several pipes can be installed in parallel and at the same elevation, provide multiple or trapeze hangers.

C. Support riser piping independently of connected horizontal piping.

D. Adjust hangers to obtain the slope specified in the piping section of this specification.

E. Space hangers for pipe as follows:

Pipe Material	Pipe Size	Max. Spacing
Steel	1/2" through 1-1/4"	6'-6"
Steel	1-1/2" through 6"	10'-0"
Thermoplastic	All sizes	6'-0"
Copper	1/2" through 1-1/4"	5'-0"
Copper	1-1/2" and larger	8'-0"

3.3 VERTICAL RISER CLAMPS

A. Support vertical piping with clamps secured to the piping and resting on the building structure or secured to the building structure below at each floor.

3.4 ANCHORS

A. Install where indicated on the drawings and details. Where not specifically indicated, install anchors at ends of principal pipe runs and at intermediate points in pipe runs between expansion loops. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.5 ROOF MOUNTED SUPPORTS

A. Use for all pipe and ductwork on roof. Secure bottom of support flat on roof deck. Apply two coats of zinc rich paint to cut edges of all galvanized steel elements. Flashing and counter flashing by the General Contractor.

3.6 EQUIPMENT CURBS

A. Secure bottom of support flat on roof deck. Secure equipment to curb in accordance with equipment manufacturer's instructions. Flashing and counter flashing by the General Contractor.

B. Fill the entire void space with compressible fiberglass insulation.

3.7 PIPE PENETRATION THROUGH ROOF

A. Install at points where pipes penetrate roof. Install as shown on the drawings, as detailed and according to the manufacturer's installation instructions. Flashing and counter flashing by the General Contractor.

END OF SECTION 23 05 29

SECTION 23 05 48

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section includes specifications for vibration isolation material for equipment, piping systems, and duct systems. Included are the following topics:

B. PART 1 – GENERAL

1. Scope
2. Related Work
3. Reference
4. Quality Assurance
5. Design Criteria
6. Shop Drawings

C. PART 2 - PRODUCTS

1. Materials
2. Vibration Isolation Manufacturers
3. Type 1: Neoprene Pad
4. Type 3: Unhoused Spring with Neoprene
5. Type 4: Housed Spring with Neoprene
6. Performance
7. Blower Minimum Deflection Guide

D. PART 3 – EXECUTION

1. Installation

1.2 RELATED WORK

Applicable provisions of Division 1 govern work under this Section.
Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
Section 23 12 13 - Facility Fuel-Oil Pumps
Section 23 73 13 - Modular Indoor Central-Station Air-Handling Units
Section 23 34 00 - HVAC Fans
Section 23 33 00 - Air Duct Accessories

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions.

1.5 DESIGN CRITERIA

A. Isolate all motor driven mechanical equipment from the building structure and from the systems which they serve to prevent equipment vibrations from being transmitted to the structure. Consider equipment weight distribution to provide uniform isolator deflections.

B. For equipment with variable speed capability, select vibration isolation devices based on the lowest speed.

C. Provide flexible piping connections for all piping to rotating or reciprocating equipment mounted on vibration isolators except do not use flexible piping connectors on any type of gas piping or with inline pumps. Piping connected to a coil which is in an assembly mounted on vibration isolators is to have flexible piping connections and piping vibration hangers as specified below. Piping connected to a coil which is in an assembly where the fan is separately isolated by means of vibration isolators and duct flexible connections does not require flexible piping connectors or piping vibration hangers.

D. Credit will be given for the inherent flexibility and vibration absorption characteristics of mechanical grooved pipe connections providing that supporting calculations are submitted for approval.

E. Coordinate the selection of devices with the isolator and equipment manufacturers.

1.6 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Include isolator type, materials of construction, isolator free and operating heights, and isolation efficiency based on the lowest operating speed of the equipment supported.

P A R T 2 - P R O D U C T S

2.1 MATERIALS

A. Use materials that will retain their isolation characteristics for the life of the equipment served. Use industrial grade neoprene for elastomeric materials.

B. Treat all isolators to resist corrosion. For isolation devices exposed to the weather or used in high humidity areas, hot dip galvanize steel parts, apply a neoprene coating on all steel parts, or use stainless steel parts; include limit stops to resist wind.

C. Provide pairs of neoprene side snubbers or restraining springs where side torque or thrust may develop.

D. Use isolators with a ratio of lateral to vertical stiffness not less than 1.0 or greater than 2.0.

2.2 VIBRATION ISOLATOR MANUFACTURERS

A. Mason Industries, Amber/Booth Co., Vibration Mounting & Controls, Peabody Noise Control, or approved equal.

2.3 TYPE 1: NEOPRENE PAD

A. Neoprene waffle pad, 40 durometer with 16 gauge shims between layers.

2.4 TYPE 3: UNHOUSED SPRING WITH NEOPRENE

A. Combination freestanding, unhoused spring and neoprene with rib molded antifriction base. Include leveling bolts for securing to the equipment. Springs to be laterally stable under load and selected so they have an additional travel to solid equal to 50% of the rated deflection. Use height saving brackets when appropriate to the application.

2.5 TYPE 4: RESTRAINED SPRING WITH NEOPRENE

A. Combination spring and neoprene with rib molded base similar to Type 3 mount above, but with a housing that includes vertical limit stops to prevent spring extension when weight is removed such that the installed and operating heights are the same. Maintain a minimum clearance of 1/2" around restraining bolts, and between the housing and the spring, so as not to interfere with the spring action. Design isolator so limit stops are out of contact during normal operation.. Use height saving brackets when appropriate to the application.

2.6 PERFORMANCE

A. Select vibration isolation devices as indicated below or to provide not less than 95% isolation efficiency, whichever is greater.

	---------- Floor Span or Column Spacing----------							
	--On Grade--		---20 Feet---		---30 Feet---		---40 Feet---	
TYPE OF EQUIPMENT	Iso. Type	Min. Static Defl. In.	Iso. Type	Min. Static Defl. In.	Iso. Type	Min. Static Defl. In.	Iso. Type	Min. Static Defl. In.
AIR-COOLED CONDENSING UNITS:	Bolt to pad		3	0.75	4	1.50	4	2.50
PACKAGED AIR HANDLING UNITS: Floor mounted Thru 5 hp	3	0.35	3	0.75	3	0.75	3	0.75

DUCTWORK IN MECHANICAL EQUIPMENT ROOMS: Use type 7 hanger with .75" minimum deflection for all ducts with a cross sectional area greater than 2.0 square feet and, where either the air velocity is great than 3500 fpm or, the pressure class is 4" water column or higher.

BLOWER MINIMUM DEFLECTION GUIDE

	----------Required Deflection (Inches)----------			
Fan Speed (RPM)	On Grade	20' Floor Span	30' Floor Span	40' Floor Span
175-224	0.35	3.50	4.50	4.50
225-299	0.35	3.50	3.50	3.50

300-374	0.35	2.50	2.50	3.50
375-499	0.35	1.50	2.50	3.50
500 and over	0.35	0.75	1.50	2.50

P A R T 3 - E X E C U T I O N

3.1 INSTALLATION

A. Install vibration isolation devices for motor driven equipment in accordance with the manufacturer's installation instructions.

B. Set steel and inertia bases for one inch clearance between the concrete floor or housekeeping pad and the base.

C. Do not allow installation practices to short circuit any isolation device.

D. Install flexible piping connections on the equipment side of shut-off valves.

END OF SECTION 23 05 48

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section includes air and water testing, adjusting and balancing for the entire project. Included are the following topics:

B. PART 1 – GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Description
6. Quality Assurance
7. Pre-Installation Meeting and Scheduling
8. Pre-Balance Conference
9. Submittals

C. PART 2 – PRODUCTS

1. Instrumentation

D. PART 3 – EXECUTION

1. Daily Reports
2. Preliminary Procedures
3. Performing Testing, Adjusting and Balancing
4. Deficiencies

1.2 RELATED WORK

Applicable provisions of Division 1 govern work under this Section.
Section 23 05 00 Common Work Results for HVAC
Section 23 07 00 HVAC Insulation
Section 23 09 14 Pneumatic and Electric Instrumentation and Control Devices for HVAC
Section 23 09 23 Direct Digital Control System for HVAC

1.3 REFERENCE

A. Applicable provisions of the General Conditions, Supplementary General Conditions and General Requirements in Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A.	AABC	National Standards for Total System Balance, Sixth Edition, 2002.
B.	ASHRAE	ASHRAE Handbook, 2007 HVAC Applications, Chapter 37, Testing Adjusting and Balancing.
C.	NEBB	Procedural Standards for Testing Adjusting Balancing of Environmental Systems, Seventh Edition, 2005.

1.5 DESCRIPTION

A. The mechanical contractor will separately contract with an independent test and balance agency to perform all testing, adjusting, and balancing of air and hydronic systems required for this project. Work related to the testing, adjusting, and balancing that must be performed by the installing mechanical contractor is specified in other section of these specifications.

B. Provide total mechanical systems testing, adjusting and balancing. Requirements include the balance of air and water distribution, adjustment of new and existing systems and equipment to provide design requirements

indicated on the drawings, electrical measurement and verification of performance of all mechanical equipment, all in accordance with standards published by AABC or NEBB.

C. Test, adjust and balance all air and hydronic systems so that each room, piece of equipment or terminal device meets the design requirements indicated on the drawings and in the specifications.

D. Accomplish testing, adjusting and balancing work in a timely manner that allows partial occupancy of major buildings, occupancy of one building when the project involves many buildings, and completion of the entire project in the time stated in the Instruction to Bidders and in accordance with the completion schedule established for this project.

E. Verify that provisions are being made to accomplish the specified testing, adjusting and balancing work. If problems are found, handle as specified in Part 3 under Deficiencies.

1.6 QUALITY ASSURANCE

A. Qualifications

1. An independent Firm specializing in the Testing and Balancing of HVAC systems for a minimum of 3 years. A Firm not engaged in the commerce of furnishing or providing equipment or material generally related to HVAC work other than that specifically related to installing Testing and Balancing components necessary for work in this section such as, but not limited to sheaves, pulleys, and balancing dampers.

2. A certified member of AABC or certified by NEBB in the specific area of work performed. Maintain certification for the entire duration of the project. If certification of firm or any staff performing work is terminated or expires during the duration of the project, contact Owner’s Project Representative.

3. Technicians on this project must have satisfactorily completed work on a minimum of (3) three projects of at least 50% in size, and of similar complexity.

4. Submit Qualifications of firm and project staff to Owner’s Project Representative upon requested.

1.7 PRE-INSTALLATION MEETING AND SCHEDULING

A. The test and balance agency is required to attend a pre-installation meeting with all other project contractors before the construction process is started. The test and balance agency shall give the Lead Contractor a detailed schedule of testing and balancing tasks for incorporation into the project schedule. Reference General Conditions Article 12 for Lead Contractor responsibilities for scheduling.

1.8 PRE-BALANCE CONFERENCE

A. 90 days prior to beginning testing, adjusting and balancing, schedule and conduct a conference with the Architect/Engineer, Owner's Project Representative and the mechanical system and temperature control system installing Contractors. Provide AE and Commissioning Provider (CxP) with a complete copy of the TAB plan for the project. The objective is final coordination and verification of system operation and readiness for testing, adjusting and balancing procedures and scheduling procedures with the above mentioned parties. Indicate work required to be completed prior to testing, adjusting, and balancing and identify the party responsible for completion of that work.

1.9 SUBMITTALS

A. See also Related Work in this section.

B. Submit testing, adjusting and balancing reports bearing the seal and signature of the NEBB or AABC Certified Test and Balance Supervisor. The reports certify that the systems have been tested, adjusted and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed and are operating; and are an accurate record of all final quantities measured to establish normal operating values of the systems.

C. Submission:

1. Distribute electronic copies of the Report to the Contractor, the Lead Contractor, the Owner’s Project Representative and the Prime A/E.

D. Format: Cover page identifying project name, project number and descriptive title of contents. Divide the contents of the report into the below listed divisions:

1. General Information
2. Summary
3. Air Systems

E. Contents: Provide the following minimum information, forms and data:

1. General Information: Inside cover sheet identifying Test and Balance Agency, Contractor, Architect, Engineer, Project Name and Project Number. Include addresses, contact names and telephone numbers. Also include a certification sheet containing the seal and signature of the Test and Balance Supervisor.

2. Summary: Provide summary sheet describing mechanical system deficiencies. Describe objectionable noise or drafts found during testing, adjusting and balancing. Provide recommendations for correcting unsatisfactory performances and indicate whether modifications required are within the scope of the contract, are design related or installation related. List instrumentation used during testing, adjusting and balancing procedures.

3. The remainder of the report to contain the appropriate standard NEBB or AABC forms for each respective item and system. Fill out forms completely. Where information cannot be obtained or is not applicable indicate same.

P A R T 2 - P R O D U C T S

2.1 INSTRUMENTATION

A. Provide all required instrumentation to obtain proper measurements. Application of instruments and accuracy of instruments and measurements to be in accordance with the requirements of NEBB or AABC Standards and instrument manufacturer's specifications

B. All instruments used for measurements shall be accurate, and calibration histories for each instrument to be available for examination by owner’s project representative upon request. Calibration and maintenance of all instruments to be in accordance with the requirements of NEBB or AABC Standards

P A R T 3 - E X E C U T I O N

3.1 DAILY REPORTS

A. Submit to Owner's Project Representative daily work activity reports for each day on which testing and balancing work is performed. Reports shall include description of day's activities and description of any system deficiencies.

3.2 PRELIMINARY PROCEDURES

A. Review preconstruction meeting report, applicable construction bulletins, applicable change orders and approved shop drawings of equipment, outlets/inlets and temperature controls.

B. Check filters for cleanliness, dampers and valves for correct positioning, equipment for proper rotation and belt tension, temperature controls for completion of installation and hydronic systems for proper charge and purging of air.

C. Notify Owner's Project Representative on a daily basis during balancing. Identify deficiencies preventing completion of testing, adjusting and balancing procedures. Do not proceed until systems are fully operational with all components necessary for complete testing, adjusting and balancing. Installing Contractors are required to provide personnel to check and verify system completion, readiness for balancing and assist Balancing Agency in providing specified system performance.

3.3 PERFORMING TESTING, ADJUSTING AND BALANCING

A. Perform testing, adjusting and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards except as may be modified below.

B. Unless specifically instructed in writing, all work in this specification section is to be performed during the normal workday.

C. In areas containing ceilings, remove ceiling tile to accomplish balancing work; replace tile when work is complete and provide new tile for any tile that are damaged by this procedure. If the ceiling construction is such that access panels are required for the work of this section and the panels have not been provided, inform the owner's project representative.

D. Cut insulation, ductwork and piping for installation of test probes to the minimum extent necessary for adequate performance of procedures. Patch using materials identical to those removed, maintaining vapor barrier integrity and pressure rating of systems.

E. In air systems employing filters, blank off sufficient filter area to simulate a pressure drop that is midway between that of a clean filter and that of a dirty filter.

F. Measure and record system measurements at the fan and/or pump to determine total flow. Adjust equipment as required to yield specified total flow at terminals. Proceed taking measurements in mains and branches as required for final terminal balancing. Perform terminal balancing to specified flows balancing branch dampers, deflectors, extractors and valves prior to adjustment of terminals.

G. Measure and record static air pressure conditions across fans, coils and filters. Indicate in report if cooling coil measurements were made on a wet or dry coil and if filter measurements were made on a clean or dirty filter. Spot check static air pressure conditions directly ahead of terminal units.

H. Adjust outside air, return air and relief air dampers for design conditions at both the minimum and maximum settings and record both sets of data. Balance modulating dampers at extreme conditions and record both sets of data. Balance variable air volume systems at maximum air flow rate, full cooling, and minimum flow rate, full heating; record all data. Coordinate set points with the Temperature Control Contractor.

I. Adjust register, grille and diffuser vanes and accessories to achieve proper air distribution patterns and uniform space temperatures free from objectionable noise and drafts within the capabilities of the installed system.

J. Provide fan and motor drive sheave adjustments necessary to obtain design performance. Provide drive changes specifically noted on drawings, if any. If work of this section indicates that any drive or motor is inadequate for the application, advise the owner's project representative by giving the representative properly sized motor/drive information (in accordance with manufacturers original service factor and installed motor horsepower requirements); Confirm any change will keep the duct/piping system within its design limitations with respect to speed of the device and pressure classification of the distribution system. Required motor/drive changes not specifically noted on drawings or in specifications will be considered an extra cost and will require an itemized cost breakdown submitted to owner's project representative. Prior authorization is needed before this work is started.

K. Areas or rooms designed to maintain positive, negative or balanced air pressures with respect to adjacent spaces, as indicated by the design air quantities, require special attention. Adjust fan drives, distribution dampers, terminals and controls to maintain indicated pressure relationship.

L. Final air system measurements to be within the following range of specified cfm:

1.	Fans	0% to +10%
2.	Supply grilles, registers, diffusers	0% to +10%
3.	Return/exhaust grilles, registers	0% to -10%

M. Contact the temperature control Contractor for assistance in operation and adjustment of controls during testing, adjusting and balancing procedures. Cycle controls and verify proper operation and setpoints. Include in report description of temperature control operation and any deficiencies found.

N. Permanently mark equipment settings, including damper and valve positions, control settings, and similar devices allowing settings to be restored. Set and lock memory stops.

O. Leave systems in proper working order, replacing belt guards, closing access doors and electrical boxes, and restoring temperature controls to normal operating settings.

P. Verify and record, in the T&B Report, “K” factors for all VAV air terminal devices and air flow stations.

Q. Coordinate and assist CxP with all verification activities defined within section (01 91 01, 02) including providing all required sampling date necessary for the commissioning process.

3.4 DEFICIENCIES

A. Division 23 00 00 contractor to correct any installation deficiencies found by the test and balance agency that were specified and/or shown on the Contract Documents to be performed as part of that division of work. Test and balance agency will notify the Owner's Project Representative of these items and instructions will be issued to the Division 23 00 00 contractor for correction of the deficient work. All corrective work to be done at no cost to the Owner. Retest mechanical systems, equipment, and devices once corrective work is complete as specified.

END OF SECTION 23 05 93

SECTION 23 07 00

HVAC INSULATION

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section includes insulation specifications for heating, ventilating and air conditioning piping, ductwork and equipment. Included are the following topics:

B. PART 1 – GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Description
7. Definitions
8. Shop Drawings
9. Operation and Maintenance Data
10. Environmental Requirements

C. PART 2 – PRODUCTS

1. Materials
2. Insulation Types
3. Jackets
4. Insulation Inserts and Pipe Shields
5. Expansion Joint and Valve Insulation Blankets
6. Accessories

D. PART 3 – EXECUTION

1. Examination
2. Installation
3. Protective Jacket Installation
4. Piping, Valve and Fitting Insulation
5. Piping Protective Jackets
6. Pipe Insulation Schedule
7. Duct Insulation
8. Ductwork Protective Coverings
9. Duct Insulation Schedule
10. Equipment Insulation
11. Equipment Insulation Schedule

1.2 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.
B. Section 23 05 00 - Common Work Results for HVAC
C. Section 23 11 00 - Facility Fuel Piping
D. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
E. Section 23 31 00 - HVAC Ducts and Casings

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. Abbreviations of standards orginizations referenced in other sections are as follows:

1. ASTM B209 Aluminum and Aluminum Alloy Sheet and Plate Test Method for Compressive Properties of Thermal Insulations
2. ASTM C177 Heat Flux and Thermal Transmission Properties
3. ASTM C195 Mineral Fiber Thermal Insulation Cement
4. ASTM C240 Cellular Glass Insulation Block
5. ASTM C302 Density of Preformed Pipe Insulation
6. ASTM C303 Density of Preformed Block Insulation
7. ASTM C355 Test Methods for Test for Water Vapor Transmission of Thick Materials
8. ASTM C449 Mineral Fiber Hydraulic Setting Thermal Insulation Cement
9. ASTM C518 Heat Flux and Thermal Transmission Properties
10. ASTM C533 Calcium Silicate Block and Pipe Thermal Insulation
11. ASTM C534 Preformed Flexible Elastomeric Thermal Insulation
12. ASTM C547 Mineral Fiber Preformed Pipe Insulation
13. ASTM C552 Cellular Glass Block and Pipe Thermal Insulation
14. ASTM C553 Mineral Fiber Blanket and Felt Insulation
15. ASTM C578 Preformed, Block Type Cellular Polystyrene Thermal Insulation
16. ASTM C591 Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
17. ASTM C610 Expanded Perlite Block and Thermal Pipe Insulation
18. ASTM C612 Mineral Fiber Block and Board Thermal Insulation
19. ASTM C921 Properties of Jacketing Materials for Thermal Insulation
20. ASTM C1136 Flexible Low Permeance Vapor Retarders for Thermal Insulation
21. ASTM D412 Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
22. ASTM D1000 Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
23. ASTM D1621 Standard Test Method for Compressive Properties Of Rigid Cellular Plastics
24. ASTM D1622 Standard Test Method for Apparent Density of Rigid Cellular Plastics
25. ASTM D1940 Method of Test for Porosity of Rigid Cellular Plastics
26. ASTM D2126 Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
27. ASTM D2240 Standard Test Method for Rubber Property—Durometer Hardness
28. ASTM E84 Surface Burning Characteristics of Building Materials
29. ASTM E814 Standard Test Method for Fire Tests of Penetration Firestop Systems
30. ASTM E2336 Standard Test Methods for Fire Resistive Grease Duct Enclosure Systems
31. MICA National Commercial & Industrial Insulation Standards
32. NFPA 225 Surface Burning Characteristics of Building Materials
33. UL 723 Surface Burning Characteristics of Building Materials

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions

B. Label all insulating products delivered to the construction site with the manufacturer's name and description of materials.

C. Insulation systems shall be applied by experienced contractors. Within the past five (5) years, the contractor shall be able to document the successful completion of a minimum of three (3) projects of at least 50% of the size and similar scope of the work specified in this section.

1.6 DESCRIPTION

A. Furnish and install all insulating materials and accessories as specified or as required for a complete installation. The following types of insulation are specified in this section:

1. Pipe Insulation
2. Duct Insulation
3. Equipment Insulation

B. Install all insulation in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions. Exceptions to these standards will only be accepted where specifically modified in these specifications, or where prior written approval has been obtained from the Owner's Project Representative.

1.7 DEFINITIONS

A. Concealed: shafts, furred spaces, space above finished ceilings, utility tunnels and crawl spaces. All other areas, including walk-through tunnels, shall be considered as exposed.

1.8 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Submit a schedule of all insulating materials to be used on the project, including adhesives, fastening methods, fitting materials along with material safety data sheets and intended use of each material. Include manufacturer's technical data sheets indicating density, thermal characteristics, jacket type, and manufacturer's installation instructions.

1.9 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not store insulation materials on grade or where they are at risk of becoming wet. Donot install insulation products that have been exposed to water.

B. Protect installed insulation work with plastic sheeting to prevent water damage.

P A R T 2 - P R O D U C T S

2.1 MATERIALS

A. Manufacturers: Armacell, Certainteed, Manson, Childers, Dow, Extol, Fibrex, Halstead, H.B. Fuller, Imcoa, Johns Manville, Knauf, Owens-Corning, Partek, Pittsburgh Corning, Rubatex, VentureTape or approved equal.

B. Materials or accessories containing asbestos will not be accepted.

C. Use composite insulation systems (insulation, jackets, sealants, mastics, and adhesives) that have a flame spread rating of 25 or less and smoke developed rating of 50 or less, with the following exceptions:

D. Pipe insulation which is not located in an air plenum may have a flame spread rating not over 25 and a smoke developed rating no higher than 450 when tested in accordance with UL 723 and ASTM E84.

2.2 INSULATION TYPES

A. Insulating materials shall be fire retardant, moisture and mildew resistant, and vermin proof. Insulation shall be suitable to receive jackets, adhesives and coatings as indicated.

B. FLEXIBLE FIBERGLASS INSULATION:

1. Minimum nominal density of 0.75 lbs. per cu. ft., and thermal conductivity of not more than 0.3 at 75 degrees F, rated for service to 250 degrees F.

C. RIGID FIBERGLASS INSULATION:

1. Minimum nominal density of 3 lbs. per cu. ft., and thermal conductivity of not more than 0.23 at 75 degrees F, minimum compressive strength of 25 PSF at 10% deformation, rated for service to 450 degrees F.

D. SEMI-RIGID FIBERGLASS INSULATION:

1. Minimum nominal density of 3 lbs. per cu. ft., thermal conductivity of not more than 0.28 at 75 degrees F, minimum compressive strength of 125 PSF at 10% deformation, rated for service to 450 degrees F. Insulation fibers perpendicular to jacket and scored for wrapping cylindrical surfaces.

E. CALCIUM SILICATE INSULATION:

1. Rigid hydrous calcium silicate, ASTM C533, Type I, minimum dry density of 12.5 lbs. per cu. ft., thermal conductivity of not more than 0.44 at 300 degrees F, maximum water absorption of 90% by volume, minimum compressive strength 140 psi at 5% deformation, rated for service range of 0 degrees F to 1,200 degrees F,. Material to be visually coded or marked to indicate it is asbestos free.

F. ELASTOMERIC INSULATION:

1. Flexible closed cell, minimum nominal density of 5.5 lbs. per cu. ft., thermal conductivity of not more than 0.27 at 75 degrees F, minimum compressive strength of 4.5 psi at 25% deformation, maximum water vapor permeability of 0.17 perm inch, maximum water absorption of 6% by weight, rated for service range of -20 degrees F to 220 degrees F on piping and 180 degrees F where adhered to equipment.

G. POLYOLEFIN INSULATION:

1. Flexible closed cell, minimum nominal density of 1.5 lbs. per cu. ft., thermal conductivity of not more than 0.24 at 75 degrees F, minimum compressive strength of 5 psi at 25% deformation, maximum water vapor permeability of 0.0 perm inch, maximum water absorption of 0% by weight and volume, rated for service range of -165 degrees F to 210 degrees F.

H. EXTRUDED POLYSTYRENE INSULATION:

1. Rigid closed cell, minimum nominal density of 1.6 lbs. per cu. ft., thermal conductivity of not more than 0.285 at 75 degrees F, minimum compressive strength of 20 psi, maximum water vapor permeability of 1.5 perm inch, maximum water absorption of .5 % by volume, rated for service range of -290 degrees F to 165 degrees F.

I. POLYISOCYANURATE INSULATION:

1. Rigid closed cell polyisocyanurate, minimum nominal density of 2.0 lbs. per cu. ft., thermal conductivity of not more than 0.19 at 75 degrees F aged 180 days, minimum compressive strength of 24 psi parallel and 13 psi perpendicular, maximum water vapor permeability of 4 perm inch, maximum water absorption of 2% by volume, rated for service range of -290 degrees F to 300 degrees F.

J. CELLULAR GLASS INSULATION:

2. Rigid closed cell, minimum nominal density of 8.5 lbs. per cu. ft., thermal conductivity of not more than 0.36 at 50 degrees F, minimum compressive strength of 100 psi, maximum water vapor permeability of 0.0 perm inch, maximum water absorption of .2% by volume, rated for service range of -450 degrees F to 900 degrees F.

K. MINERAL WOOL INSULATION:

1. Rigid preformed mineral fiber, minimum nominal density of 8 lbs. per cu. ft.,thermal conductivity of not more than 0.29 at 200 degrees F, minimum compressive strength of 3 psi, maximum wicking of 1%, maximum water adsorption of 1% by volume, rated for service of -120 degrees F to 1200 degrees F.

2. Pipe insulation shall be preformed in two (2) half cylinder sections. Cut V-groove sheet insulation is not acceptable. Provide three (3) stainless steel bands for each section of insulation.

L. FIREPROOFING INSULATION:

1. Mineral fiber with nominal density of 8 lbs. per cu. ft., flame spread index of 25, fuel contribution index of 0, and smoke developed index of 0, thermal conductivity of not more than 0.23 at 75 degrees F, rated for service of -120 degrees F to 1200 degrees F. Use rigid or semi-rigid board for duct insulations.

2. Foil-scrim-polyethylene vapor barrier jacket, factory applied to insulation,maximum permeance of .02 perms.

M. FIRE-STOP INSULATION:

1. Noncombustible, non-asbestos, non-ceramic fiber, high temperature blanket or board fireproofing insulation, constructed of calcium silicate or calcium/magnesium/silica amorphous wool with 2-hour ASTM E814 “F” and “T” fire ratings, UL or equivalent third party listed, labeled and specifically evaluated for such purpose in accordance with ASTM E2336. Foil-scrim-polyethylene fiberglass reinforced factory applied jacket.

2.3 JACKETS

A. PVC FITTING COVERS AND JACKETS (PFJ):

1. White PVC film, gloss finish one side, semi-gloss other side, FS LP-535D, Composition A, Type II, Grade GU. Ultraviolet inhibited indoor/outdoor grade to be used where exposed to high humidity, ultraviolet radiation, in kitchens or food processing areas or installed outdoors. Jacket thickness to be minimum .02” indoors/.03”outdoors for piping 12” and smaller, .03” indoors/.04” outdoors for piping 15” and larger.

B. ALL SERVICE JACKETS (ASJ):

1. Heavy duty, fire retardant material with white kraft reinforced foil vapor barrier, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of .02 perms and minimum beach puncture resistance of 50 units.

C. FOIL SCRIM ALL SERVICE JACKETS (FSJ):

1. Glass fiber reinforced foil kraft laminate, factory applied to insulation. Maximum permeance of .02 perms and minimum beach puncture resistance of 25 units.

D. PROTECTIVE METAL JACKETS (PMJ):

1. .016 inch thick aluminum or .010 inch thick stainless steel with safety edge.

E. SELF-ADHERING JACKETS (SAJ):

1. 5-ply, self-adhering multiple laminated waterproofing material with reflective aluminum foil, high density polymer films and cold weather acrylic adhesive providing zero (0.0) permeability. Minimum 6 mils material thickness, 35lb

puncture resistance when tested in accordance with ASTM D1000 and flame spread/smoke developed rating of 10/20 when tested in accordance with UL 723.

2. Vapor retarding tape shall be specifically designed and manufactured for usewith the self-adhering jacket specified above. Tape shall be provided by the same manufacturer that provides jacketing. Vapor retarding tapes used with self-adhering jackets shall have a maximum permeance of 0.0 perms.

F. FABRIC REINFORCED MASTIC JACKETS (FMJ):

1. Glass fiber reinforcing fabric imbedded in weather barrier mastic as per manufacturer's recommended procedure for 2 coat application.

G. VAPOR RETARDING JACKETS (VRJ):

1. Polyvinylidene chloride (PVDC) vapor retarding jacket material with minimum 6 mils material thickness and maximum permeance of 0.01 perms. Material shall not support the growth of mold or mildew. Dow Saran or equivalent.

2. Vapor retarding tape shall be specifically designed and manufactured for use with the vapor retarding jacket specified above. Tape shall be provided by the same manufacturer that provides jacketing. Vapor retarding tapes used with vapor retarding jackets shall have a maximum permeance of 0.01 perms.

2.4 INSULATION INSERTS AND PIPE SHIELDS

A. Manufacturers: B-Line, Pipe Shields, Value Engineered Products

B. Construct inserts with calcium silicate or polyisocyanurate (service temperatures below 300 degrees F only), minimum 140 psi compressive strength. Piping 12" and larger, supplement with high density 600 psi structural calcium silicate insert. Provide galvanized steel shield. Insert and shield to be minimum 180 degree coverage on bottom supported piping and full 360 degree coverage on clamped piping. On roller mounted piping and piping designed to slide on support, provide additional load distribution steel plate.

C. Where contractor proposes shop/site fabricated inserts and shields, submit schedule of materials, thicknesses, gauges and lengths for each pipe size to demonstrate equivalency to preengineered/premanufactured product described above. On low temperature systems, high density rigid polyisocyanurate may be substituted for calcium silicate provided insert and shield length and shield gauge are increased to compensate for lower insulation compressive strength.

D. Precompressed 20# density molded fiberglass blocks, Hamfab or equal, of the same thickness as adjacent insulation may be substituted for calcium silicate inserts with one 1"x6" block for piping through 2-1/2" and three 1"x6" blocks for piping through 4". Submit shield schedule to demonstrate equivalency to preengineered/premanufactured product described above.

E. Wood blocks will not be accepted.

2.5 EXPANSION JOINT AND VALVE INSULATION BLANKETS

A. Manufacturers: Advance Thermal Corporation, TANI Division B.D. Schiffler or approved equal.

B. Jacket shall be 7 ounce per square yard Teflon coated Nomex fabric which is designed for wet and dry steam applications to 550ºF. Equal to Advance Thermal Corp. Steamguard-1 cloth. The covers shall be installed to shed water and have a 1-inch rain flap.

C. All seams shall be sewn twice with double locked stitching. One seam shall be sewn with 3-ply Nomex and the other with 3-ply stainless steel. Hog rings and staples shall not be used.

D. The insulation shall be a 2-inch thick, 6 lb. density ceramic fiber which is held in place with 12 gauge stainless quilt pins which do not puncture the inner surface of the cover.

E. Covers shall be designed to allow access to the expansion and ball joints packing cylinder plungers for repacking with removing the covers.

F. Adjacent pipe insulation must be installed to allow the piping to expand into expansion joints without damaging the insulation or removable covers.

2.6 ACCESSORIES

A. All products shall be compatible with surfaces and materials on which they are applied, and be suitable for use at operating temperatures of the systems to which they are applied.

B. Adhesives, sealants, and protective finishes shall be as recommended by insulation manufacturer for applications specified.

C. Insulation bands to be 3/4 inch wide, constructed of aluminum or stainless steel. Minimum thickness to be .015 inch for aluminum and .010 inch for stainless steel.

D. Tack fasteners to be stainless steel ring grooved shank tacks.

E. Staples to be clinch style.

F. Insulating cement to be ANSI/ASTM C195, hydraulic setting mineral wool.

G. Finishing cement to be ASTM C449.

H. Fibrous glass or canvas fabric reinforcing shall have a minimum untreated weight of 6 oz./sq. yd.

I. Bedding compounds to be non-shrinking and permanently flexible.

J. Vapor barrier coatings to have maximum applied water vapor permeance of .05 perms.

K. Fungicidal water base coating (Foster 40-20 or equal) to be compatible with vapor barrier coating.

P A R T 3 - E X E C U T I O N

3.1 EXAMINATION

A. Verify that all piping, equipment, and ductwork are tested and approved prior to installing insulation. Do not insulate systems until testing and inspection procedures are completed.

B. Verify that all surfaces are clean, dry and without foreign material before applying insulation materials.

3.2 INSTALLATION

A. All materials shall be installed by skilled labor regularly engaged in this type of work. All materials shall be installed in strict accordance with manufacturer's recommendations, building codes, and industry standards. Do not install products when the ambient temperature or conditions are not consistent with the manufacturer's recommendations. Surfaces to be insulated must be clean and dry.

B. Locate insulation and cover seams in the least visible location. All surface finishes shall be extended in such a manner as to protect all raw edges, ends and surfaces of insulation.

C. Install insulation with smooth and even surfaces. Poorly fitted joints or use of filler in voids will not be accepted. Provide neatly beveled and coated terminations at all nameplates, uninsulated fittings, or at other locations where insulation terminates.

D. Install fabric reinforcing without wrinkles. Overlap seams a minimum of 2 inches.

E. Use full length material (as delivered from manufacturer) wherever possible. Scrap piecing of insulation or pieces cut undersize and stretched to fit will not be accepted.

F. All pipe and duct insulation shall be continuous through walls, ceiling or floor openings and through sleeves except where firestop or firesafing materials are required. Vapor barriers shall be maintained continuous through all penetrations.

G. Provide a continuous unbroken moisture vapor barrier on insulation applied to systems noted below. Attachments to cold surfaces shall be insulated and vapor sealed to prevent condensation.

H. Provide a complete vapor barrier for insulation on the following systems:

1. Refrigerant
2. Insulated Duct
3. Equipment, ductwork or piping with a surface temperature below 65 degrees F

3.3 PROTECTIVE JACKET INSTALLATION

A. SELF-ADHERING JACKETS (SAJ):

1. Install according to manufacturer's recommendations. Cut allowing minimum 4" overlap on ends and 6" on longitudinal joints. Align parallel to surface. Remove release paper and press flat to surface to avoid wrinkles. Rub entire surface for full adhesion and sealing at joint overlaps. On exterior applications, provide a bead of compatible caulk along exposed edges.

2. Piping with self-adhering (SAJ) jackets shall have elbows, fittings, valves and butt joints wrapped with 2 layers of vapor retarding tape. Piping with a PVC jacket (PFJ) installed over the self-adhering (SAJ) jacket may be provided with a single, lapped layer of vapor retarding tape for elbows, fittings and valves under the PVC jacket. Vapor retarding tape shall be compatible with the jacket material used.

B. VAPOR RETARDING JACKETS (VRJ):

1. Piping with vapor retarding (VRJ) jackets shall have elbows, fittings, valves and butt joints wrapped with 2 layers of vapor retarding tape. Piping with a PVC jacket (PFJ) installed over the vapor retarding (VRJ) jackets may be provided with a single, lapped layer of vapor retarding tape for elbows, fittings and valves under the PVC jacket. Vapor retarding tape shall be compatible with the jacket material used.

C. PVC FITTING COVERS AND JACKETS (PFJ):

1. Lap seams and joints a minimum of 2 inches and continuously seal PVC with welding solvent recommended by jacket manufacturer. Lap slip joint ends 4" without fasteners where required to absorb expansion and contraction. For sections where vapor barrier is not required and jacket requires routine removal, tack fasteners may be used. Secure PVC fitting covers with tack fasteners. For systems requiring a vapor barrier, apply a 1-1/2" band of mastic over ends, throat, seams and penetrations.

D. PROTECTIVE METAL JACKET (PMJ):

1. Lap seams a minimum of 2 inches. Secure with metal bands for end to end joints, and rivets or sheet metal screws for longitudinal joints. Rivets, screws, and bands to be constructed of the same material as the jacket. Locate seams on bottom for exterior applications.

E. FABRIC REINFORCED MASTIC JACKETS (FMJ):

1. Glass fiber fabric shall be fitted without wrinkles. Glass fiber fabric shall be sized immediately upon application with lagging adhesive and shall be capable

of drying within 6 hrs. Apply adhesive and coating in accordance with manufacturer's recommendations. All seams shall overlap not less than 2".

3.4 PIPING, VALVE, AND FITTING INSULATION

A. GENERAL:

1. Install insulation with butt joints and longitudinal seams closed tightly. Provide minimum 2" lap on jacket seams and 2" tape on butt joints, firmly cemented with lap adhesive unless otherwise noted. Additionally secure with staples along seams and butt joints. Coat staples, longitudinal and transverse seams with vapor barrier mastic on systems requiring vapor barrier.

2. Install insulation continuous through pipe hangers and supports with hangers and supports on the exterior of insulation. Where a vapor barrier is not required or where roller hangers are not being used, hangers and supports may be attached directly to piping with insulation completely covering hanger or support and jacket sealed at support rod penetration. Where riser clamps are required to be attached directly to piping requiring vapor barrier, extend insulation and vapor barrier jacketing/coating around riser clamp.

3. Where insulated piping is installed on hangers and supports, the insulation shall be installed continuous through the hangers and supports. High density inserts shall be provided as required to prevent the weight of the piping from crushing the insulation. Pipe shields are required at all support locations. The insulation shall not be notched or cut to accommodate the supporting channels.

4. Fully insulate all reheat coil piping, fittings and valves (with the exeption of unions) up to coil connection to prevent condensation when coil is inactive during cooling season. Provide a vapor proof seal between the pipe insulation and the insulated coil casing.

B. INSULATION INSERTS AND PIPE SHIELDS:

1. Provide pipe shields at all hanger and support locations. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Quantity and placement of inserts shall be according to the manufacturer's installation instructions, however the inserts shall be no less than 12" in length. Inserts shall be of equal thickness to the adjacent insulation and shall be vapor sealed as required for system.

2. Provide insulation inserts and pipe shields at all hanger and support locations. Inserts may be omitted on 3/4" and smaller copper piping provided 12" long 22 gauge pipe shields are used.

C. FITTINGS AND VALVES:

1. Fittings, valves, unions, flanges, couplings and specialties may be insulated with factory molded or built up insulation of the same thickness as adjoining insulation. Where the ambient temperature exceeds 150 degrees F, cover insulation with fabric reinforcing and mastic. Where the ambient temperatures do not exceed 150 degrees, furnish and install PVC fitting covers.

D. MINERAL FIBER:

1. Secure each 3' section with three stainless steel bands or five 16 gauge stainless steel or annealed copper tie wires evenly spaced and at ends. Twist wire ends, snip off excess and turn ends over into insulation. Stagger joints where more than one layer is used.

E. ELASTOMERIC AND POLYOLEFIN:

1. Where practical, slip insulation on piping during pipe installation when pipe ends are open. Miter cut fittings allowing sufficient length to prevent stretching. Completely seal seams and joints for vapor tight installation. For elastomeric

insulation, apply full bed of adhesive to both surfaces. For polyeolefin, seal factory preglued seams with roller and field seams and joints with full bed of hot melt polyolefin glue to both surfaces. Cover elastomeric insulation on systems operating below 40 degrees F with vapor barrier mastic.

F. EXTRUDED POLYSTYRENE AND POLYISOCYANURATE:

1. Fittings, valves, unions, flanges, couplings and specialties shall be insulated with factory molded insulation of the same thickness as adjoining insulation. Secure insulation sections with two wraps of nylon filament tape 9”-12” on center. On single insulation layer systems and on the outer layer of double insulation layer systems, apply a thin coat of elastomeric joint sealant rated for system operating temperatures to all longitudinal and butt insulation joints covering entire face of joint. Allow sealant to fully cure before applying protective covering. For piping service below 0°F, use two layers of insulation with inner and outer butt and longitudinal joints staggered and offset 90 degrees. Where two layers of insulation are used, do not use sealant on the inner layer or adhere the inner layer to the outer layer. Apply vapor stop bead of joint sealant between pipe and insulation on both sides of valves, expansion/contraction joints, flanges, thermometers/gauges, attached vent and drain lines. Insulate attached non-circulated lines, control lines, vents, etc. for a minimum distance of 6” from pipe. Cover insulation with a protective jacket as specified below. Do not penetrate protective covering or insulation with mechanical fasteners.

3.5 PIPING PROTECTIVE JACKETS

A. In addition to the the jackets specified in the pipe insulation schedule below the following protective jackets are required:

B. Provide a protective PVC jacket (PFJ) for the following insulated piping:

1. Piping exposed in finished locations

C. Provide a protective PVC (PFJ) or Fabric Reinforced Mastic (FMJ) jacket for the following insulated piping:

1. All piping within mechanical rooms

D. Provide a protective metal (PMJ) or self-adhering (SAJ) jacket for the following insulated piping:

1. Exterior installed refrigeration piping

E. Provide a protective covering of 2 coats of vapor barrier mastic with fibrous glass or canvas fabric reinforcing (FMJ) for the following insulated piping:

Provide a protective self-adhering (SAJ) jacket for the following insulated piping:

PIPE INSULATION SCHEDULE:

A. Provide insulation on new and existing remodeled piping as indicated in the following schedule:

Service	Insulation	Jacket	Insulation Thickness by Pipe Size				
			≤ 1-1/4”	1-1/2"	2" to <4"	4" to 6"	8" and larger
Refrigerant Suction							
>40°F	Elast./Polyol	None	0.5"	1"	1.5"	1.5"	1.5"
40°F to 20°F	Elast./Polyol	None	1”	1.5”	1.5”	1.5”	1.5”
20°F to -20°F	Ext Poly/Polyiso	VRJ or SAJ	1.5”	2”	2”	2”	2.5”
-20°F to -60°F	Ext Poly/Polyiso	VRJ or SAJ	2”	2”	2.5”	2.5”	3”

Cooling Coil Condensate Drain	Rigid Fiberglass	ASJ	0.5"	0.5"	1"	1"	1"

B. The following piping and fittings are not to be insulated:

1. Piping unions for systems not requiring a vapor barrier

C. For systems with fluid temperatures 65° F or less, furnish and install removable elastomeric insulation covers, plugs or caps for all mechanical equipment and devices that require access by balancing contractors or service and maintenance personnel. Examples include but are not limited to: flow sensing devices, circuit setters, manual ball valve air vents, drain valves, blowdown valves, pressure/temperature test plugs, grease fittings, pump bearing caps, equipment labels, etc. Covers shall be tight fitting to ensure a complete vapor barrier.

3.6 DUCT INSULATION

A. GENERAL:

1. Secure flexible duct insulation on sides and bottom of ductwork over 24" wide and all rigid duct insulation with weld pins. Space fasteners 18” on center or less as required to prevent sagging.

2. Secure rigid board insulation to ductwork with weld pins. Apply insulation with joints firmly butted as close as possible to the equipment surface. Pins shall be located a maximum of 3” from each edge and spaced no greater than 12” on center.

3. Install weld pins without damage to the interior galvanized surface of the duct. Clip pins back to washer and cover penetrations with tape of same material as jacket. Firmly butt seams and joints and cover with 4” tape of same material as jacket. Seal tape with plastic applicator and secure with staples. All joints, seams, edges and penetrations to be fully vapor sealed.

4. Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation or jacket material.

5. External supply duct insulation is not required where ductwork contains continuous 1” acoustical liner. Provide 4” overlap of external insulation over ends of acoustically lined sections.

6. Where insulated ductwork is supported by trapeze hangers, the insulation shall be installed continuous through the hangers. Drop the supporting channels required to facilitate the installation of the insulation. Where rigid board or flexible insulation is specified, install high density inserts to prevent the weight of the ductwork from crushing the insulation.

7. Where insulated low temperature (below 45ºF) ductwork is supported by steel metal straps or wire ropes that are secured directly to the duct, the straps or ropes shall be completely covered with insulation and sealed to provide a complete vapor barrier.

8. Where insulated duct risers are supported by steel channels secured directly to the duct, extend the insulation and vapor barrier jacketing to encapsulate the support channels.

9. Where ductwork exposed to the weather is insulated with any product other than fluid-applied ductwork insulation, the top surface of the insulation shall be sloped a minimum of ¼” per foot to eliminate ponding and create positive drainage off of insulation. Refer to fluid-applied ductwork insulation section below for slope requirements.

3.7 DUCTWORK PROTECTIVE COVERINGS:

A. In addition to the the jackets specified in the duct insulation schedule below the following protective coverings are required:

B. Provide a protective covering of 2 coats of indoor/outdoor vapor barrier mastic with fibrous glass or canvas fabric covering (FMJ) for the following ductwork:

1. Ductwork within 6’ of floor, catwalks and mezzanines in mechanical rooms

C. Provide a protective self-adhering jacket (SAJ) for the following insulated ductwork:

DUCT INSULATION SCHEDULE:

A. Provide duct insulation on new and existing remodeled ductwork in the following schedule:

Service	Insulation Type	Jacket	Insulation Thickness
Outside air ducts	Rigid Fiberglass	FSJ	2"
Mixed air ducts	Rigid Fiberglass	FSJ	2"
Exposed supply ducts	Rigid Fiberglass	FSJ	2"
Concealed supply ducts	Flexible Fiberglass	FSJ	1-1/2"
All Ducts located in unconditioned	Flexible Fiberglass	FSJ	3”
Exhaust and relief ducts downstream of motorized backdraft dampers	Rigid Fiberglass	FSJ	2"
All ducts exposed to weather	Ext. Polystyrene	SAJ	3"
Exhaust ducts downstream of heat recovery units and dessicant dryers	Rigid Fiberglass	FSJ	2"

3.8 EQUIPMENT INSULATION

A. GENERAL:

1. Do not insulate over equipment access manholes, fittings, nameplates or ASME stamps. Bevel and seal insulation at these locations.

B. PROTECTIVE JACKETS:

1. Provide a protective metal jacket (PMJ) for the following: Generator exhaust pipe (that is not concealed in a shaft) and muffler.

C. SEMI-RIGID FIBERGLASS:

1. Apply insulation to equipment shells using weld pins, bonding adhesive, banded and wired in place. Fill all joints, seams and depressions with insulating cement to a smooth, even surface. Cover with reinforcing fabric and 2 coats of mastic (FMJ). Use vapor barrier mastic on systems requiring a vapor barrier.

D. ELASTOMERIC/POLYOLEFIN:

1. Apply full cover coat of adhesive to surface to be insulated, insulation and edge butt joints. Place insulation with edge joints firmly butted pressing to surface for full adhesion. Seal seams and joints vapor tight.

E. REMOVABLE COVERS:

1. Provide insulated easily removable galvanized steel metal boxes for routine service access on the following equipment:

2. Provide insulated easily removable elastomeric insulation sections for the following equipment:

3.9 EQUIPMENT INSULATION SCHEDULE:

A. Provide equipment insulation as follows:

Equipment	Insulation Type	Jacket	Thickness
Air Handling Unit Casings or attached component sections not factory insulated*	Rigid Fiberglass	ASJ	2”

* The thickness and type of insulation provided for non-factory fabricated transitions or component sections shall be consistent with the sections constructed at the factory.

END OF SECTION 23 07 00

SECTION 23 09 14

PNEUMATIC AND ELECTRIC INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section includes pneumatic control system specifications for all HVAC work as well as related pneumatic control for systems found in other specification sections. Included are the following topics:

B. PART 1 – GENERAL

1. Scope
2. Point List
3. Related Work
4. Reference
5. Quality Assurance
6. Reference Standards
7. System Description
8. Submittals
9. Demolition
10. Design Criteria
11. Operation and Maintenance Data
12. Material Delivery and Storage

C. PART 2 - PRODUCTS

1. Control Dampers
2. Control System Instrumentation
3. Electric/Electronic Thermostats
4. Duct Smoke Detector and Fire Alarm Interface Modules
5. Time Clocks
6. Temperature Control Panels
7. Temperature Sensors
8. Current Status Switches
9. Carbon Dioxide (CO2) Sensor
10. Power Supplies

D. PART 3 – EXECUTION

1. Installation
2. Wire and Air Piping Conduit and Tubing Installation Schedule
3. Control and Smoke Dampers
4. Control System Instrumentation
5. Room Thermostats and Temperature Sensors
6. Low Limit Thermostats (Freezestats)
7. Temperature Control Panels
8. Differential Pressure Switches
9. Current Status Switches
10. Owner Training

1.2 POINT LIST (Section 23 09 15)

1.3 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.
B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC - Coordination
C. Section 23 09 15 - Direct Digital Control Input/Output Point Summary Tables
D. Section 23 09 23 - Direct Digital Control System for HVAC
E. Section 23 09 93 - Sequence of Operation
F. Section 23 33 00 - Ductwork Accessories - for control damper installation
G. Division 23 - HVAC - Equipment provided to be controlled or monitored

H. Division 26 - Electrical - Installation requirements & Equipment provided to be controlled or monitored
I. Division 28 - Electronic Safety and Security

1.4 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.5 QUALITY ASSURANCE

A. Installing contractor must be a manufacturer's branch office or an authorized representative of a Direct Digital Control (DDC) equipment manufacturer that provides engineering and commissioning of the DDC equipment. Submit written confirmation of such authorization from the manufacturer. Indicate in letter of authorization that installing contractor has successfully completed all necessary training required for engineering, installation, and commissioning of equipment and systems and that such authorization has been in effect for a period of not less than three years. DDC equipment may or may not be required to be installed by this contractor as part of the project, but the intent of this quality assurance specification is to ensure that the installing contractor has the capabilities to engineer, install, and commission the field devices supplied under this section for temperature control.

1.6 REFERENCE STANDARDS

A. ANSI B16.22 Wrought Copper and Wrought Copper Alloy Solder Joint Pressure Fittings
B. ANSI/ASTM B32 Specification for Solder Metal
C. ASTM B75 Seamless Copper Tube
D. ASTM D1693 Environmental Stress-Cracking of Ethylene Plastics
E. ASTM D 635 Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
F. UL 94 Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
G. AMCA 500-D Laboratory Method of Testing Dampers for Rating

1.7 SYSTEM DESCRIPTION

A. System is to be electric/electronic.

B. System is to use direct digital control with electric actuation for air handling units; direct digital control with electric actuation for room temperature, room humidity, and terminal airflow control; and electric control for other terminal units.

1.8 SUBMITTALS

A. Include the following information:

B. Manufacturer’s data sheets indicating model number, pressure/temperature ratings, capacity, methods and materials of construction, installation instructions, and recommended maintenance. General catalog sheets showing a series of the same device is not acceptable unless the specific model is clearly marked.

C. Schematic flow diagrams of systems showing fans, pumps, coils, dampers, valves, and other control devices. Label each device with setting or adjustable range of control. Indicate all wiring, clearly, differentiating between factory and field installed wiring. Wiring should be shown in schematics that detail contact states, relay references, etc. Diagrammatic representations of devices alone are not acceptable.

D. Details of construction, layout, and location of each temperature control panel within the building, including instruments location in panel and labeling. Also include on drawings location of mechanical equipment controlled (room number), horsepower and flow of motorized equipment (when this data is available on plans), locations of all remote sensors and control devices (either by room number or column lines).

E. Schedule of control dampers indicating size, leakage rating, arrangement, pressure drop at design airflow, and number and size of operators required.

F. Schedule of control valves indicating system in which the device is to be used, rated capacity, flow coefficient, flow required by device served, actual pressure drop at design flow, size of operator required, close-off pressure, and locations where valves are to be installed.

G. A complete description of each control sequence for equipment that is not controlled by direct digital controls. Direct digital controlled equipment control sequences will be provided by the DDC control contractor.

H. Prior to request for final payment, submit record documents which accurately record actual location of control components including panels, thermostats, wiring, and sensors. Incorporate changes required during installation and start-up.

1.9 DESIGN CRITERIA

A. Size all control apparatus to properly supply and/or operate and control the apparatus served.

B. Provide control devices subject to corrosive environments with corrosion protection or construct them so they are suitable for use in such an environment.

C. Provide devices exposed to outside ambient conditions with weather protection or construct them so they are suitable for outdoor installation.

D. Use only UL labeled products that comply with NEMA Standards. Electrical components and installation to meet all requirements of the electrical sections (Division 26) of project specifications.

1.10 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.11 MATERIAL DELIVERY AND STORAGE

A. Provide factory shipping cartons for each piece of equipment and control device. This contractor is responsible for storage of equipment and materials inside and protected from the weather.

P A R T 2 - P R O D U C T S

2.1 CONTROL DAMPERS

A. Provide control dampers shown on the plans and as required to perform the specified functions. Dampers shall be rated for velocities that will be encountered at maximum system design and rated for pressure equal or greater than the ductwork pressure class as specified in Section 23 31 00 of the ductwork where the damper is installed.

B. Use only factory fabricated dampers with mechanically captured replaceable resilient blade seals, stainless steel jamb seals and with entire assembly suitable for the maximum temperature and air velocities encountered in the system.

C. All dampers in stainless steel, PCD coated steel, PVC, PTFE, or fiberglass ductwork shall be constructed of stainless steel.

D. All dampers in aluminum ductwork shall be constructed of stainless steel or aluminum.

E. Dampers in galvanized ductwork shall be constructed of galvanized steel and/or aluminum.

F. All dampers, unless otherwise specified, to be rated at a minimum of 180º F working temperature. Leakage testing shall be certified to be based on latest edition of AMCA Standard 500-D and all dampers, unless otherwise specified, shall have leakage ratings as follows:

	Damper Class	DifferentialPressure	Leakage
1.	Class IA	1" w.g.	$\leq$3 CFM/ft^2
2.	Class I	4" w.g.	$\leq$8 CFM/ft^2

G. Leakage rate dampers for differential pressures that they will encounter at maximum system design pressures.

H. Steel framed dampers: Nailor models 2010 & 2020; Greenheck models VCD-33 & VCD-42; Johnson Controls model V-1330; Ruskin Models CD60 & CD40; other approved equal.

I. Aluminum frame and blade dampers: Nailor models 2010EAF & 202EAF; Greenheck model VCD-43; Ruskin model CD50; Arrow model AFD-20; other approved equal.

J. Dampers used for directed mixing of airstreams, i.e. outside air and return air, to be parallel blade type and sized for an air velocity of 1800 to 2000 fpm with the damper blades shall be arranged so that the air streams are directed at one another to facilitate mixing. Dampers used for throttling or modulating applications other than air stream mixing to be opposed blade type. Two position dampers may be parallel or opposed blade type.

K. Dampers used for isolation on the discharge of centrifugal fans shall have damper blades perpendicular to the fan shaft to minimize system effect. Dampers mounted with blades vertically shall be designed for vertical blade orientation.

L. Dampers for applications other than fume exhaust to have frames of not less than 16 gauge galvanized steel or 12 gauge extruded aluminum. Blades to be two-ply steel airfoil of not less than 2 x 20 gauge galvanized steel (14 gauge equivalent) or extruded aluminum airfoil, with stainless steel, acetal, Celcon, bronze, or nylon bearings. Maximum allowable blade width is 8 inches. Use plated steel linkage hardware.

M. Maximum damper width is 48 inches; where required width exceeds 48 inches, use multiple damper sections. Inside frame free area shall be a minimum of 90% of total inside duct area.

N. Multiple width damper sections shall utilize jack shaft linkages unless noted below. Sections over 144 inches wide shall be actuated from two locations on the jack shaft. Double width damper sections for two-position operation may be actuated without jack shafts if each damper section is actuated separately. Dampers that have multiple width and multiple vertical sections shall have a jackshaft for each vertically stacked set of dampers and be provided with crossover linkages between jack shafts to transfer uneven loading.

O. Jack shafts shall be extended outside of the ductwork for external actuator mounting. Provide bearings on the point of exit for support of damper shafts to prevent wear on the shaft and the ductwork. If locating actuators out of the air stream is impossible, obtain mounting location approval from the designer unless the contract documents indicate in air stream mounting is acceptable. In no cases shall damper actuators for fume exhaust systems be located in the air stream or require entering the air stream to service an actuator.

P. Provide weatherproof NEMA 4X stainless steel enclosures (Belimo ZS-300 or equal) that have removable covers that have clasps or machine screws (no sheet metal screws) and that do not require removing fasteners from the ductwork or actuators that have NEMA 4X or IP66 watertight housings (Belimo, Elodrive, or equal) to prevent actuator failure or freeze-up when mounting in locations exposed to harsh environments or outdoor locations.

Q. Size operators for smooth and positive operation of devices served, and with sufficient torque capacity to provide tight shutoff against system temperatures and pressure encountered. For pneumatic actuation, use rolling diaphragm, piston type operators with adjustable stops. For electric modulating actuation, use fully proportional actuators with zero and span adjustments. For terminal unit actuators, stepping motors may be used and zero and span is not required. For two-position electric actuation use 24 VAC for DDC controlled actuators, 120 VAC actuators may be used for hardwire interlocking. See 23 09 15 for specific type of input signal required. Actuator stroke times shall match the requirements of the DDC controllers provided under 23 09 23 and 23 09 25 and/or the specific system requirements for proper operation. All electric actuators will be provided with overload protection to prevent motor from damage when stall condition is encountered. Equip operators with spring return or stored energy fail-safe return for applications involving fire, freeze protection, moisture protection or specified normally open/closed operation. Provide damper end switches with form "C" contacts where control sequences require damper position indication. End switches shall not contain mercury.

R. All power required for electric actuation shall be provided by this contractor if it is not able to be directly provided from the DDC controller.

S. Provide operators with linkages and brackets for mounting on device served.

T. Provide pilot positioners for pneumatic operators serving all modulating outside air, return air, relief air, and face and bypass dampers, where more than one operator is controlled in sequence, or where required to provide sufficient power to the operator.

2.2 CONTROL SYSTEM INSTRUMENTATION

A. DUCT THERMOMETERS:

1. 3-1/2" dial type with swivel mount. Maximum scale graduations of 2°F. Provide averaging type, liquid filled capillary sensing element.

B. REMOTE BULB THERMOMETERS:

1. 3-1/2 inch dial type with recalibration screw on face. Accuracy within 1% of scale range. Thermometers with sensing elements in air ducts with an area of above 4 square feet to have averaging elements. Provide separable wells for all pipeline applications.

2.3 ELECTRIC/ELECTRONIC THERMOSTATS

A. ELECTRIC THERMOSTATS:

1. For single setpoint applications, provide line or low voltage electric type suitable for heating or heating and cooling as required. Provide the required number of heating and/or cooling stages required for the application. For line voltage ventilation applications utilizing fans and where otherwise specified in the sequence of operations, provide an integral manual On/Off/Auto selector switch. Minimum contact rating shall be equal to electrical load of device being controlled.

B. LOW VOLTAGE ELECTRONIC THERMOSTATS: Manufacturers: Honeywell, Johnson Controls, Viconics, or equal.

1. Where unoccupied setpoints are specified, provide electronic programmable type with seven day setup/setback scheduling with a minimum of two occupied and unoccupied schedules per day through keypad entry on front of unit. For heating and cooling applications, provide automatic heating/cooling switchover. For applications that control fans, provide fan override switch. For ventilation or packaged economizer applications provide a dry contact for ventilation damper or economizer initiation. For thermostat control of economizer, provide a 0-10VDC modulated output for economizer damper control.

2. For applications that require integration to the building automation system, provide a BACnet communication interface. If a communication interface is specified, occupancy scheduling in the thermostat is not required.

C. LOW LIMIT THERMOSTATS (freezestats):

1. Electric two-position type with temperature sensing element and manual reset. Unit to be capable of opening control circuit if any one-foot length of sensing element is subject to a temperature below the setpoint. Length of sensing element to be not less than one lineal foot per square foot of coil surface areas. Unless otherwise indicated, set low limit controls at 36°F.

D. AQUASTATS:

1. Line voltage type with single pole, double throw switch of adequate rating for the applied load.

E. REMOTE BULB THERMOSTATS:

1. Line voltage type with single pole, double throw switch of adequate rating for the applied load. Thermostat to have adjustable setpoint suitable for controlled load.

2.4 DUCT SMOKE DETECTOR AND FIRE ALARM INTERFACE MODULES

A. Detectors with auxiliary contacts or fire alarm control modules will be provided by others. Provide wiring, conduit, and necessary interface with fire alarm system to perform specified sequence of operation.

2.5 TIME CLOCKS

A. UL listed, digital, 7-day, minimum of 10 on/off programs per day, holiday programming, automatic daylight savings switchover, and minimum of seven-day battery back-up.

2.6 TEMPERATURE CONTROL PANELS

A. Constructed of steel or extruded aluminum, with hinged door, keyed lock, and baked enamel finish. Install controls, relays, transducers and automatic switches inside panels. Label devices with permanent printed labels and provide asbuilt wiring/piping diagram within enclosure. Provide raceways for wiring and poly within panel for neat appearance and to separate high and low voltage wiring. Provide termination blocks and resettable circuit breaker for 120VAC power wiring. Provide label within the panel indicating circuit number of 120VAC serving panel. Label outside of panel with panel number corresponding to plan tags and asbuilt control drawings as well as building system(s) served.

B. Provide a service shutdown toggle switch for each air handling unit system located inside the temperature control panel that will initiate a logical shutdown of the air handling unit system. Label the switch so it is clear which position is shutdown and which is auto.

2.7 TEMPERATURE SENSORS

A. Thermistor temperature sensor manufacturers: PreCon, BAPI, and ACI

B. Use thermistor or RTD type temperature sensing elements constructed so accuracy and life expectancy is not affected by moisture, physical vibration, or other conditions that exist in each application.

C. RTD's shall be of nickel or platinum construction and have a base resistance of 1000Ω at 70°F and 77°F respectively. 100Ω platinum RTD's are acceptable if used with temperature transmitters.

D. The temperature sensing device used must be compatible with the DDC controllers used on the project.

E. RTD

Accuracy (Room Sensor Only)	minimum + 1.0°F
Accuracy (Averaging)	minimum + 1.2°F
Accuracy (Other than Room Sensor or Averaging)	minimum + 0.65°F
Range	minimum -40 - 220°F

F. Thermistor

Accuracy (All)	minimum + 0.36°F
Range	minimum -30 - 230°F
Heat Dissipation Constant	minimum 2.7 mW/°C

G. Temperature Transmitter

Accuracy	minimum + 0.1°F or +0.2% of span
Output	4-20 mA

H. Provide limited range or extended range sensors if required to sense the range expected for a respective point. Use RTD type sensors for extended ranges beyond -30 to 230°F. If RTD's are incompatible with DDC controller direct temperature input use temperature transmitters in conjunction with RTD's.

I. Use wire size appropriate to limit temperature offset due to wire resistance to 1.0°F. If offset is greater than 1.0°F due to wire resistance, use temperature transmitter. If feature is available in DDC controller, compensate for wire resistance in software input definition.

J. Provide sensors in occupied spaces with brushed aluminum or brushed nickel covers unless otherwise noted or features specified will not allow for this. Terminal unit sensors with setpoint adjustments and digital displays may use plastic covers. Provide information to the AE on sensor colors offered by the manufacturer and obtain approval on what color should be provided on the project.

K. Terminal unit sensors shall be provided with digital displays that indicate room temperature and setpoint and have a manual occupancy override and indication of occupancy status. Provide setpoint adjustment as specified in the DDC Input/Output Summary Table and sequence of operation.

L. Use averaging elements on duct sensors when the ductwork is ten square feet or larger. All mixed air and heating coil discharge sensors shall have averaging elements regardless of duct size.

M. In piping systems use temperature sensors with separable wells designed to be used with temperature element.

2.8 CURRENT STATUS SWITCHES

A. Provide a current sensor with adjustable threshold and digital output with LED display, equal to a Veris model H-708/H-904. Threshold adjustment must be by a multi-turn potentiometer or set by multiprocessor that will automatically compensate for frequency and amperage changes associated with variable frequency drives. When used on variable speed motor applications, use a current sensor that will not change state due to varying speeds.

2.9 CARBON DIOXIDE (CO2) SENSOR

A. Provide a Carbon Dioxide (CO_2) sensor that shall utilize non-dispersive infrared (NDIR) technology. The sensor shall have a linear analog output over a range of 0-2000 ppm and have built in display of CO_2 level. The sensor shall have an automatic calibration algorithm that will compensate for sensor drift over time due to sensor element degradation. Unit shall be provided with a 0-10VDC or 4-20mA analog output that is selectable and a field adjustable relay alarm output. Accuracy shall be better than ±5% of reading or ±50ppm whichever is higher. The sensor shall be user calibratible with a minimum calibration interval of five years.

2.10 POWER SUPPLIES

A. Provide all required power supplies for transducers, sensors, transmitters and relays. All low voltage transformers shall have a resettable secondary circuit breaker and be listed as class 2 power supplies.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install system with trained mechanics and electricians employed by the control equipment manufacturer or an authorized representative of the manufacturer. Where installing contractor is an authorized representative of the control manufacturer, such authorization shall have been in effect for a period of no less than three years.

B. Install all control equipment, accessories, wiring, and piping in a neat and workmanlike manner. All control devices must be installed in accessible locations. This contractor shall verify that all control devices furnished under this Section are functional and operating the mechanical equipment as specified in Section 23 09 93.

C. Label all control devices with the exception of dampers, valves, and terminal unit devices with permanent printed labels that correspond to control drawings. Temperature control junction and pullboxes shall be identified utilizing spray painted green covers. Other electrical system identification shall follow the 26 05 53 specification.

D. All control devices and electrical boxes mounted on insulated ductwork shall be mounted over the insulation. Provide mounting stand-offs where necessary for adequate support. Cutting and removal of insulation to mount devices directly on ductwork is not acceptable. This contractor shall coordinate with the insulation contractor to provide for continuous insulation of ductwork.

E. Mounting of electrical or electronic devices shall be protected from weather if the building is not completely enclosed. This Contractor shall be solely responsible for replacing any equipment that is damaged by water that infiltrates the building if equipment is installed prior to the building being enclosed.

F. Provide all electrical relays and wiring, line and low voltage, for control systems, devices and components. Install all high voltage and low voltage wiring (includes low voltage cable) in metal conduit, Electrical Non-metallic Tubing (ENT), or Electrical Metallic Tubing (EMT), as scheduled below and hereafter referred to generically as conduit. See Wire and Air Piping Conduit Installation Schedule below for specific conduit or tubing to be used. All conduit must be installed in accordance with electrical sections (Division 26) of this specification and the National Electrical code.

G. Conduit shall be a minimum of 1/2 " for low voltage control provided the pipe fill does not exceed 40%.

H. Minimum low voltage wiring gauge to be 18 AWG for outputs and 20 AWG for inputs. All low voltage wiring to be stranded.

I. Low voltage wiring can be run without conduit above accessible lay-in tile ceilings. All wiring in mechanical rooms, above inaccessible hard ceilings, exterior locations, and in any exposed areas, and in all other locations should be in conduit. Wire for wall sensors must be run in conduit. Wiring for radiation valves shall be run in conduit where routed through walls.

J. Where wiring is installed free-air, installation shall consider the following:

1. Wiring shall utilize the cable tray wherever possible.

2. Wiring shall run at right angles and be kept clear of other trades work.

3. Wiring shall be supported utilizing "J" or "Bridal-type" steel mounting rings anchored to ceiling concrete, piping supports, walls above ceiling or structural steel beams. Mounting rings shall be of open design (not a closed loop) to allow additional wire to be strung without being threaded through the ring. For mounting rings that do not completely surround the wire, attach the wire to the mounting ring with a strap.

4. Supports shall be spaced at a maximum 4-foot interval unless limited by building construction. If wiring "sag" at mid-span exceeds 6-inches; another support shall be used.

5. Wiring shall never be laid directly on the ceiling grid or attached in any manner to the ceiling grid wires.

6. Wall penetrations shall be sleeved.

K. Wiring shall not be attached to existing cabling, existing tubing, plumbing or steam piping, ductwork, ceiling supports or electrical or communications conduit.

L. Control panels serving equipment fed by emergency power shall also be served by emergency power. This contractor shall be responsible for all 120VAC power, not provided in the Division 26 specifications, required for equipment provided under this section. Power shown for temperature control panels on plans may be utilized by the 23 09 24 and/or 23 09 23, and 23 09 14 contractors.

M. Provide communication trunk wiring to integrated devices (i.e. VFD's, Flow Meters, Chillers, Lighting Panels, Electrical Meters, etc.) that are specified to be connected to the building automation system. Communication trunk wiring shall be as required by the equipment specified under the 23 09 24 or 23 09 23 Sections and shall be routed to the DDC panel designated for that equipment as shown on the plans or the closest DDC panel if not designated. If communication trunks required daisy chained style wiring, provide two communication cables to the DDC panel so that the communication trunk is not dead ended.

N. Install "hand/off/auto" selector switches on systems where automatic interlock controls are specified and "hand/off/auto" selector switches are not supplied with the equipment controlled. Control panel power will not be required for "hand" switch to operate. When switch is in "hand" position, allow manual operation of the selected device without operating the interlocked motors but allowing all unit safety devices to stay in the circuit.

O. All pneumatic tubing and electrical wiring are to be permanently tagged or labeled within one inch of terminal strip with a numbering system to correspond with the "Record Drawings".

P. After completion of installation, test and adjust control equipment. Submit data showing set points and final adjustments of controls.

3.2 WIRE AND AIR PIPING CONDUIT AND TUBING INSTALLATION SCHEDULE

A. The following conduit schedule shall apply to both polyethylene tubing and wire in conduit where conduit is specified for air tubing or wiring. Conduit and tubing referenced below shall meet specifications in Section 26 05 33 and as defined below.

B. Conduit other than that specified below for specific applications shall not be used.

C. Exposed Outdoor Locations: Rigid steel conduit.

D. Concealed in Concrete and Block Walls: Rigid steel conduit. Schedule 40 PVC conduit. Electrical Nonmetallic Tubing (ENT).

E. Concealed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.

F. Exposed Dry Interior Locations: Rigid steel conduit. Intermediate metal conduit. Electrical metallic tubing.

3.3 CONTROL AND SMOKE DAMPERS

A. All control dampers furnished by the control manufacturer are to be installed by the Mechanical Contractor under the coordinating control and supervision of the Control Contractor in locations shown on plans or where required to provide specified sequence of control.

B. Coordinate installation with the sheetmetal installer to obtain smooth duct transitions where damper size is different than duct size. Blank off plates will not be accepted.

C. Each operator shall serve a maximum damper area of 36 square feet. Where larger dampers are used, provide multiple operators.

3.4 CONTROL SYSTEM INSTRUMENTATION

A. For pneumatically actuated systems install pressure gauges as follows: for indication of supply air pressure in each temperature control panel; at the output of pneumatic/electric transducers; the output of each pneumatic controller; the output of each solenoid air valve; the input of each PE switch; at each modulated damper and valve except terminal devices; other points where the visible indication of air pressure is required for operating and maintenance purposes. On dampers and valves with pilot positioners, locate gauge in the output of positioner to controlled device. Mount gauges so they are visible when looking at the monitored device. At each receiver controller input port, install a 1-1/2" diameter dial indicator with scale to match input range (in degrees F., % R.H., in. w.c., etc.). Equip control air output line with a 1-1/2" diameter air pressure gauge.

B. Install thermometers at each point of temperature transmission (sensors) and control, except reheat coils, unless the drawings indicate a thermometer is to be installed by the piping or sheetmetal installer. Install thermometers to permit easy reading from the floor or operating platform. Provide remote mounting or swiveled mounting as required for easy reading. Flush mounting where not easily read is not acceptable.

3.5 ROOM THERMOSTATS AND TEMPERATURE SENSORS

A. Check and verify location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation. Locate room thermostats and sensors 48 inches above floor. Align with light switches and humidistats. For drywall installations, thermostat mounting shall use a back-box attached to a wall stud, drywall anchors are not acceptable.

B. Any room thermostats or sensors mounted on an exterior wall shall be mounted on a thermally insulated sub-base. Subbase to provide a minimum of one half inch of insulation.

C. Where thermostats or sensors are mounted on exterior walls or in any location where air transfer will affect the measured temperature or humidity seal the conduit and any other opening that will effect the measurement.

D. Provide guards on thermostats in entrance hallways, other public areas, or in locations where thermostat is subject to physical damage.

3.6 LOW LIMIT THERMOSTATS (Freezestats)

A. Install low limit controls where indicated on the drawings or as specified. Unless otherwise indicated, install sensing element on the downstream side of heating coils.

B. Mount units using flanges and element holders. Provide duct collars or bushings where sensing capillary passes through sheetmetal housings or ductwork; seal this penetration to eliminate air leakage. Mount the units in an accessible location as to allow for resetting after low limit trips while still meeting manufacturer's installation requirements for proper function.

C. Distribute (serpentine) sensing element horizontally across the coil to cover every square foot of coil; on larger coils this may require more than one instrument. Install controls at accessible location with mounting brackets and element duct collars where required.

D. For integral face and bypass coils the elements are to be run vertically on the face of the heating coil inside the damper enclosure, this will require drilling the frame to run element around the by-pass.

3.7 TEMPERATURE CONTROL PANELS

A. Mount control panels adjacent to associated equipment on vibration-free walls or freestanding angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide permanent printed labeling for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.

B. Provide as-built control drawings of all systems served by each local panel in a location adjacent to or inside of panel cover. Provide a protective cover or envelope for drawings.

3.8 DIFFERENTIAL PRESSURE SWITCHES

A. Provide for each fan or pump specified, or shown on point list. Provide shutoff valves at piping takeoff points. Readjust pressure and/or differential setpoints for proper operation after final balancing is completed.

3.9 CURRENT STATUS SWITCHES

A. Provide for each fan or pump specified, or shown on point list. Set threshold adjustment to indicate belt or coupling loss. Readjust threshold for proper operation after final balancing is completed. Use the variable frequency drive (VFD) integrated relay output for motor status, if provided on the VFD, in lieu of a discrete current switch. A separate current switch provided under this Section shall be wired in parallel with the VFD motor status relay when a bypass starter is provided on the VFD to prove motor status in the bypass mode.

3.10 OWNER TRAINING

A. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 8 hours.

END OF SECTION 23 09 14

SECTION 23 09 23

DIRECT DIGITAL CONTROL SYSTEM FOR HVAC

PART 1 - GENERAL

1.1 SCOPE

A. Work in this section includes Direct Digital Control (DDC) panels, main communication trunk, software programming, and other equipment and accessories necessary to constitute a complete Direct Digital Control (DDC) system. This system interfaced with pneumatic/electric controls (Section 23 09 14) utilizing Direct Digital Control signals to operate actuated control devices will meet, in every respect, all operational and quality standards specified herein. The system shall be capable of interfacing with either the City of Milwaukee's Building Management System or other entity. This system shall also be BACnet compatible.

B. PART 1 - GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Work Not Included
6. Quality Assurance
7. Submittals
8. Operation and Maintenance Data
9. Material Delivery and Storage

C. PART 2 - PRODUCTS

1. General
2. Local Control Panels
3. Direct Digital Controls (DDC)
4. Networking/Communications
5. Supervisory Controllers
6. System Software Features
7. Programmable Controllers
8. Application Specific Controllers – HVAC Applications
9. Operator Interface Requirements
10. Operator Workstation and Server
11. Web Based HTML Browser Interface
12. Portable Operator Terminal
13. ASC Portable Service Terminal

D. PART 3 - EXECUTION

1. General
2. Installation
3. Owner Training

1.2 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.
B. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC - Coordination
C. Section 23 09 14 - Pneumatic and Electric Instrumentation and Control Devices for HVAC
D. Section 23 09 15 - Direct Digital Control Input/Output Point Summary Tables
E. Section 23 09 93 - Control Sequences

F. Division 23 - HVAC - Equipment provided to be controlled or monitored
G. Division 26 - Electrical - Equipment provided to be controlled or monitored

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. FCC Part 15, Subpart J, Class A - Digital Electronic Equipment to Radio Communication Interference

1.5 WORK NOT INCLUDED

A. Section 23 09 14 work includes furnishing and installing all field devices, including electronic sensors for the DDC of this section, equipment, and all related field wiring, interlocking control wiring between equipment, pneumatic tubing, sensor mounting, etc., that is covered in that section.

B. Motorized control dampers and actuators, thermowells (temperature sensing wells), automatic control valves and their actuators are also covered in Section 23 09 14.

1.6 QUALITY ASSURANCE

A. MANUFACTURER:

1. A firm regularly engaged in manufacture of DDC control equipment similar to the specified equipment and has been in satisfactory similar service for not less than 8 years.

B. INSTALLER:

1. A firm specializing and experienced in DDC control system installation for no less than 3 years. All work shall be done by qualified mechanics in the direct employ of this manufacturer, or of an Authorized Representative of that manufacturer that provides engineering and commissioning of the manufacturers control equipment. Where installing contractor is an authorized representative of the control equipment manufacturer, submit written confirmation of such authorization. Indicate in letter of authorization that the installing contractor has successfully completed all necessary training required for the engineering, installation, and commissioning of equipment and systems to be provided for the project, and that such authorization has been in effect for a period of not less than three years.

C. RESPONSE TIME:

1. During warrantee period, four (4) hours or less, 24-hours/day, 7 days/week.

D. ELECTRICAL STANDARDS:

1. Provide electrical products, which have been tested, listed and labeled by Underwriters' Laboratories (UL) and comply with NEMA standards.

2. DDC Standards: DDC manufacturer shall provide written proof with shop drawings that the equipment being provided is in compliance with F.C.C. rules governing the control of interference caused by Digital Electronic Equipment to Radio Communications (Part 15, Subpart J, Class A).

1.7 SUBMITTALS

A. PRODUCT DATA

1. Submit manufacturer's specifications for each control device furnished, including installation instructions and start-up instructions. General catalogue sheets showing a series of the same device is not acceptable unless the specific model is clearly marked. Annotated software program documentation shall be submitted for system sequences, along with descriptive narratives of the sequence of operation of the entire system involved. Submit wiring diagram for each electrical control device along with other details required to demonstrate that the system has been coordinated and will function as a system.

B. MAINTENANCE DATA

1. Submit maintenance data and spare parts lists for each control device. Include this data in maintenance manual.

C. RECORD DRAWINGS

1. Prior to request for final payment provide complete composite record drawings to incorporate the DDC and Pneumatic/Electric field work.

1.8 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.9 MATERIAL DELIVERY AND STORAGE

A. Provide factory shipping cartons for each piece of equipment and control device. This contractor is responsible for storage of equipment and materials inside and protected from the weather.

PART 2 - PRODUCTS

2.1 GENERAL

A. Provide DDC control products in sizes and of capacities as required, conforming to manufacturer's standard materials and components as published in their product information, designed and constructed as recommended by the manufacturer and as required for application indicate.

B. System shall be capable of operating with 120 VAC power supply, fully protected with a shutdown-restart circuit, and associated hardware and software.

2.2 LOCAL CONTROL PANELS

A. Use control panels with suitable mounting brackets for each supply fan system. Locate panel adjacent to system served.

B. Fabricate panels of 14 gauge furniture grade steel or 6063-T5 extruded aluminum alloy, totally enclosed on six sides, hinged door and keyed lock, with manufacturer's standard shop painted finish and color.

C. Provide UL listed cabinets for use with line voltage devices.

D. Plastic control enclosures will be approved provided all conduits are bonded and grounded.

E. Provide control panels for all DDC Controllers, ASC's and associated function modules. All controls to be in panels except for terminal unit controllers mounted within the terminal unit equipment enclosure or VAV box controllers designed to be directly mounted on air terminals. Provide terminal unit equipment enclosures with removable cover for all terminal units located in exposed ceilings that completely enclose the DDC controller and allow for conduit terminations.

F. Permanently label all controls; tag all control wiring.

2.3 DIRECT DIGITAL CONTROLS

A. System to be capable of integrating multiple building functions, including equipment supervision and control, alarm management, energy management, and trend data collection.

B. DDC to consist of Supervisory Controllers, Programmable Controllers, stand-alone Application Specific Controllers (ASC's), Operators Terminals, Operator Workstations, DDC system servers, and other operator interface devices.

C. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, ASC's, and operator devices.

D. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

2.4 NETWORKING/COMMUNICATIONS

A. The design of the DDC shall be networked. Inherent in the system's design shall be the ability to expand or modify the network either via a local network, auto-dial telephone line modem connections, or a combination of the two schemes.

B. The DDC communications network shall be capable of direct connection to and communication with a high-speed local area network (LAN) such as ARCNET or Ethernet.

C. The supervisory controller shall directly oversee a local network such that communications may be executed directly to and between programmable controllers and ASC's. All operator devices, either network resident or connected via dial-up modems, shall have the ability to access all points and application reports on the network.

D. Provide RS-232 ports on all ASC's for operator's terminal communications with the DDC Controller from any ASC on the network.

E. Access to system data shall not be restricted by the hardware configuration of the DDC system.

F. Global data sharing or global point broadcasting shall allow point data to be shared between programmable controllers and ASC's when it would be impractical to locate multiple sensors.

G. Network design shall include the following provisions:

1. Data transfer rates for alarm reporting and quick point status from multiple programmable controllers and ASC's. The minimum baud rate shall be 9600 baud.
2. Support of any combination of programmable controllers and ASC's. A minimum of 32 programmable controllers and ASC's shall be supported on a single local network. The buss shall be addressable for up to 32 ASC's.
3. Detection of single or multiple failures of ASC's or the network media.
4. Error detection, correction, and re-transmission to guarantee data integrity.
5. Use commonly available, multiple-sourced, networking components.
6. Use of an industry standard communication transport, such as, ARCNET, Ethernet, and IEEE RS-485 communications interface.

2.5 SUPERVISORY CONTROLLERS

A. Supervisory controllers shall be microprocessor-based, multi-tasking, multi-user and digital control processors.

B. Each supervisory controller shall have sufficient memory to support its own operating system and databases including:

1. Control processes

2. Energy management application

3. Alarm management

4. Trend data

5. Maintenance support applications

6. Operator I/O

7. Dial-up communications

8. Manual override monitoring

C. The system shall be modular in nature, and shall permit easy expansion through the addition of field controllers, sensors, and actuators.

D. Supervisory controllers shall provide at least two RS-232C or USB serial communication ports or Ethernet ports for simultaneous operation of multiple operator I/O devices, such as laptop computers, personal computers, and video display terminals.

E. Supervisory controllers shall monitor the status of all overrides and include this information in the logs and summaries to inform the operator that automatic control has been inhibited.

F. Each supervisory controller shall continuously perform self-diagnostics, communications diagnostics, and diagnostics of all subsidiary equipment. Supervisory controllers shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each supervisory controller.

G. Isolation shall be provided at all network terminations, as well as all field point terminations, to suppress induced voltage transients consistent with IEEE Standard 587-1980. Isolation levels shall be sufficiently high to allow all signal wiring to be run in the same conduit as high voltage wiring acceptable by electrical code.

H. In the event of the loss of normal power, there shall be an orderly shutdown of the supervisory controller to prevent the loss of data base or operating system software. Non-volatile memory shall be incorporated for all critical controller configuration data, and battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

I. Upon restoration of normal power, the supervisory controller shall automatically resume full operation without manual intervention.

J. Should supervisory controller memory be lost for any reason, the supervisory controller shall have the capability of reloading it's programming via high speed local area network from the control system archive workstation or server, the local RS-232C port, or telephone line dial-in.

2.6 SYSTEM SOFTWARE FEATURES

A. All necessary software to form a complete operating system, as described in this specification, shall be provided as an integral part of the supervisory controller, and shall not be dependent upon higher level computer for execution.

B. Control software shall include a provision for limiting the number of times that each piece of equipment may be cycled within any one-hour period.

C. The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.

D. Supervisory controllers shall have the ability to perform any or all of the following energy management routines:

1. Time of day scheduling
2. Calendar based scheduling
3. Holiday scheduling
4. Optimal start
5. Optimal stop
6. Demand limiting
7. Load rolling
8. Heating/cooling interlock

E. All programs to be executed automatically without the need for operator intervention, and be flexible enough to allow user customization. Programs shall be applied to building equipment described in Section 23 09 93 of this specification.

F. Supervisory controllers shall be able to execute configured processes defined by the user to automatically perform calculations and control routines.

G. It shall be possible to use any of the following in a configured process:

1. Any system-measured point data or status
2. Any calculated data
3. Any results from other processes
4. Boolean logic operators (and, or)

H. Configured processes may be triggered based on any combination of the following:

1. Time of day
2. Calendar date
3. Other processes
4. Events (e.g., point alarms)

I. A single process shall be able to incorporate measured or calculated data from any and all other ASC's.

J. A single process shall be able to issue commands to points in any and all other programmable controllers and ASC's on the local network.

K. Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each supervisory controller shall perform distributed; independent alarm analysis and filtering to minimize network traffic and prevent alarms from being lost. At no time shall the ability of supervisory controllers to report alarms be affected by either operator activity at the local I/O device or communications with other ASC's on the network.

L. All alarm or point change reports shall include the English language description of each point and the time and date of the occurrence.

M. The user shall be able to define the specific system reaction for each point. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms. A minimum of three priority levels shall be provided. Users shall have the ability to manually inhibit alarm reporting for each point.

N. The user shall also be able to define conditions under which point changes need to be acknowledged by an operator and/or logged for analysis at a later date.

O. Alarms reports and messages shall be directed to an operator device.

P. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 60-character alarm message to more fully describe the alarm condition or direct operator response.

Q. Each supervisory controller shall be capable of storing a library of at least 100 messages. Each message may be assignable to any number of points in the panel.

R. A data collection utility shall be provided to automatically sample, store, and display system data.

S. Measured and calculated analog and binary data shall be assignable to user definable trends for the purpose of collecting operator specified performance data over extended periods of time. Sample intervals of 1 minute to 24 hours, in one minute or one hour intervals, shall be provided. Each supervisory controller shall have a dedicated buffer for trend data and shall be capable of storing 16 trend logs. Each trend log shall have up to four points trended at 48 data samples each. Data shall be stored at the supervisory controller and up-loaded to the DDC system server when archiving is desired.

T. Supervisory controllers shall automatically accumulate and store runtime hours for binary input and output points specified in Section 23 09 14 of this specification.

U. Supervisory controllers shall automatically sample, calculate and store consumption totals on a daily, weekly, or monthly basis, user defined, for user-selected analog and binary pulse input type points.

V. Totalization shall provide calculation and storage accumulations of up to 9,999,999 units (e.g., KWH, gallons KBTU, tons, etc.).

W. The totalization routine shall have a sampling resolution of one minute.

X. The user shall have the ability to define a warning limit. Unique, user specified messages shall be generated when the limit is reached.

Y. The information available from pulse totalization shall include, but not be limited to, the following:

1. Peak demand, with date and time stamp
2. 24-hour demand log
3. Accumulated KWH for day
4. Sunday through Saturday KWH usage
5. Demand KW annual history for past 12 periods
6. KWH annual history for past periods

Z. Supervisory controllers shall have the ability to count events, such as the number of times a pump or fan system is cycled on and off.

AA. The event totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.

2.7 PROGRAMMABLE CONTROLLERS

A. Programmable controllers shall be provided with a software program that shall allow the user to design flexible software algorithms for the control sequences as described in Sections 23 09 14 and 23 09 93 portions of this specification.

B. Programmable controllers shall support all necessary point inputs and outputs to perform the specified control sequence in a totally stand-alone fashion.

C. Each programmable controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

D. Each programmable controller shall support the use of a locally mounted status and adjust panel interface to allow for the local adjustment of all setpoints, temporary override of any input or output points and status of all points directly at the controller. The capabilities of the locally mounted status and adjust panel shall include, but not be limited to, the following information for the programmable controllers to which:

1. Display temperatures
2. Display status
3. Display setpoints
4. Display control parameters

5. Override binary output control
6. Override analog setpoints
7. Modification of gain and offset constants

E. All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the programmable controller.

F. Programmable controllers shall support, but not be limited to, the following configurations of systems to address current requirements as described in Sections 23 09 14 and 23 09 93 portions of this specification, and for future expansion of air handling units:

1. Mixed air handling units
2. 100 percent outside air handling units
3. Generic system interlocking through hardware

2.8 APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS

A. Each supervisory controller shall be able to extend its monitoring and control through the use of stand-alone application specific controllers (ASC's).

B. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor based, multi-tasking, real-time digital control processor.

C. Each ASC shall have sufficient memory to support its own operating system and databases including:

1. Control Processes
2. Energy Management Applications
3. Operator I/O (Portable Service Terminal)

D. The operator interface to any ASC point or program shall be through the supervisory controller connection to any ASC on the network.

E. ASC's shall directly support the temporary use of a portable service terminal that can be connected to the ASC via zone temperature or directly at the controller. The capabilities of the portable service terminal shall include, but not be limited to, the following information for the:

1. Display temperatures
2. Display status
3. Display setpoints
4. Display control parameters
5. Override binary output control
6. Override analog setpoints
7. Modification of gain and offset constants

F. All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the ASC.

G. ASC’s shall support, but not be limited to, the following configurations of systems to address current requirements as described in Sections 23 09 14 and 23 09 93 portions of this specification, and for future expansion of air handling units:

1. Packaged Air Handling Units

2.9 OPERATOR INTERFACE REQUIREMENTS

A. <u>COMMAND ENTRY/MENU SELECTION PROCESS:</u>

1. Operator interface software shall minimize operator training through the use of English language prompting and English language point identification.

B. TEXT-BASED DISPLAYS:

1. The operator interface shall provide consistent text-based displays of all system point and application data described in this specification. Point identification, engineering units, status indication, and application naming conventions shall be the same at all operator devices.

C. GRAPHIC-BASED DISPLAYS:

1. The operator interface shall provide graphic based displays of each system. The point data associated with each system shall dynamically update at a minimum of every 30 seconds. Graphic displays shall be linked to each other to provide a "drill down" capability from main graphic displays to more specific system based displays. Provide a building level graphic display that links to system graphics. For systems that have ASC controlled terminal unit controls, provide a building floor plan with dynamic temperatures shown on the graphic that can be drilled into for more specific terminal information.

D. PASSWORD PROTECTION:

1. Multiple-level password access protection shall be provided to allow the user/manager to limit control, display, and data base manipulation capabilities as he deems appropriate for each user, based upon an assigned password.

2. Passwords shall be exactly the same for all operator devices.

3. A minimum of three levels of access shall be supported:

   a) Level 1: Data access and display
   b) Level 2 = Level 1 + operator overrides and commands
   c) Level 3 = Level 2 + database generation and modification

4. A minimum of 4 passwords shall be supported at each supervisory controller.

5. Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed at any operator device shall be limited to only those items defined for the access level of the password used to log-on.

6. Provide user definable, automatic log-off timers of from 1 to 60 minutes to prevent operators from inadvertently leaving devices on-line.

E. OPERATOR COMMANDS:

1. The operator interface shall allow the operator to perform commands including, but not limited to, the following:

   a) Start-up or shutdown selected equipment
   b) Adjust setpoints
   c) Add/modify/delete time programming
   d) Enable/disable process execution
   e) Lock/unlock alarm reporting for each point
   f) Enable/disable totalization for each point
   g) Enable/disable trending
   h) Enter temporary override schedules
   i) Define holiday schedules
   j) Change time/date
   k) Enter/modify analog alarm limits

l) Enable/disable analog alarm limits
m) Enable/disable demand limiting
n) Enable/disable duty cycle

F. LOGS AND SUMMARIES:

1. Reports shall be generated manually, and directed to the displays. As a minimum, the system shall allow the user to easily obtain the following general listing of all points in the system that shall include, but not be limited to:

a) Points currently in alarm
b) Off-line points
c) Points currently in override status
d) Points in weekly schedules
e) Holiday programming

2. Summaries shall be provided for specific points, for a logical point group, for a user-selected group of groups, or for the entire facility without restriction due to the hardware configuration on the facility management system. Under no conditions shall the operator need to specify the address of hardware controller to obtain system information.

G. SYSTEM CONFIGURATION AND DEFINITION:

1. All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.

2. The system shall be provided complete with all equipment, software, and documentation necessary to allow an operator to independently perform the following functions:

a) Add/delete/modify application specific controllers
b) Add/delete/modify points of any type, and all associated point parameters, and tuning constants
c) Add/delete/modify alarm reporting definition for each point
d) Add/delete/modify energy management applications
e) Add/delete/modify time and calendar-based programming
f) Add/delete/modify totalization for every point
g) Add/delete/modify historical data trending for every point
h) Add/delete/modify configured control processes
i) Add/delete/modify dial-up telecommunication definition
j) Add/delete/modify all operator passwords
k) Add/delete/modify alarm messages

H. PROGRAMMING DESCRIPTION:

1. Definition of operator device characteristics, ASC's, individual points, and shall be performed through fill-in-the-blank templates.

I. NETWORK-WIDE STRATEGY DEVELOPMENT:

1. Inputs and outputs for any process shall not be restricted to a single ASC, but shall be able to include data from any and all other ASC's to allow the development of network-wide control strategies.

J. SYSTEM DEFINITION/CONTROL SEQUENCE DOCUMENTATION:

1. All portions of system definition shall be self-documenting and be capable of providing hardcopy printouts of all configuration and application data.

K. DATA BASE SAVE/RESTORE/BACK-UP:

1. Backup copies of all programmable controller, ASC and supervisory controller databases shall be stored in at least one personal computer or laptop. Users shall also have the ability to manually execute downloading of a programmable controller, ASC or supervisory controller database.

2.10 OPERATOR WORK STATION & DDC SYSTEM SERVER

A. A Personal Computer (PC) Operator Workstation and DDC System Server software shall be provided for command entry, information management, network alarm management, database management and archiving functions. The functions of the operator workstation and DDC system server may reside on a single personal computer. Provide a separate DDC System Server PC if required to perform the specified requirements. All functions specified under the entire Operator Interface section of this specification must be met.

B. All real-time control functions shall be resident in the stand-alone supervisory controllers to facilitate greater fault tolerance and reliability.

C. Workstation shall be general purpose, commercially available, personal computers with a minimum processor speed of 3 GHz, a minimum of 8GB of RAM, a minimum hard drive size of 500GB, and a DVDRW/CDRW drive. Provide more memory and/or a faster processor if necessary to perform all the functions described in this specification.

D. Sufficient storage shall be provided to accommodate all fully configured point databases all application databases, all graphics databases, all user-defined reports, and all historical data archived as described in this specification.

E. The display provided for system operation shall have a diagonal screen measurement of no less than 17" and have a minimum display resolution of no less than 1024 x 1280 pixels. Separate controls shall be provided for color, contrast, and brightness.

F. Printer shall be a current production model.

G. Provide software, including but not limited to functions such as:

1. Grouping point data by systems or types
2. Displaying trends in textual and graphical format
3. Application software for programming all DDC controllers specified herein
4. Graphics definition and development
5. Managing archive data and programs

2.11 WEB BASED HTML BROWSER INTERFACE

A. Provide a HTML based browser interface (Web Server) for accessing the DDC system. This shall include all hardware and software to provide an Ethernet twisted pair connection to the owners local or wide area network (LAN or WAN) that can be used to access the DDC system through a standard internet browser.

B. All information shall be provided to the owners IT staff to facilitate connection through the owners LAN/WAN.

C. At a minimum, this interface shall be capable of all functions described under the Operator Interface section, Password Protection, Operator Commands, and Logs and Summary subsections of this specification.

2.12 PORTABLE OPERATOR TERMINAL

A. Provide a portable interface for accessing the DDC system from a connection to a supervisory controller. This device shall, at a minimum, be capable of all functions described under the Operator Interface section, Password Protection, Operator Commands, and Logs and Summary subsections of this specification.

2.13 ASC PORTABLE SERVICE TERMINAL

A. Provide a portable service terminal capable of interfacing to ASC's through a local serial port located on the ASC or if a remote thermostat is provided for the ASC, at the thermostat. The service terminal shall be capable of displaying all input and output points, adjusting all setpoints, and all tuning parameters for the ASC. This device is primarily for setup and servicing of ASC's.

PART 3 - EXECUTION

3.1 GENERAL

A. All electronic work required as an integral part of the Direct Digital Control system work is the responsibility of this section unless specifically indicated otherwise in this section, Section 23 09 14, or in Division 26.

B. This contractor shall provide all labor, materials, engineering, software, permits, tools, checkout and certificates required to install a complete Direct Digital Control system as herein specified.

C. Any and all points added with this project shall be grouped for display purposes into the system such that all points associated with a new or existing DDC system can appear together on the CRT display or printed log. Assignment of points to a group shall not be restricted by hardware configuration of the points of direct digital control. It shall be possible to assign a point to appear in more than one system. An English descriptor and an alpha/numeric identifier shall identify each system.

D. This Direct Digital Control system as herein specified shall be fully integrated and completely installed by this section. It shall include all required computer CPU software and hardware. Include the engineering, installation, supervision, calibration, software programming, and checkout necessary for a fully operational system.

3.2 INSTALLATION

A. All work and materials are to conform in every detail to the rules and requirements of the National Electrical Code and present manufacturing standards. All wiring and cable installation shall conform with the wiring installation as specified in the installation section of Section 23 09 14. All material shall be UL approved.

B. Install system and materials in accordance with manufacturer's instructions, rough-in drawings and details on drawings.

C. Line voltage wiring to power the DDC Controllers, not provided by the Division 26 contractor, to be by this contractor.

D. Control panels serving equipment fed by emergency power shall also be served by emergency power.

E. Provide uninterruptable power supplies where necessary to provide proper start-up of equipment or to accomplish power restart control sequences specified.

F. Mount control panels adjacent to associated equipment on vibration-free walls or free-standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

G. Provide as-built control drawings of all systems served by each local panel in a location adjacent to or inside of panel cover. Provide a protective cover or envelope for drawings.

H. Cable tray routing of the communication trunks is acceptable.

I. Provide an input for a service shutdown toggle switch for each air handling unit system provided inside the temperature control panel that will initiate a logical shutdown of the air handling unit system.

J. All tubing, cable and individual wiring is to be permanently tagged, with numbers corresponding with "Record Drawings", spares are to be labelled as "Spare".

K. Provide technician to work with air balancing contractor and/or provide balancing contractor with necessary hardware to over-ride DDC controllers for air balancing.

L. Provide documentation to demonstrate that all points, input and output, have been checked out and verified operational, note any points not operating properly with notation of reason.

3.3 OWNER TRAINING

A. All training provided for owner shall comply with the format, general content requirements and submission guidelines specified under Section 23 05 00.

B. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 24 hours.

C. Provide two follow-up visits for troubleshooting and instruction, one six months after substantial completion and the other at the end of the warranty period. Length of each visit to be not less than 2 hours or the time necessary to provide required information and complete troubleshooting and inspection activity for all controls installed under 23 09 23, 23 09 14, and 23 09 93. Coordinate the visit with the Owner and provide an inspection report to the Owner of any deficiencies found.

END OF SECTION

SECTION 23 09 93

SEQUENCE OF OPERATION FOR HVAC CONTROLS

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section includes control sequences for HVAC equipment as well as equipment furnished by others that may need monitoring or control. Included are the following topics:

B. PART 1 - GENERAL

1. Scope
2. Related Work
3. Description of Work
4. Submittals
5. Operation and Maintenance Data
6. Design Criteria

C. PART 2 - PRODUCTS

1. Not Applicable

D. PART 3 - EXECUTION

1. General Control
2. Constant Volume Mixed Air Handling Unit Control
   Mechanical / Electrical Room Ventilation Control

1.2 RELATED WORK

A. Applicable provisions of Division 1 govern work under this Section.
B. Section 23 09 23 - Direct Digital Controls (DDC)
C. Section 23 09 14 - Pneumatic and Electric Controls
D. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC – Coordination
E. Division 23 - HVAC - Equipment provided to be controlled or monitored
F. Division 26 - Electrical - Equipment provided to be controlled or monitored
G. Division 28 - Electronic Safety and Security

1.3 REFERENCE

A. The A/E must properly coordinate the necessary power wiring.

B. Section 23 09 14 work includes furnishing and installing all field devices, including electronic sensors for the DDC of this section, equipment, and all related field wiring, interlocking control wiring between equipment, pneumatic tubing, sensor mounting, etc., that is covered in that section.

C. Motorized control dampers and actuators, thermowells (temperature sensing wells), automatic control valves and their actuators are also covered in Section 23 09 14.

1.4 DESCRIPTION OF WORK

A. Control sequences are hereby defined as the manner and method by which automatic controls function. Requirements for each type of operation are specified in this section.

B. Operation equipment, devices and system components required for automatic control systems are specified in other Division 23 control sections of these specifications.

C. All temperature, humidity, and pressure sensing, and all other control signal transportation for the control sequences shall be furnished under Section 23 09 14. All pneumatic, electronic, and electric input/output signals shall be extended under Section 23 09 14, with adequate lead length for termination within the appropriate control panel being provided under Section 23 09 23.

D. Sequences for equipment controlled by Direct Digital Controls (DDC) as specified are accomplished by hardware and software provided under Section 23 09 23. Sequences for equipment controlled by pneumatic or electric self-contained controls are accomplished by hardware provided under Section 23 09 14.

1.5 SUBMITTALS

A. Refer to Division 1, General Conditions, Submittals, Section 23 05 00 and Sections 23 09 23, and 23 09 14 for descriptions of what should be included in the submittals.

B. Shop drawings shall be provided by contractor(s) providing equipment under Sections 23 09 23 and 23 09 14. The contractor providing the DDC equipment shall provide a complete narrative of the sequence of operations for equipment that is controlled through the DDC system. The contractor providing the 23 09 14 equipment shall provide a complete narrative of the sequence of operation for equipment that is controlled directly from that equipment (without control logic through the DDC system). The narrative of the sequence of operation shall not be a verbatim copy of the sequences contained herein, but shall reflect the actual operation as applied by the contractor.

1.6 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.7 DESIGN CRITERIA

A. Reference Section 23 09 14.

P A R T 2 - P R O D U C T S

2.1 Not applicable to this Section – reference Sections 23 09 23 and 23 09 14 for product descriptions.

P A R T 3 - E X E C U T I O N

3.1 GENERAL:

A. SETPOINTS:

1. All setpoints indicated in the control specification are to be adjustable. The setpoints shall be readily available to be modified in the mechanical system software system summary (either textual or graphic based) and under the same software level as hardware points. Some less used setpoints may be provided on a lower software level, if requested by the user Agency for clarity. The setpoints indicated herein are only specified as a calculated starting point (or initial system operation). It is expected that setpoint adjustments and control loop tuning shall be required to provide optimum system operation based on requirements of the building. The control contractor shall work with the balancing contractor and the user Agency to provide the final system setpoint adjustments and control loop tuning after the system is in operation and building is in use. Document all final setpoints on the as-built control drawings. Any questions regarding the intended operation of the HVAC equipment and control systems shall be referred to the HVAC design engineer through the appropriate construction communication process. The following setpoints should be used as initial setpoints unless otherwise specified in the individual control sequences:

a) Occupied Space Terminal Unit Heating: 68º F
b) Occupied Space Terminal Unit Cooling: 76º F
c) Entry Way Heating: 60° F

d) Mechanical or Unoccupied Space Ventilation: 82º F
e) Mechanical or Unoccupied Space Heating: 60º F

B. ANTI-CYCLING:

1. When HVAC equipment or a sequence is specified to be started and stopped by a temperature, humidity, pressure setpoint or any other controlled variable, there shall be an adjustable differential setpoint that shall be set to prevent short cycling of the systems and equipment due to minor changes in the controlled variable. Temperature differential setpoints shall be set at 2º F and non-temperature setpoints shall be set at 10% of the controlled range unless otherwise specified. Setpoints shall indicate at when the process should be turned on. Heating and cooling differentials shall be set for above setpoint and will be used to turn the process off. For example, an economizer sequence called to switch at 68º F, would turn on at 68º F and off at 70º F since it is a cooling function. A heating lockout setpoint of 50º F would turn on heating control at 50º F and off at 52º F Non-temperature differentials shall be set above setpoint if the setpoint is indicating a minimum value or below setpoint if the setpoint is indicating a maximum value. Provide minimum runtime timers for loads that are cycled to prevent over-cycling. Timers shall be set as specified or as needed to prevent damage or excessive wear to the equipment. Unless otherwise specified in the individual control sequences, fans and pumps shall have a minimum runtime on timers of 15 minutes (adj.) and off timers of 5 minutes (adj.). Safeties shall override runtime timers.

C. DEADBANDS:

1. Provide deadbands for all DDC control loops to prevent constant hunting of output signals to controlled devices. Deadbands shall be set to provide adequate control around setpoint as follows unless otherwise specified in the individual control sequences:

a) Temperature Control: ±0.5º F
b) Humidity Control: ±1% RH
c) Airflow Control: ±2% of total flow
d) AHU Static Pressure Control: ±0.01 in. w.c.

D. ALARMS:

1. Provide all alarmed points with adjustable time delays to prevent nuisance tripping under normal operation and on equipment start-up. For all commanded outputs that have status feedback, provide an alarm that will indicate the commanded output is not in its commanded state. Provide alarms on all points as indicated on point charts. For existing campus automations systems, add/delete what is called on the point charts for after consultation with user Agency to provide consistent alarming throughout the automation system.

E. EQUIPMENT START/STOP FAILURE STATES:

1. All start/stop points for equipment shall utilize normally open contacts unlesscalled out specifically in the individual control sequences.

F. LEAD/LAG SEQUENCING:

1. For sequences that call for lead/lag of equipment connected to building automation systems, the lead device shall be able to be chosen through a selectable day of the week and time of day through the building automation system. Coordinate with the user Agency for scheduling switchover and frequency. Unless otherwise directed, switchover shall occur at 10AM Tuesday and shall rotate the lead device on a weekly cycle rotating through all devices sequentially. For standalone lead/lag sequence controllers (non-DDC), the lead device shall be selected by a switch on the panel face.

G. VARIABLE FREQUENCY DRIVE (VFD) MOTOR RUN STATUS:

1. Use the VFD programmable relay dry contact output specified to be provided with the VFD under Section 23 05 14 to prove motor run status and detect belt loss or coupling break. If a bypass contactor is provided with the VFD, provide an adjustable current switch and wire it in parallel with the VFD output for proving motor status.

H. VFD BYPASS & SAFETY INTERLOCKS:

1. VFD's equipped with bypass starters shall be interlocked so that the start/stop and safety circuits that are called out for VFD operation shall be functional when the VFD is indexed to the bypass starter mode. Unless otherwise specified in the sequence below, the switch from inverter to bypass starter modes shall be through a manual switch provided on the VFD/bypass starter package.

I. VFD MINIMUM SPEED & RAMP TIMERS:

1. The VFD start-up technician shall work with the DDC Temperature Control Contractor determine the minimum speed required for the motor controlled by the VFD to provide cooling of the motor as installed to prevent heat related problems. This minimum speed shall be set in the VFD controller. The VFD start-up technician shall work with the DDC Temperature Control Contractor to set the acceleration and deceleration timers in the VFD controller at 30 seconds for motors less than 40 HP and 60 seconds for motors 40 HP and greater.

J. CURRENT SWITCH SETUP:

1. When current switches are used for proving fan or pump status, they shall be set up so that they will detect belt or coupling loss by the reduction in current draw loss of coupled load. The current switch set up shall be redone by the 23 09 14 contractor after the balancer is complete.

K. DAMPER INTERLOCKS FOR FANS WITH STARTERS:

1. For fan systems with magnetic starters and shutoff dampers specified with end switches, the damper interlock shall be hardwired in such a way that the damper shall open if the fan starter hand / off / auto switch is in the hand or in the auto position and being called to start. After the damper end switch has proven the damper open, a hardwire interlock from the end switch to the starter holding coil for the fan shall cause the fan to start. For fan systems that are ducted in parallel, see specific sequence for fan system on interlock requirements.

L. DAMPER INTERLOCKS FOR FANS WITH VFD'S:

1. For fan systems with VFD's and shutoff dampers specified with end switches, the damper end switches shall be hardwire interlocked to the safety circuit(s) of the VFD to prevent the fan from starting until the damper is proven open. This interlock shall prevent the fan from running in either the VFD or bypass (if provided) mode. The damper end switch shall also be monitored by the DDC system. For fan systems that are ducted in parallel, see specific sequence for fan system on additional interlock requirements.

2. For fan systems with VFD's and shutoff dampers specified with end switches, hardwire interlock the shutoff damper with the fan VFD. When the fan is remotely or locally commanded to start, VFD contacts shall energize outside air damper actuator to open damper. The damper position end switch shall be wired to run permissive input on the VFD and enable the VFD to start when the damper position end switch provides the damper is open. This operation shall be provided for VFD and bypass operation if the VFD is provided with a bypass. The damper end switch shall also be monitored by the DDC system. For fan systems that are ducted in parallel, see specific sequence for fan system on additional interlock requirements.

M. FAN INTERLOCKING:

1. Provide interlocks between supply and return or exhaust fan systems as scheduled on the plans or called out in individual control sequences. If DDC controlled, interlocks shall be done through DDC start/stop points unless otherwise specified in individual control sequences. If not DDC controlled, interlocks shall be accomplished via hardwire interlocks between fan starters or VFD's.

N. THERMOSTATS AND SENSORS:

1. All devices and equipment including terminal units, specified to be controlled in a control sequence by a thermostat or sensor, shall be provided with a thermostat or sensor, whether or not the device is indicated on the plans. Consult the HVAC design engineer for the thermostat or sensor location.

O. ORIGINAL EQUIPMENT MANUFACTURER (OEM) CONTROLLER DDC INTEGRATION:

1. Provide DDC programming to define all equipment integral input/output points, setpoints, data points, calculations, etc. that are available through the manufacturers communication interface. Consult with the Owner's DDC operations personnel to determine if some of the points should be omitted (for clarity or lack of value). The following equipment shall be integrated into the DDC system:

a) Variable Frequency Drives

P. WEEKLY SCHEDULING

1. Provide scheduling of DDC terminal units in groups based on occupancy. Work with the user Agency to determine how many groups are required and which zones should be included. Individual terminal units shall be able to receive temporary schedules that will override the group schedules. Temporary override buttons at the zone sensor (where specified on point charts) shall override the scheduling to occupied. When groups that consist of more than 20% of terminal units are indexed to occupied, the associated air handling unit shall start if not already running.

Q. CALCULATED DATA POINTS

1. Provide calculated data points for actual dirty pressure drop for all variable volume air handling units with supply flow measurement based on the following equation:

a) Actual Dirty Filter ΔP = (Measured Supply CFM/Design CFM)^2 x Design Dirty Filter ΔP

2. Provide a calculated data point for outside airflow for all fans that have return and outside air mixing dampers and the points required to allow for the following equation:

a) Outside Airflow = Supply CFM x (MAT-RAT)/(OAT-RAT)

3. Where Supply CFM is measured either on variable volume fans or as balanced on constant volume units, MAT is Mixed Air Temperature, RAT is Return Air Temperature, and OAT is Outside Air Temperature. This point is designed as a check for outside air flow stations accuracy and outside air ventilation minimum damper positions. It should be noted that the accuracy of the calculated outside airflow will diminish as outside air temperature approaches return air temperature. It should be used as a check only when the RAT and OAT are greater than 20 DegF and the accuracy of the RAT and OAT temperature sensors are assured.

3.2 CONSTANT VOLUME MIXED AIR HANDLING UNIT CONTROL (AHU-1):

A. GENERAL:

1. The Air Handling unit is constant air volume, indoor air unit.

2. The Air Handling unit is controlled by direct digital controller (DDC).

3. The Air Handling unit is equipped with the following:

a) Supply fan with starter.
b) Outside air damper
c) Return air damper
d) Relief air damper
e) Direct expansion coil for cooling.
f) Indirect gas-fired heating
g) Mixing Box.

B. FAN CONTROL:

1. Start/Stop: The DDC system shall start and stop the supply and return fan.

2. Current Status Switch: Provide for both supply and return fans and set up as described under GENERAL, Current Switch Setup, in this Section.

C. VENTILATION AIR CONTROL:

1. Minimum Outside Ventilation Air Flow Control: When the economizer sequence is not enabled, the outside air damper shall be positioned at its minimum position to maintain the scheduled outside air flow ventilation rate. When the economizer sequence is enabled, the outside air damper will be limited from closing below the minimum outside air ventilation position. The control contractor shall work with the balancing contractor to calibrate the outside air damper minimum position to establish the minimum scheduled ventilation airflow.

D. FILTERS:

1. Install a differential static pressure sensor across each filter bank. Ensure that the static probes do not impede filter removal.

E. DISCHARGE AIR TEMPERATURE CONTROL:

1. Install a temperature sensor in the supply duct downstream of the supply fan, all water coils and humidifiers.

2. Discharge Air Temperature Setpoint Reset from Zone Temperature (Heating and Cooling Unit): Reset the discharge air temperature setpoint based on the zone temperature between 55º F (adj.) and 90º F (adj.) to maintain a zone heating and economizer setpoint of 72º F (adj.). Mechanical cooling shall maintain a zone mechanical cooling setpoint of 76º F (adj.). Mechanical cooling shall be locked out below the mechanical cooling setpoint unless dehumidification control is required.

F. ECONOMIZER CONTROL:

1. When the economizer sequence is enabled by the switchover sequence below, the outside air economizer damper, return damper, and relief damper will modulate in sequence to provide outside air to be used for free cooling. The dampers will modulate in sequence with the heating and cooling elements as described in the discharge air temperature control sequence above.

2. Floating Dry Bulb Economizer Switchover: The economizer sequence shall be enabled whenever the outside air temperature is more than 4º F (adj.) cooler than the return air temperature.

G. SAFETIES:

1. General: All safeties shall be hard wired to the supply and return fan starters or VFD safety circuits. Starters shall not function in the “Hand” or “Auto” and VFD’s shall be disabled if they are indexed to the “Auto” or “Hand” position in either the VFD or bypass modes.

2. Freezestat: Install an electric freezestat (refer to specification Section 23 09 14 for location) to shut down the unit (see Unit Shutdown for additional information) if the temperature downstream of the heating coil drops below 35º F (adj.). The electric freezestat shall act independently of the DDC system via hardwire interlock and shall override the DDC system control signal to open the heating coil control valve(s). A freezestat trip shall notify the DDC system that shall send an alarm to the operator interface.

3. Supply Fan Low Pressure Limit: Install a static pressure probe located in the air handling unit immediately downstream of the prefilter and pipe to a differential pressure switch located in the temperature control panel. Wire in series with the safety circuit of the supply and return fans. Differential pressure switch shall be a manual reset type and the DDC system shall monitor the status of the differential pressure switch. Initial setpoint shall be -2.0" w.c. (adj.).

4. Fire Alarm Shutdown: Upon a Fire Alarm System alarm, the fire alarm control module provided by the electrical contractor at the temperature control panel shall change state of its contacts. This shall cause the unit to be shut down (see Unit Shutdown for additional information) and all fire/smoke and smoke dampers within this system shall close. An auxiliary contact shall be provided to notify the DDC system of a fire alarm shutdown.

H. UNIT SHUTDOWN:

1. Whenever the air handling unit is indexed off, the supply and return fans shall stop. If the return fan fails off, the supply fan shall be indexed off. On a failure of either the supply or return fan, an alarm will be sent through the DDC system. Whenever both supply and return fans are off for any reason the following shall occur:

2. The outside air dampers and relief air dampers shall close and the return dampers shall open.

3. The direct expansion coil control shall be deenergized.

4. The heating coil control valve(s) shall remain under control from the mixed air sensor to maintain 55 ºF (adj.). Freezestat shall override heating control valve(s) open.

5. All fire/smoke dampers associated with the air handling system shall close.

I. UNOCCUPIED CONTROL:

1. General: Occupied/unoccupied schedule shall be set at the DDC operator interface. When indexed to unoccupied the unit shall shutdown. Where provided, index DDC controlled heating and cooling terminal units associated with this air handling unit to maintain setback and setup temperature setpoints unless overridden by occupancy sensor or manual pushbutton.

J. HEATING OPTIMUM START-UP:

1. This cycle shall override the unoccupied cycle. If the system was operating as a result of the unoccupied cycle, the system shall continue to operate. The DDC system shall measure the zone air temperature designated on the plans and the outside air dry bulb temperature to determine the minimum run time to warm the zone(s) to its setpoint. When the computed start time is reached, the DDC system shall start the air handling system and operate with the outside air and relief air dampers closed and the return air damper open. The air handling unit discharge air temperature shall be controlled as specified under Discharge Air Control. If a pneumatic thermostat dual air main is provided, the main shall be indexed to occupied (day) pressure when this mode is started. When the occupied time is reached, the unit shall be switch to occupied control and ventilation air will be provided.

K. COOLING OPTIMUM START-UP:

1. This cycle shall override the unoccupied cycle. If the system was operating as a result of the unoccupied cycle, the system shall continue to operate. The DDC system shall measure the zone air temperature designated on the plans and the outside air dry bulb temperature to determine the minimum run time to cool the zone(s) to its setpoint. When the computed start time is reached, the DDC system shall start the air handling system. The air handling unit discharge air temperature shall be controlled as specified under Discharge Air Control with the economizer and chilled water control active. If a pneumatic thermostat dual air main is provided, the main shall stay indexed to setback (night) pressure when this mode is active. When the occupied time is reached, the unit shall be switch to occupied control and ventilation air will be provided.

END OF SECTION 23 09 93

SECTION 23 11 00

FACILITY FUEL PIPING

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section contains specifications for fuel pipe and fuel pipe fittings for this project. Included are the following topics:

B. PART 1 - GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Shop Drawings
6. Quality Assurance
7. Delivery, Storage, and Handling
8. Design Criteria
9. Welder Qualifications
10. Natural Gas Service

C. PART 2 - PRODUCTS

1. Natural Gas
2. Vents and Relief Valves
3. Unions and Flanges

D. PART 3 - EXECUTION

1. Preparation
2. Erection
3. Welded Pipe Joints
4. Threaded Pipe Joints
5. Natural Gas
6. Vents and Relief Valves
7. Unions and Flanges
8. Piping System Leak Tests
9. Piping System Test Report

1.2 RELATED WORK

Section 23 05 23 - General-Duty Valves for HVAC Piping
Section 23 05 15 - Piping Specialties
Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A.	ANSI B16.3	Malleable Iron Threaded Fittings
B.	ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
C.	ASTM A234	Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

1.5 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

C. TYPE E OR S STEEL PIPE:

1. Mill certification papers, also known as material test reports, for the pipe furnished for this project, in English. Heat numbers on these papers to match the heat numbers stencilled on the pipe. Chemical analysis indicated on the mill certification papers to meet or exceed the requirements of the referenced ASTM specification.

1.6 QUALITY ASSURANCE

A. Order all Type E and Type S steel pipe with heat numbers rolled, stamped, or stenciled to each length or each bundle, depending on the size of the pipe, and in accordance with the appropriate ASTM specification.

B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

B. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place.

C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.8 DESIGN CRITERIA

A. Use only new material, free of defects, rust and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

B. Construct all piping for the highest pressures and temperatures in the respective system in accordance with ANSI B31, but not less than 125 psig unless specifically indicated otherwise.

C. Non-metallic piping will be acceptable only for the services indicated. It will not be acceptable in occupied spaces and ventilation plenum spaces, including plenum ceilings.

D. Where weld fittings or mechanical grooved fittings are used, use only long radius elbows having a centerline radius of 1.5 pipe diameters.

E. Where ASTM A53 grade A pipe is specified, ASTM A53 grade B pipe may be substituted at Contractor's option. Where the grade or type is not specified, Contractor may choose from those commercially available.

1.9 WELDER QUALIFICATIONS

A. Before any metallic welding is performed, Contractor to submit his Standard Welding Procedure Specification together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure Vessel Code and/or the National Certified Pipe Welding Bureau.

B. Before any polyethylene fusion welding is performed, Contractor to submit certification that the welders to be used on this project have successfully demonstrated proper welding

procedures in accordance with the Code of Federal Regulations, Title 49, Part 192, Section 192.285.

C. The A/E or DSF reserves the right to test the work of any welder employed on the project, at the Contractor's expense. If the work of the welder is found to be unsatisfactory, the welder shall be prevented from doing further welding on the project.

1.10 NATURAL GAS SERVICE

A. All charges for the gas service as shown on the plans, including the connection from the main in the street or other location to the gas meter, shall be paid by this Contractor, including setting of gas meter(s) and all work performed by the gas company.

List the contact person at the gas utility along with their telephone number and address so the contractor can properly schedule this work.

Verify whether or not a gas meter needs a concrete pad. If it does, coordinate this with the architect so that the general contractor installs it.

P A R T 2 - P R O D U C T S

2.1 NATURAL GAS

A. 2" and Smaller: ASTM A53, type E or S, standard weight (schedule 40) black steel pipe with ASTM A197/ANSI B16.3 class 150 black malleable iron threaded fittings or ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.

B. 2-1/2" and Larger: ASTM A53, type E or S, standard weight black steel pipe with ASTM A234 grade WPB/ANSI B16.9 standard weight, seamless, carbon steel weld fittings.

2.2 VENTS AND RELIEF VALVES

A. Use pipe and pipe fittings as specified for the system to which the relief valve or vent is connected.

2.3 UNIONS AND FLANGES

A. 2" and Smaller: ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Use unions of a pressure class equal to or higher than that specified for the fittings of the respective piping service but not less than 250 psi.

B. 2-1/2" and Larger: ASTM A181 or A105, grade 1 hot forged steel flanges of threaded, welding and of a pressure class compatible with that specified for valves, piping specialties and fittings of the respective piping service. Flanges smaller than 2-1/2" may be used as needed for connecting to equipment and piping specialties. Use raised face flanges ANSI B16.5 for mating with other raised face flanges on equipment with flat ring or full face gaskets. Use ANSI B16.1 flat face flanges with full face gaskets for mating with other flat face flanges on equipment.

P A R T 3 - E X E C U T I O N

3.1 PREPARATION

A. Remove all foreign material from interior and exterior of pipe and fittings.

3.2 ERECTION

A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult

drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

B. Provide anchors, expansion joints, swing joints and/or expansion loops so that piping may expand and contract without damage to itself, equipment, or building.

C. Mitered ells, notched tees, and orange peel reducers are not acceptable. On threaded piping, bushings are not acceptable.

D. "Weldolets" and "Threadolets" may be used for branch takeoffs up to one-half (1/2) the diameter of the main.

E. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment

F. Install all valves, and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

3.3 WELDED PIPE JOINTS

A. Make all welded joints by fusion welding in accordance with ASME Codes, ANSI B31, and State Codes where applicable.

B. Electrodes shall be Lincoln, or approved equal, with coating and diameter as recommended by the manufacturer for the type and thickness of work being done.

3.4 THREADED PIPE JOINTS

A. Use a Teflon based thread lubricant or Teflon tape when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.5 NATURAL GAS

A. Pitch horizontal piping down 1" in 60 feet in the direction of flow. Install a 4" minimum depth dirt leg at the bottom of each vertical run and at each appliance. When installing mains and branches, cap gas tight each tee or pipe end which will not be immediately extended. All branch connections to the main shall be from the top or side of the main.

B. Do not install gas pipe in a ventilation air plenum.

C. If an above ground vent terminates in an area subject to snow accumulation, terminate the line at least five feet above grade.

D. Install a shut off valve at each appliance. Provide a valved connection at the main for equipment and appliances furnished by others.

E. Piping through a roof shall be run through an approved roof penetration with flashing and counter flashing.

F. Each gas pressure reducing valve vent and relief valve vent shall be run separately to a point outside of the building, terminated with a screened vent cap, and located according to gas utility regulations.

G. Clean all welded piping before all regulators and control valves. Test by placing target cloth over piping and blow with compressed air. Clean piping until target cloth is clean and free of debris.

3.6 VENTS AND RELIEF VALVES

A. Install vent and relief valve discharge lines as indicated on the drawings, as detailed, and as specified for each specific valve or piping specialty item. In no event is a termination to occur less than six feet above a roof line.

3.7 UNIONS AND FLANGES

A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair, or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve. Concealed unions or flanges are not acceptable.

3.8 PIPING SYSTEM LEAK TESTS

A. Verify that the piping system being tested is fully connected to all components and that all equipment is properly installed, wired, and ready for operation. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Verify that hangers can withstand any additional weight load that may be imposed by the test.

B. Provide all piping, fittings, blind flanges, and equipment to perform the testing.

C. Conduct pressure test with test medium of air or water unless specifically indicated. Minimum test time is indicated in the table below; additional time may be necessary to conduct an examination for leakage. Each test must be witnessed by the Owner's project representative. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.

D. Do not insulate pipe until it has been successfully tested.

E. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges/unions. Measure and record test pressure at the high point in the system.

F. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking. After testing is complete, slowly release the pressure in a safe manner.

G. Measure natural gas system test pressure with a water manometer or an equivalent device calibrated in increments not greater than 0.1 inch water column. System will not be approved until it can be demonstrated that there is no measurable loss of test pressure during the test period.

H. Conduct fuel oil system test so as not to impose a pressure of more than 10 psig on the tank. Instead of a pressure test, suction lines may be tested under a vacuum of not less than 20 inches of mercury maintained for at least one hour.

System	Pressure	Medium	Duration
Natural gas	100 psig	Air	24 hr

I. On piping that can not be tested because of connection to an active line, provide temporary blind flanges and hydrostatically test new section of piping. After completion of test, remove temporary flanges and make final connections to piping. Die penetrate test pass weld or x-ray the piping that was not hydrostatically tested up to the active system.

END OF SECTION 23 11 00

SECTION 23 23 00

REFRIGERANT PIPING

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section contains specifications for all Refrigerant piping for this project. Included are the following topics:

B. PART 1 - GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Shop Drawings
6. Quality Assurance
7. Delivery, Storage, and Handling
8. Design Criteria

C. PART 2 - PRODUCTS

1. Refrigerant Piping
2. Refrigerant Piping Accessories

D. PART 3 - EXECUTION

1. Preparation
2. Erection
3. Refrigerant Piping
4. Refrigerant Piping Accessories

1.2 RELATED WORK

A. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
B. Section 23 07 00 - HVAC Insulation

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

ASTM B88	Seamless Copper Water Tube
ASTM B280	Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASHRAE 15	Safety Code for mechanical Refrigeration

1.5 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Contractor shall submit schedule indicating the ASTM specification number of the pipe being proposed along with its type and grade and sufficient information to indicate the type and rating of fittings for each service.

C. COPPER TUBE:

1. Statement from manufacturer on his letterhead that the pipe furnished meets the ASTM specification contained in this section.

1.6 QUALITY ASSURANCE

A. Order all copper refrigeration tube with each shipping unit marked with the purchase order number, metal or alloy designation, temper, size, and name of supplier; with soft straight lengths or coils identified with a tag indicating that the product was manufactured in accordance with ASTM B280; and with each hard temper straight length identified throughout its length by a blue colored marking not less than 3/16 inch in height and a legend at intervals of not greater than three feet that includes the designation "ACR" and pipe outside diameter.

B. Any installed material not meeting the specification requirements must be replaced with material that meets these specifications without additional cost to the Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Promptly inspect shipments to insure that the material is undamaged and complies with specifications.

B. Cover pipe to eliminate rust and corrosion while allowing sufficient ventilation to avoid condensation. Do not store materials directly on grade. Protect pipe, tube, and fitting ends so they are not damaged. Where end caps are provided or specified, take precautions so the caps remain in place. If end caps are not present on tube bearing the "ACR" designation, clean and re-cap in accordance with ASTM B280. Protect fittings, flanges, and unions by storage inside or by durable, waterproof, above ground packaging.

C. Offsite storage agreements will not relieve the contractor from using proper storage techniques.

D. Storage and protection methods must allow inspection to verify products.

1.8 DESIGN CRITERIA

A. Use only new material, free of defects and scale, and meeting the latest revision of ASTM specifications as listed in this specification.

B. Where ASTM B88, type L hard temper copper tubing is specified, ASTM B88, type K hard temper copper tubing may be substituted at Contractor's option.

P A R T 2 - P R O D U C T S

2.1 REFRIGERANT PIPING

A. ASTM B88 type L hard drawn copper tube, cleaned and capped in accordance with ASTM B280, and marked "ACR", with ANSI B16.22 wrought copper or forged brass solder-type fittings.

2.2 REFRIGERANT PIPING ACCESSORIES

A. Provide all refrigerant piping specialties with a maximum working pressure of full vacuum to 450 psig and a maximum working temperature of 225 deg F. For systems using R-410A, provide all refrigerant piping specialties with a maximum working pressure of full vacuum to 850 psig and a maximum working temperature of 225 deg F.

B. Flexible pipe connectors: Double braided bronze hose flexible pipe connectors with solder end connections.

C. Filter Dryers: For circuits 15 tons and over provide angle pattern filter dryers with replaceable core. For circuits below 15 tons provide straight pattern filter dryers without replaceable core.

D. Sight glasses: Two piece brass construction with solder end connections. Include color indicator for sensing moisture.

E. Solenoid Valves: Two way normally closed with two piece brass body, full port, stainless steel plug, stainless steel spring, teflon diaphragm and solder end connections. Provide replaceable coil assembly.

F. Hot Gas Bypass Valves: Provide with integral solenoid valve, external equalizer connection and adjustable pilot assembly.

G. Thermostatic Expansion Valves: Brass body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

H. Charging Valves: Provide ¼" SAE brass male flare access ports with finger tight, quick seal caps. Provide 2-inch long copper extension sections.

I. Check valves: Spring loaded type with bronze body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

P A R T 3 - E X E C U T I O N

3.1 PREPARATION

A. Remove all foreign material from interior and exterior of pipe and fittings.

3.2 ERECTION

A. Install all piping parallel to building walls and ceilings and at heights which do not obstruct any portion of a window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings, or other architectural details before installing piping.

B. Do not route piping through transformer vaults or above transformers, panelboards, or switchboards, including the required service space for this equipment, unless the piping is serving this equipment

C. Install all valves and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

3.3 REFRIGERANT PIPING

A. Refrigeration piping to be installed by firms who are experienced in installation of such piping and in accordance with the requirements of the Wisconsin Administrative Code Section ILHR 45.

B. All solder joints to be ASTM Grade 4 or 5 and have a melting point of approximately 1250 degrees F. Solder impurities shall not exceed 0.15%. Tubing to be new and delivered to the job site with the original mill end caps in place. Clean and polish all joints before soldering. Avoid prolonged heating and burning during soldering. Purge all lines with nitrogen during soldering. Provide manual shut-off and check valves as required.

C. No refrigerant is to be vented directly to the atmosphere except that which may escape through leaks in the system during leak testing. During evacuation procedures, use equipment designed to recover and allow recycling of the refrigerant.

D. Leak test the system by charging the system to a pressure of 10 psig with an HFC refrigerant, with the compressor suction and discharge valves closed and with all other system valves open. Increase pressure to 300 psig with dry nitrogen. Rap all joints with a mallet and check for leaks with an electric leak detector having a certified sensitivity of at least one ounce per year. Seal any leaks that may be found and retest.

E. After completion of the leak test, evacuate the system with a vacuum pump to an absolute pressure not exceeding 1500 microns while the system ambient temperature is above 60°F. Break the vacuum to 2 psig with the refrigerant to be used in the system. Repeat the evacuation process, again breaking the vacuum with refrigerant. Install a drier of the required size in the liquid line, open the compressor suction and discharge valves, and evacuate to an absolute pressure not exceeding 500 microns. Leave the vacuum pump running for not less than two hours without interruption. Raise the system pressure to 2 psig with refrigerant and remove the vacuum pump.

F. Charge refrigerant directly from original drums through a combination filter-drier. Each drier may be used for a maximum of three cylinders of refrigerant and then must be replaced with a fresh drier. Charge the system by means of a charging fitting in the liquid line. Weigh the refrigerant drum before charging so that an accurate record can be kept of the weight of refrigerant put in the system. If refrigerant is added to the system through the suction side of the compressor, charge in vapor form only.

3.4 REFRIGERANT PIPING ACCESSORIES

A. Install accessories in accordance with the manufacturer's written instructions and recommendations.

END OF SECTION 23 23 00

SECTION 23 31 00

HVAC DUCTS and CASINGS

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section includes specifications for all duct systems used on this project. Included are the following topics:

B. PART 1 - GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Shop Drawings
7. Design Criteria
8. Delivery, Storage and handling

C. PART 2 – PRODUCTS

1. General
2. Materials
3. Low Pressure Ductwork (Maximum 2 inch pressure class)
4. Duct Sealant
5. Gaskets

D. PART 3 – EXECUTION

1. Installation
2. Low Pressure Duct (Maximum 2 inch pressure class)
3. Cleaning
4. Leakage Test

E. APPENDIX

1. Duct Leakage Test Report
2. Duct Structural Test Report

1.2 RELATED WORK

23 33 00 – Air Duct Accessories
23 01 30.51 – HVAC Air Duct Cleaning
23 05 93 - Testing, Adjusting, and Balancing for HVAC

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this Section.

1.4 REFERENCE STANDARDS

ANSI SS-EN 485-2	Aluminum and Aluminum Alloys-Sheet, Strip and Plate-Part 2: Mechanical Properties
ASTM B209	Specification for Aluminum and Aluminum-Alloy Sheet and Plate
ASTM A90	Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles
ASTM A167	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM A623 Process	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip
ASTM A527	Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality
ASTM 924	Standard Specification for General Requirements for Sheet Steel, Metallic-coated by the Hot-dip Method
ASTM C 1071	Specification for Fibrous Glass Duct Lining Insulation
ASTM C 411	Test Method for Hot Surface Performance of High Temperature Thermal Insulation
ASTM E 84	Test Method for Surface Burning Characteristics of Building Materials
ASTM C 1338	Test Method for Determining Fungal Resistance of Insulation Materials and Facings
ASTM G 21	Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi
ASTM C 916	Standard Specification for Adhesives for Duct Thermal Insulation
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems
UL 181	Standard for Safety for Factory Made Air Ducts and Air Connectors.
NAIMA	Fibrous Glass Duct Liner Standard

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions.

1.6 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Include manufacturer's data and/or Contractor data for the following:

1. Fabrication and installation drawings.

2. Schedule of duct systems including material of construction, gauge, pressure class, system class, method of reinforcement, joint construction, fitting construction, and support methods, all with details as appropriate.

3. Duct sealant and gasket material.

4. Duct liner including data on thermal conductivity, air friction correction factor, and limitation on temperature and velocity.

1.7 DESIGN CRITERIA

A. Construct all ductwork to be free from vibration, chatter, objectionable pulsations and leakage under specified operating conditions.

B. Use material, weight, thickness, gauge, construction and installation methods as outlined in the following SMACNA publications, unless noted otherwise:

1. HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005
2. HVAC Air Duct Leakage Test Manual, 1st Edition, 1985
3. HVAC Systems - Duct Design, 4th Edition, 2006
4. Rectangular Industrial Duct Construction Standard, 2nd Edition, 2004
5. Round Industrial Duct Construction Standards, 2nd Edition, 1999
6. Thermoplastic Duct (PVC) Construction Manual, 2nd Edition, 1995

C. Use products which conform to NFPA 90A, possessing a flame spread rating of not over 25 and a smoke developed rating no higher than 50.

1.8 DELIVERY, STORAGE AND HANDLING

A. Promptly inspect shipments to ensure that Ductwork is undamaged and complies with the specification.

B. Protect Ductwork against damage.

C. Protect Ductwork by storing inside or by durable, waterproof, above ground packaging. Do not store material on grade. Protect Ductwork from dirt, dust, construction debris and foreign material. Where end caps/packaging are provided, take precautions so caps/packaging remain in place and free from damage.

D. Offsite storage agreements do not relieve the contractor from using proper storage techniques.

E. Storage and protection methods must allow inspection to verify products.

P A R T 2 - P R O D U C T S

2.1 GENERAL

A. All sheet metal used for construction of duct shall be 24 gauge or heavier except for round and spiral ductwork and spiral duct take-offs 12” and below may be 26 gauge where allowed in SMACNA HVAC Duct Construction Standards, Metal and Flexible, 3rd Edition, 2005.

B. Duct sizes indicated on plans are net inside dimensions; where duct liner is specified, dimensions are net, inside of liner.

C. DUCTWORK PRESSURE CLASS

1. Minimum acceptable duct pressure class, for all ductwork except transfer ductwork, is 2 inch W.G. positive or negative, depending on the application. Transfer ductwork minimum acceptable duct pressure class is 1 inch W.G. positive or negative, depending on the application. Duct system pressure classes not indicated on the drawings to be as follows:

Transfer ducts	_____2 in. calc. S.P.	_____1 in. pressure class
Exhaust ducts	_____2 in. calc. S.P.	_____1 in. pressure class
Return ducts	_____2 in. calc. S.P.	_____1 in. pressure class
Relief ducts	_____2 in. calc. S.P.	_____1 in. pressure class

2.2 MATERIALS

A. GALVANIZED STEEL SHEET:

1. Use ASTM A 653 galvanized steel sheet of lock forming quality. Galvanized coating to be 1.25 ounces per square foot, both sides of sheet, G90 in accordance with ASTM A90. Provide “Paint Grip” finish for ductwork that will be painted.

2.3 LOW PRESSURE DUCTWORK (Maximum 2 inch pressure class)

A. Fabricate and install ductwork in sizes indicated on the drawings and in accordance with SMACNA recommendations, except as modified below.

B. Construct so that all interior surfaces are smooth. Use slip and drive or flanged and bolted construction when fabricating rectangular ductwork. Use spiral lock seam construction when fabricating round spiral ductwork. Sheet metal screws may be used on duct hangers, transverse joints and other SMACNA approved locations if the screw does not extend more than 1/2 inch into the duct.

C. Use elbows and tees with a center line radius to width or diameter ratio of 1.5 wherever space permits. When a shorter radius must be used due to limited space, install single wall sheet metal splitter vanes in accordance with SMACNA publications, Type RE 3. Where space will not allow and the C value of the radius elbow, as given in SMACNA publications, exceeds 0.31, use rectangular elbows with turning vanes as specified in

Section 23 33 00. Square throat-radius heel elbows will not be acceptable. Straight taps or bullhead tees are not acceptable.

D. Where rectangular elbows are used, provide turning vanes in accordance with Section 23 33 00.

E. Provide expanded take-offs or 45 degree entry fittings for branch duct connections with branch ductwork airflow velocities greater than 700 fpm. Square edge 90-degree take-off fittings or straight taps will not be accepted.

F. Button punch snaplock construction will not be accepted on aluminum ductwork.

G. Round ducts may be substituted for rectangular ducts if sized in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission of the Architect/Engineer.

H. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

2.4 DUCT SEALANT

A. Manufacturer: 3M 800, 3M 900, H.B. Fuller/Foster, Hardcast, Hardcast Peal & Seal, Lockformer cold sealant, Mon-Eco Industries, United Sheet Metal, or approved equal. Silicone sealants are not allowed in any type of ductwork installation.

B. Install sealants in strict accordance with manufacturer's recommendations, paying special attention to temperature limitations. Allow sealant to fully cure before pressure testing of ductwork, or before startup of air handling systems.

2.5 GASKETS

A. 2 INCH PRESSURE CLASS AND LOWER:

1. Soft neoprene or butyl gaskets in combination with duct sealant for flanged joints.

P A R T 3 - E X E C U T I O N

3.1 INSTALLATION

A. Verify dimensions at the site, making field measurements and drawings necessary for fabrication and erection. Check plans showing work of other trades and consult with Architect in the event of any interference.

B. Make allowances for beams, pipes or other obstructions in building construction and for work of other contractors. Transform, divide or offset ducts as required, in accordance with SMACNA HVAC Duct Construction Standards, Figure 4-7, except do not reduce duct to less than six inches in any dimension and do not exceed an 8:1 aspect ratio. Where it is necessary to take pipes or similar obstructions through ducts, construct easement as indicated in SMACNA HVAC Duct Construction Standards, Figure 4-8, Fig. E. In all cases, seal to prevent air leakage. Pipes or similar obstructions may not pass through high pressure or fume exhaust ductwork.

C. Test openings for test and balance work will be provided under Section 23 05 93.

D. Provide frames constructed of angles or channels for coils, filters, dampers or other devices installed in duct systems, and make all connections to such equipment including equipment furnished by others. Secure frames with gaskets and screws or nut, bolts and washers.

E. Install duct to pitch toward outside air intakes and drain to outside of building. Solder or seal seams to form watertight joints.

F. Where two different metal ducts meet, the joint shall be installed in such a manner that metal ducts do not contact each other by using proper seal or compound.

G. Install all motor operated dampers and connect to or install all equipment furnished by others. Blank off all unused portions of louvers, as indicated on the drawings, with 1-1/2 inch board insulation with galvanized sheet metal backing on both sides.

H. Do not install ductwork through dedicated electrical rooms or spaces unless the ductwork is serving this room or space.

I. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

J. Provide adequate access to ductwork for cleaning purposes.

K. Provide temporary capping of ductwork openings to prevent entry of dirt, dust and foreign material.

L. Protect diffusers, registers and grilles with plastic wrap or some other approved form of protection to maintain dirt and dust free and to prevent entry of dirt, dust and foreign material into the Ductwork.

M. Install prefabricated grease ductwork assemblies in accordance with manufacturer requirements and NFPA 96.

N. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.2 DUCTWORK SUPPORT

A. Support ductwork in accordance with SMACNA HVAC Duct Construction Standards, Figure 5-5, except supporting ductwork with secure wire method is not allowed.

B. Support with 3/32 inch, 7 x 7, stainless steel air-craft cable, with matching fastener rated for 50% of actual load, will be allowed on round ductwork under 12 inches if installed as detailed, with cable double looped on duct and at point of support.

3.3 LOW PRESSURE DUCT (Maximum 2 inch pressure class)

A. Seal all duct, with the exception of transfer ducts, in accordance with SMACNA seal class "A"; all seams, joints, and penetrations shall be sealed.

B. Install a manual balancing damper in each branch duct and for each diffuser or grille. The use of splitter dampers, extractors, or grille face dampers will not be accepted for balancing dampers.

C. Hangers must be wrapped around bottom edge of duct and securely fastened to duct with sheetmetal screws or pop rivets. Trapeze hangers may be used at contractor's option.

3.4 CLEANING

A. Remove all dirt and foreign matter from the entire duct system and clean diffusers, registers, grilles and the inside of air-handling units before operating fans.

B. Clean duct systems with high power vacuum machines where systems have been used for temporary heat, air-conditioning, or ventilation purposes during construction. Protect equipment that may be harmed by excessive dirt with filters, or bypass during cleaning.

3.5 LEAKAGE TEST

A. Test all ductwork in accordance with test methods described in Section 5 of SMACNA HVAC Air Duct Leakage Test Manual. Do not insulate ductwork until it has been successfully tested. Test pressure shall be equal to the duct pressure class.

B. If excessive air leakage is found locate leaks, repair the duct in the area of the leak, seal the duct, and retest.

C. Leakage rate shall not exceed more than 5% of the system air quantity for low pressure ductwork, determined in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.

D. Leakage rate shall not exceed more that 1% of the system air quantity for high pressure ductwork, determined in accordance with Appendix C of the SMACNA HVAC Air Duct Leakage Test Manual.

E. Leakage test for ductwork downstream of air terminal devices may be omitted but will not relieve the contractor from duct sealing requirements.

F. Submit a signed report to the Owner's Project Representative, indicating test apparatus used, results of the leakage test, and any remedial work required to bring duct systems into compliance with specified leakage rates.

3.6 STRUCTURAL TEST

A. Random test all ductwork per DSF direction. Do not insulate ductwork until it has been successfully tested. Test pressure shall be equal to the duct pressure class.

B. Deflection limits shall not exceed those listed in accordance with Chapter 11 of SMACNA HVAC Duct Construction Standards, 3.0 Performance Requirements.

C. Submit a signed report to the Owner's Project Representative, indicating test apparatus used, results of the structural test, and any remedial work required.

DUCT LEAKAGE TEST REPORT

Project Number:_____

Date Submitted:_____

Project	**Name:_____**		
	Location:_____		
	Contractor:_____		
System Data	**Fan No:_____**	**Leakage Class (C_L):_____**	
	Fan Design CFM:_____	**Duct Pressure Class (P_C):_____**	
		Test Pressure (P_T):_____	
Test Equipment	**Manufacturer:_____**	**Model No:_____**	**Serial No:_____**

For large systems, use the reverse side for a simple sketch of the entire duct system. Then use letter designations to indicate the various duct sections being tested at one time. Also use the reverse side for test comments.

Note that due to normal construction sequencing it is usually necessary to test risers separately prior to enclosing chases.

Design Data					**Field Test Data**							
			Allowable Leakage		**Diameter**		**Pressure (in. wc.)**					
Duct Section	**Duct Shape**	**Duct Surface (Ft^2)**	**Leakage Factor ($P^{.65}C_L$)**	**CFM for Section**	**Tube (D_1)**	**Orifice (D_2)**	**In Duct (P)**	**Across Orifice (P_{drop})**	**Date**	**Performed By**	**Observed By**	**Actual CFM**
TOTAL												

DUCT STRUCTURAL TEST REPORT

Project Number:_____

Date Submitted:_____

Project **Name:_____**

Location:_____

Contractor:_____

System Data **Fan No:_____**

Description of Test Method:_____

_____

_____

Test Equipment **Manufacturer:_____** **Model No:_____** **Serial No:_____**

For large systems, use the reverse side for a simple sketch of the entire duct system. Then use letter designations to indicate the various duct sections being tested at one time. Also use the reverse side for test comments.

Note that due to normal construction sequencing it is usually necessary to test risers separately prior to enclosing chases.

Design Data								Field Test Data						
Duct Test Location	Ductwork Shape		Duct Pressure Class	Allowable Ductwork Wall Deflection		Allowable Joint/ Reinforcement Deflection		Pressure (in. wc.) In Duct	Measured Ductwork Wall Deflection		Measured Joint/ Reinforcement Deflection		Per-formed By/ Date	Wit-nessed By/ Date
	H	W		H	W	H	W		H	W	H	W		

END OF SECTION 23 31 00

SECTION 23 33 00

AIR DUCT ACCESSORIES

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This sections includes accessories used in the installation of duct systems. Included are the following topics:

B. PART 1 – GENERAL

1. Related Work
2. Reference
3. Reference Standards
4. Quality Assurance
5. Shop Drawings
6. Operation and Maintenance Data

C. PART 2 – PRODUCTS

1. Manual Volume Dampers
2. Turning Vanes
3. Fire Dampers
4. Control Dampers
5. Smoke Detectors
6. Access Doors
7. Flexible Duct
8. Flashings
9. Duct Flexible Connections
10. Louvers

D. PART 3 – EXECUTION

1. Manual Volume Dampers
2. Turning Vanes
3. Fire Dampers
4. Control Dampers
5. Smoke Detectors
6. Access Doors
7. Flashings
8. Duct Flexible Connections
9. Louvers

1.2 RELATED WORK

A. 23 05 29 – Hanger and Supports for HVAC Piping and Equipment
B. 23 05 48 – Vibration and Seismic Controls for HVAC Piping and Equipment
C. 23 31 00 – HVAC Ducts and Casings

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this Section.

1.4 REFERENCE STANDARDS

NFPA 90A	Standard for Installation of Air Conditioning and Ventilating Systems
SMACNA	HVAC Duct Construction Standards - Metal and Flexible, 2nd Edition, 1995
UL 214	

UL 555 (6th edition)	Standard for Fire Dampers and Ceiling Dampers
UL 555S (4th edition)	Leakage Rated Dampers for Use in Smoke Control Systems

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions

1.6 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Submit for all accessories and include dimensions, capacities, ratings, installation instructions, and appropriate identification.

C. Include certified test data on dynamic insertion loss, self-noise power levels, and aerodynamic performance of sound attenuators.

D. Submit manufacturer's color charts where finish color is specified to be selected by the Architect/Engineer.

1.7 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

P A R T 2 - P R O D U C T S

2.1 MANUAL VOLUME DAMPERS

A. Manufacturers: Ruskin, Vent Products, Air Balance, or approved equal.

B. Dampers must be constructed in accordance with SMACNA Fig. 2-12, Fig. 2-13, and notes relating to these figures, except as modified below.

C. Reinforce all blades to prevent vibration, flutter, or other noise. Construct dampers in multiple sections with mullions where width is over 48 inches. Use rivets or tack welds to secure individual components; sheet metal screws will not be accepted. Provide operators with locking devices and damper position indicators for each damper; use an elevated platform on insulated ducts. Provide end bearings or bushings for all volume damper rods penetrating ductwork constructed to a 3" w.c. pressure class or above.

2.2 TURNING VANES

A. Manufacturers: Aero Dyne, Anemostat, Barber-Colman, Hart & Cooley, or approved equal.

B. Construct turning vanes and runners for square elbows in accordance with SMACNA Fig. 2-3 and Fig. 2-4 except use only airfoil type vanes. Construct turning vanes for short radius elbows and elbows where one dimension changes in the turn in accordance with SMACNA Fig. 2-5 and Fig. 2-6.

2.3 FIRE DAMPERS

A. Manufacturers: Air Balance, Advanced Air, American Warming and Ventilating, Greenheck, Phillips-Aire, Prefco, Ruskin, Safe-Air or approved equal.

B. STATIC FIRE DAMPERS

1. Static fire damper assemblies must be UL 555 (6th edition) listed and labeled for static applications (where air systems do not operate during a fire) and meet requirements of NFPA 90A. Damper must be type B curtain type with blades

out of the air stream; dampers with blades in the air stream will not be accepted. Damper fire rating to be compatible with the rating of the building assembly in which the damper is used.

2.4 CONTROL DAMPERS

A. Control dampers are specified in section 23 09 14.

2.5 SMOKE DETECTORS

A. Smoke detectors are furnished and installed by the Electrical Contractor.

2.6 ACCESS DOORS

A. Access door to be designed and constructed for the pressure class of the duct in which the door is to be installed. Doors in exposed areas shall be hinged type with cam sash lock. Hinges shall be steel full length continuous piano type. Doors in concealed spaces may be secured in place with cam sash latches. For both hinged and non hinged doors provide sufficient number of camp sash latches to provide air tight seal when door is closed. Do not use hinged doors in concealed spaces if this will restrict access. Use minimum 1" deep 24 gauge galvanized steel double wall access doors with minimum 24 gauge galvanized steel frames. For non-galvanized ductwork, use minimum 1" deep double wall access door with frame that shall use materials of construction identical to adjacent ductwork. Provide double neoprene gasket that shall provide seals from the frame to the door and frame to the duct. When access doors are installed in insulated ductwork or equipment provide insulated doors with insulation equivalent to what is provided for adjacent ductwork or equipment. Access doors constructed with sheet metal screw fasteners will not be accepted.

B. Use insulated, 1-1/2 hour UL 1978 listed and labeled access doors in kitchen exhaust ducts.

2.7 FLEXIBLE DUCT

A. Manufacturers: Anco Products, Clevaflex, Thermaflex, Flexmaster or approved equal.

B. Factory fabricated , UL 181 listed as a class 1 duct, and having a flame spread of 25 or less and a smoke developed rating of 50 or under in accordance with NFPA 90A.

C. Suitable for pressures and temperatures involved but not less than a 180°F service temperature and ±2 inch pressure class, depending on the application.

D. Duct to be composed of polyester film, aluminum laminate or woven and coated fiberglass fabric bonded permanently to corrosion resistant coated steel wire helix. Two-ply, laminated, and corrugated aluminum construction may also be used.

E. Where duct is specified to be insulated, provide a minimum 1 inch fiberglass insulation blanket with maximum thermal conductance of 0.23 K (75 degrees F.) and vapor barrier jacket of polyethylene or metalized reinforced film laminate. Maximum perm rating of vapor barrier jacket to be 0.1 perm.

2.8 FLASHINGS

A. Provide flashing to completely weatherproof connection of ductwork to louvers. Flashing to be constructed of material similar to louver material.

B. Flashing and counterflashing for roof curbs will be provided by others.

C. Flashing and curbs for duct and pipe penetrations of roof assemblies to be in accordance with details.

2.9 DUCT FLEXIBLE CONNECTIONS

A. Material to be fire retardant, be UL 214 listed, and meet the requirements of NFPA 90A.

B. Connections to be a minimum of 3 inches wide, crimped into metal edging strip, and air tight. Connections to have adequate flexibility and width to allow for thermal expansion/contraction, vibration of connected equipment, and other movement.

C. Use coated glass fiber fabric for all applications. Material for inside applications other than corrosive environments, fume exhaust, or kitchen exhaust to be double coated with neoprene, air and water tight, suitable for temperatures between -10°F and 200°F, and have a nominal weight of 30 ounces per square yard. Material used for outdoor applications other than corrosive environments, fume exhaust, or kitchen exhaust to be double coated with Hypalon¿,air and water tight, suitable for temperatures between -10°F and 250°F, and have a nominal wight of 26 ounces per square yard.

D. For corrosive environments or fume exhaust applications indoors or outdoors, use a material coated with Teflon that is air and water tight, suitable for temperatures between -20°F and 500°F, and has a nominal weight of 14 ounces per square yard.

2.10 LOUVERS

A. Manufacturers: Airolite K6776, Industrial Louvers 658, American Warming and Ventilating LE-31, or Construction Specialties 6177, or approved equal.

B. Similar to Airolite Type K6776, extruded aluminum alloy not less than 12 gauge (.081" thick), 6063 series frame and blades, all-welded assembly, 35 degree or 45 degree blades with water baffle, 6 inches thick. Provide with bird screen of ½” x ½” mesh aluminum in 12 gauge aluminum frame and an aluminum sill. Locate the bird screen inside of the louver unless noted otherwise.

C. Louver to bear the AMCA certified ratings seal for both air performance and water penetration, having a free area not less than 50% based on a 48" x 48" section, a water penetration less than 0.1 oz/square foot under AMCA test at 1000 feet per minute, and an intake pressure drop less than 0.20 inches of water at 1000 feet per minute.

D. Finish to be anodized or Kynar 500 in a custom color to be selected by the Architect. Furnish sufficient paint in the same color as the louver to paint the outer surface of panels over unused portions of louvers and to paint the interior portion of ductwork visible through the louvers.

P A R T 3 - E X E C U T I O N

3.1 MANUAL VOLUME DAMPERS

A. Install manual volume dampers in each branch duct and for each grille, register, or diffuser as far away from the outlet as possible while still maintaining accessibility to the damper. Install so there is no flutter or vibration of the damper blade(s).

3.2 TURNING VANES

A. Install turning vanes in all rectangular, mitered elbows in accordance with SMACNA standards and/or manufacturer's recommendations.

B. Install double wall, airfoil, 2 inch radius vanes in ducts with vane runner length 18" or greater and air velocity less than 2000 fpm. Install double wall, airfoil, 4-1/2 inch radius vanes in ducts with vane runner length 18" or greater and air velocity 2000 fpm or greater.

C. If duct size changes in a mitered elbow, use single wall type vanes with a trailing edge extension. If duct size changes in a radius elbow or if short radius elbows must be used, install sheetmetal turning vanes in accordance with SMACNA Figure 2-5 and Figure 2-6.

3.3 FIRE DAMPERS

A. Install dampers in strict accordance with manufacturer's installation instructions. Install damper sleeves with retaining angles on both sides of rated partition. Connections of ductwork to fire damper assemblies to be as specified on the installation instructions. Where it is necessary to set dampers out from the rated wall, install a sleeve extension encased in two hour rated fire proofing insulation. Install an access door at each fire damper, located to permit resetting the damper replacing the fusible link.

B. Manually test each fire damper for proper operation by removing the fusible link. Repair or replace any fire damper that does not close completely. Re-install fusible link after test.

3.4 CONTROL DAMPERS

A. Install dampers in locations indicated on the drawings, as detailed, and according to the manufacturer's instructions. Install blank-off plates or transitions where required for proper mixing of airstreams in mixing plenums. Provide adequate operating clearance and access to the operator. Install an access door adjacent to each control damper for inspection and maintenance.

3.5 SMOKE DETECTORS

A. Installation and wiring of detectors will be by the Electrical Contractor. Install an access door at each detector location.

3.6 ACCESS DOORS

A. Install access doors where specified, indicated on the drawings, and in locations where maintenance, service, cleaning or inspection is required. Examples include, but are not limited to motorized dampers, fire and smoke dampers, smoke detectors, fan bearings, heating and cooling coils, filters, valves, and control devices needing periodic maintenance.

B. Size and numbers of duct access doors to be sufficient to perform the intended service. Minimum access door size shall be 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, or other size as indicated. Install access doors on both inlet and outlet sides of reheat coils as well as other duct mounted coils.

C. Label fire, smoke and combination fire smoke dampers on the exterior surface of ductwork directly adjacent to access doors using a minimum of 0.5 inch height lettering reading, “SMOKE DAMPER” or “FIRE DAMPER”. Smoke and combination fire smoke dampers shall also include a second line listing the individual damper tag. The tags must be coordinated with the mechanical schedules. Utilize stencils or manufactured labels. All other forms of identification are unacceptable. All labels shall be clearly visible from the ceiling access point.

3.7 FLEXIBLE DUCT

A. Flexible duct may only be used for final connections of air inlets and outlets at diffuser, register, and grille locations. Where flexible duct is used, it shall be the minimum length required to make the final connections, but no greater than 5 feet in length, and have no more than one (1) 90 degree bend.

B. Secure inner jacket of flexible duct in place with stainless steel metal band clamp. Secure insulation vapor barrier jacket in place with steel or nylon draw band. Sheetmetal screws and/or duct tape will not be accepted.

C. Flexible duct used to compensate for misalignment of main duct or branch duct will not be accepted.

D. Individual sections of flexible ductwork shall be of one piece construction. Splicing of short sections will not be accepted.

E. Flexible ductwork used as transfer duct shall be sized for a maximum velocity of 300 fpm.

F. Penetration of any partition, wall, or floor with flexible duct will not be accepted.

3.8 FLASHINGS

A. Flashing for roof curbs, equipment supports or rails located on roof, will be installed by others.

3.9 DUCT FLEXIBLE CONNECTIONS

A. Install at all duct connections to rotating or vibrating equipment, including air handling units (unless unit is internally isolated), fans, or other motorized equipment in accordance with SMACNA Figure 2-19. Install thrust restraints to prevent excess strain on duct flexible connections at fan inlets and outlets; see Related Work.

B. For applications in corrosive environments or fume exhaust systems, use a double layer of the Teflon¿ coated fabric when making the connector.

3.10 LOUVERS

A. Furnish louvers to the General Contractor for mounting in exterior walls. Connect outside air intake duct to the louver, sealing all connections air and water tight.

B. Provide bird screen on inside of active louver area where none is provided with louvers. Where louvers are equipped with inside birdscreen, remove screen at all locations where duct connections are not made.

C. Install insulated metal panel on unused portion of louver. Panels must be sealed weathertight to louver assembly with flashing as required for proper drainage to outside of building. Paint outside surface of panel to match louver prior to installation. Where ductwork is visible through louver when viewed from outside the building, paint inside of duct to match louver color.

END OF SECTION 23 33 00

SECTION 23 34 00

HVAC FANS

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section includes specifications for fans that are not an integral part of a manufactured device. Included are the following topics:

B. PART 1 – GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Shop Drawings
7. Operation and Maintenance Data
8. Design Criteria

C. PART 2 – PRODUCTS

1. General
2. Sidewall Centrifugal Fans
3. Ceiling Exhaust Fans
4. Ceiling Destratification Fans

D. PART 3 – EXECUTION

1. Installation
2. Owner Training

1.2 RELATED WORK

A. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
B. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
C. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this Section.

1.4 REFERENCE STANDARDS

AMCA 203	AMCA Fan Application Manual - Troubleshooting
AMCA 210	Laboratory Method of Testing Fans for Rating
AMCA 300	Reverberant Room Method for Sound Testing of Fans
NFPA 90A	Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 96	Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions.

1.6 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Include dimensions, capacities, fan curves, materials of construction, ratings, weights, motors and drives, sound power levels, appropriate identification and vibration isolation

for all equipment. Sound power levels to be based on tests performed in accordance with AMCA Standard 300.

C. Submit color selection charts for equipment where applicable.

D. Fan curves shall indicate the relationship of CFM to static or total pressure for various fan speeds. Brake horsepower, recommended selection range, and limits of operation are to also be indicated on the curves. Indicate operating point on the fan curves at design air quantity and indicate the manufacturer's recommended drive loss factor for the specific application. Tabular fan performance data is not acceptable.

E. For variable air volume application, include data which indicates the effect of capacity control devices, such as inlet vanes, on performance.

1.7 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.8 DESIGN CRITERIA

A. Tested and certify all fans in accordance with the applicable AMCA test code.

B. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.

C. Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA Publication 203, Appendix L.

D. Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, provide any motor, drive and/or wiring changes required due to increased static pressure or baffling necessary to prevent uneven airflow or improve mixing.

E. All internal insulation and other components exposed to the airstream are to meet the flame spread and smoke ratings contained in NFPA 90A.

F. All roof mounted equipment to be provided with curbs or equipment stands in accordance with specification in Section 23 05 29.

P A R T 2 - P R O D U C T S

2.1 GENERAL

A. Use fan size, class, type, arrangement, and capacity as scheduled.

B. Furnish complete with motors, wheels, drive assemblies, bearings, vibration isolation devices, and accessories required for specified performance and proper operation. All single phase motors to have inherent thermal overload protection.

C. Provide variable pitch sheaves for drives 3 hp and smaller, fixed pitch sheaves for drives 5 hp and larger. Design all drives for 150% of motor rating.

D. Use OSHA approved belt guards that totally enclose the entire drive. Construct guards of expanded metal to allow for ventilation; provide tachometer openings at shaft locations.

E. Statically and dynamically balance all fans so they operate without objectionable noise or vibration.

F. Use AMCA Type A spark resistant construction for all fans handling flammable or explosive vapors.

G. All fans handling grease laden vapors shall meet the requirements of UL 762 and NFPA 96.

H. Provide a corrosion resistant coating on all surfaces exposed to fume and other corrosive exhaust air. Coating to be as scheduled.

2.2 SIDEWALL CENTRIFUGAL FANS

A. Manufacturers: Carnes, Greenheck, Cook, Jenn-Air, ACME, Penn, or approved equal.

B. Dome type with spun aluminum housing, non-overloading centrifugal wheel, factory mounted and wired motor and disconnect switch housed in a separate ventilated compartment, belt or drive drive as scheduled, 24 volt electrically operated control damper with blade edge and jamb seals, damper operator, and birdscreen.

2.3 CEILING EXHAUST FANS

A. Carnes, Greenheck, Penn, Jenn-Air, Cook, ACME, or approved equal.

B. Centrifugal blower wheel, steel housing with acoustical lining, integral exhaust grille, adjustable mounting brackets to allow for any ceiling thickness, permanently lubricated motor, integral junction box with permanently lubricated and thermally protected motor factory wired, 24 volt electrically operated contol damper with blade edge and jamb seals, and damper operator.

C. Provide wall, eave, or roof discharge assembly, as indicated on the drawings.

2.4 DESTRATIFICATION FANS

A. Emerson-Chromalox, Envirofan, Hunter, or approved equal.

B. U.L. listed, all metal construction, baked enamel finish with factory standard color selected by Architect. Motors to be totally enclosed, impedance protected, single speed, of split capacitor design with permanently lubricated ball bearings.

C. Provide solid state variable speed controls as scheduled.

D. Motors to be reversible for summer/winter operation.

P A R T 3 - E X E C U T I O N

3.1 INSTALLATION

A. Install as shown on the drawings, as detailed, and according to manufacturer's installation instructions. On units provided with a drain connection, reduce drain connection down to ½” fitting and leave open.

B. Install thrust restraints in accordance with the requirements of Section 23 05 48.

C. Contractor shall balance blade assembly of destratification fans after installation to assure stable operation.

3.2 OWNER TRAINING

A. All training provided for the owner will be videotaped and then transferred onto a DVD with 3 copies given to owner.

END OF SECTION 23 34 00

SECTION 23 37 13

DIFFUSERS, REGISTERS & GRILLES

PART 1 - GENERAL

1.1 SCOPE

A. This section includes specifications for air terminal equipment. Included are the following topics:

B. PART 1 - GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Submittals
7. Design Criteria

C. PART 2 - PRODUCTS

1. Manufacturers
2. Square Ceiling Diffusers
3. Eggcrate Grille
4. Door Grille
5. Drum Diffuser

D. PART 3 - EXECUTION

1. Installation

1.2 RELATED WORK

Section 23 31 00 - HVAC Ducts and Casings
Section 23 33 00 - Air Duct Accessories
Section 23 05 93 - Testing, Adjusting and Balancing for HVAC

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. NFPA 90A - Installation of Air Conditioning and Ventilation Systems
B. UL 181 - Factory-Made Air Ducts and Connectors
C. ARI-ADC Standard 880

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions.

1.6 SUBMITTALS

A. Refer to division 1, General Conditions, Submittals.

B. Furnish submittal information including, but not limited to, the following:

1. Manufacturer's name and model number
2. Identification as referenced in the documents
3. Capacities/ratings
4. Materials of construction
5. Sound ratings
6. Dimensions
7. Finish
8. Color selection charts where applicable
9. Manufacturer's installation instructions
10. All other appropriate data

1.7 DESIGN CRITERIA

A. All performance data shall be based on tests conducted in accordance with Air Diffusion Council (ADC) Test Code 1062 GRD 84.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Carnes, Krueger, Titus, Metal-Aire, and E.H. Price, and United Sheet Metal.

B. Acceptable manufacturers for specific products are listed under each item.

2.2 SQUARE CEILING DIFFUSERS

A. Titus model TDC/TDC-AA, Carnes series SK or SE, Price model SMD/AMD, Metal Aire series 5500 or 5500S, and Krueger series S.

B. Aluminum (Steel) unless otherwise indicated, louvered face furnished with frame type appropriate to installation.

C. Directional blow pattern as shown on the drawings and/or as scheduled.

D. One-piece construction louver cones with no corner joints.

E. White, baked enamel finish or powder coat finish, unless otherwise indicated.

2.3 EGGCRATE GRILLE

A. Titus model 50, Carnes model RAE or RAT, Price model 80, Metal Aire model CC, Krueger model EGC.

B. Aluminum construction with frame type appropriate to installation.

C. Grille face 1/2" x 1/2" or 1" x 1" grid pattern 1" deep with a minimum of 85% free area.

D. Grille sizes and finishes as shown on drawings and/or as scheduled.

E. White, baked enamel finish or powder coat finish, unless otherwise indicated..

F. Screw holes on surface counter sunk to accept recessed type screws.

2.4 DOOR GRILLE

A. Titus Series 700, Carnes Series RF or RG, Metal Aire Series DG, Price ATG/STG

B. Aluminum (Steel) Sight tight.

C. Grille sizes, frame types, and finishes as shown on drawings and/or as scheduled.

D. White, baked enamel finish or powder coat finish, unless otherwise indicated.

2.5 DRUM DIFFUSER

A. Krueger series DPL, Metal Aire RH, or Price HCD

B. Extruded aluminum with adjustable cylindrical drums and deflecting vanes. Minimum 60° angular adjustment, of jet centerline rotating drum.

C. White, baked enamel finish or powder coat finish, unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install grilles, registers and diffusers as shown on drawings and according to manufacturer's instructions.

B. Furnish diffusers with equalizing grids where it is not possible to maintain minimum 2 duct diameter straight duct into diffuser. Equalizing grids shall consist of individually adjustable vanes designed for equalizing airflow into diffuser neck and providing directional control of airflow.

C. Unless otherwise indicated, size ductwork drops to diffusers or grilles to match unit collar size.

D. Seal connections between ductwork drops and diffusers/grilles airtight.

E. Blank off unused portion of linear slot diffusers, linear bar diffusers and grilles.

F. Where diffusers, registers and grilles cannot be installed to avoid seeing inside duct, paint inside of duct with flat black paint to reduce visibility.

G. In clean rooms and animal holding rooms, caulk space between diffuser or grille and ceiling or wall to be air and watertight. User clear non-hardening silicone sealant compatible with ceiling or wall surfaces. Sealant shall be resistant to microbiological growth.

END OF SECTION 23 37 13

SECTION 23 41 00

PARTICULATE AIR FILTRATION

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section includes specifications for air system filters. Included are the following topics:

B. PART 1 – GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Shop Drawings
7. Operation and Maintenance Data
8. Design Criteria

C. PART 2 – PRODUCTS

1. Manufacturers
2. MERV 7 Filters
3. Housings for MERV 7 Filters
4. Filter Gauges

D. PART 3 – EXECUTION

1. Installation
2. Filter Gauges
3. Owner Training

1.2 RELATED WORK

Section 23 07 00 - HVAC Insulation

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ASHRAE Standard 52
B. UL 181 – Standard for Factory-Made Air Ducts and Air Connectors
C. UL 586 – Standard for High Efficiency Particulate Air Filter Units
D. UL 900 – Standard for Air Filter Units

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions.

1.6 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Include data concerning dimensions, materials, efficiencies, installation instructions and appropriate identification.

C. Independent test reports verifying filter performance, test procedures and ratings.

1.7 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.8 DESIGN CRITERIA

A. Use UL Class 1 or Class 2 filters unless noted otherwise.(Reference applicable UL standard referenced)

B. Efficiencies indicated in this section are based on ASHRAE Standard 52.

C. Fan motors have been selected to operate against the resistance of dirty filters as specified in this section.

P A R T 2 - P R O D U C T S

2.1 MANUFACTURERS

A. American Air Filter, Barnebey-Cheney, Cambridge, Continental, Flanders, Camil-Farr, Mine Safety Appliances, Research Products, or approved equal.

2.2 MERV 7 FILTERS

A. Use 2" thick, pleated panels, 100% synthetic, self supported media fully bonded and sealed in cardboard frame.

B. Media nominal rating to be 500 FPM face velocity, 0.20 inch WG initial resistance, 1.0 inches WG recommended final resistance., Average arrestance of filter media shall be 90-92%

C. Furnish side access housing or holding frame as scheduled. Filter tracks shall be constructed to provide a minimum clearance of 2 inches between the pre-filter and final-filter media to facilitate the installation of static pressure tips.

2.3 HOUSINGS FOR MERV 7 FILTERS

A. Housing or holding frame to be of the same manufacturer as filter media or provided by the air handling unit manufacturer. Contractor fabricated housings or filter racks will not be accepted. Casing and tracks constructed of galvanized or enameled steel or aluminum. Provide access to the media tracks from outside the casing so media and be readily changed. Filter tracks shall be constructed to provide a minimum clearance of 2 inches between the pre-filter and final-filter media to facilitate the installation of static pressure tips.

2.4 FILTER GAUGES

A. Manufacturers: Dwyer, or approved equal.

B. Direct reading, 3-1/2 inch dial type, diaphragm actuated, in a metal case. Lettering shall be black figures on white background. Provide front recalibration adjustment.

C. Provide gauges with the following ranges:

Filter Type	Scale Range (inch W.G.)
MERV 7	0.0 to 1.0

D. Provide one gauge for each filter bank, suitable for flush or surface mounting. Include an air filter gauge accessory package consisting of mounting bracket, aluminum tubing, two static pressure tips, and vent valves for each gauge

P A R T 3 - E X E C U T I O N

3.1 INSTALLATION

A. Where air handling equipment is to be used for temporary heating or ventilation of a facility, do not operate the equipment until specified filter media has been installed. Contractor shall be responsible for maintaining the cleanliness of air handling apparatus and air distribution systems during construction through regular inspection and changing of filter media throughout the construction period.

B. Where air handling apparatus is used during the construction period, install new filter media prior to start of air balancing. Additionally, deliver one new set of media to the owner prior to substantial completion.

C. Install units as shown on drawings and details according to manufacturer's instructions.

D. Reinforce filter holding frames per manufacturer's instructions.

E. Maintain necessary clearance for changing filters.

F. ULPA FILTER MEDIA

1. The filter assembly shall be leak tested and factory certified per referenced ASME and IES standards.

3.2 FILTER GAUGES

A. Install filter gauge static pressure tips upstream and downstream of filters. Mount gauge on outside of filter housing or filter plenum in accessible position outside of the unit housing, install tubing and gauge valves between gauge and sensor tips. Adjust and level each gauge.

3.3 OWNER TRAINING

A. All training provided for the owner will be videotaped and then transferred onto a DVD with 3 copies given to owner.

END OF SECTION 23 41 00

SECTION 23 51 00

BREECHINGS, CHIMNEYS, AND STACKS

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section includes specifications for all breechings, chimneys, stacks, emergency

B. PART 1 – GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Shop Drawings
7. Design Criteria

C. PART 2 – PRODUCTS

1. Double Wall Positive Pressure Vents and Breeching

D. PART 3 – EXECUTION

1. Installation
2. Cleaning and Protection

1.2 RELATED WORK

A. Section 23 07 00 - HVAC Insulation

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

UL 959	
ANSI/ASTM C64	
ANSI/ASTM C105	
ANSI/ASTM A525	Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dipped Process
ASTM A527	Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dipped Process, Lock-Forming Quality
ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A234	Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions

1.6 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Include materials of construction, dimensions, weight, support and layout of breechings. Where factory built units are used, submit layout drawings indicating plan view and

elevations. Identify all methods of support and building structural members utilized for such support.

C. Submit manufacturer's installation instructions including required clearance to combustible materials.

1.7 DESIGN CRITERIA

A. Follow the requirements of NFPA 211 and State codes.

B. Factory built vents and chimneys used for venting natural draft appliances shall comply with NFPA 211 and UL listed and labeled.

P A R T 2 - P R O D U C T S

2.1 DOUBLE WALL POSITIVE PRESSURE VENTS AND BREECHING

A. Manufacturers: Selkirk Metalbestos, Metal-Fab, Van Packer, Stacks Inc., General Products Co., or approved equal.

B. Stack, breeching, and accessory fittings to be double wall type with minimum 1" air space between walls, and U.L. listed for continuous operation at 1400°F under positive pressure.

C. Inner pipe to be type 304 stainless steel of 0.035" minimum thickness for sizes through 36" ID and minimum thickness of 0.048" for sizes over 36" ID.

D. Construct outer jacket of aluminized steel where located inside building, and Type 304 stainless steel where located outside building. Minimum thickness of outer jacket to be 24 gage for sizes 10 inches to 24 inches and 20 gage for sizes 28 inches to 48 inches.

E. Join sections with high temperature acid-resistance joint cement and steel drawbands. Stacks to be self supporting and mounted on a concrete foundation. Allow for expansion of stacks from -20°F. to 1100°F.

F. Provide all necessary accessories including flashing, counter-flashing, cable guys where required, cleanout, drain, exit cone, roof thimble and necessary supports. Coat all external welded joints and seams with galvanized paint. Provide expansion guides for stacks over 40 feet in height.

P A R T 3 - E X E C U T I O N

3.1 INSTALLATION

A. DOUBLE WALL METAL STACKS AND BREECHING:

1. Install stack, breeching, and accessories in accordance with the manufacturer's recommendations, maintaining minimum clearances from combustibles specified in UL listing.

2. Support breechings from building structure with suitable ties, braces, hangers and anchors to hold shape and prevent buckling. Minimum support for vertical sections shall be at all floor penetrations. Support from floor structure, roof structure, or adjacent structural surfaces. Verify load bearing capacity of support points with Architect/Engineer.

3. Install breechings with a minimum of joints. Align connections accurately and maintain smooth internal surfaces.

4. Install concrete inserts for support of breechings, chimneys, and stacks in coordination with formwork.

5. Maintain UL listed minimum clearances from combustibles.

6. Install stacks plumb. Pitch breeching upward from fuel-fired equipment to chimney or stack.

7. Clean breechings, chimneys, and stacks during installation, removing dust and debris.

8. At appliances, provide slip joints to allow removal of appliances without removal or dismantling of breechings, chimneys, or stacks.

9. Seal all joints of positive pressure stacks and breeching in accordance with manufacturer's recommendations, using only sealants recommended by stack manufacturer.

3.2 CLEANING AND PROTECTION

A. Clean breeching internally during installation to remove dust and debris. Clean external surfaces to remove welding slag and mill film.

B. At ends of breeching and chimneys which are not completed or connected to equipment, provide temporary closure which will prevent entrance of dust and debris until final connections are made.

END OF SECTION 23 51 00

SECTION 23 55 00

FUEL-FIRED HEATERS

PART 1 – GENERAL

1.1 SCOPE

A. This section includes specifications for fuel-fired heaters. Included are the following topics:

B. PART 1 - GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Submittals
7. Operation and Maintenance Data
8. Warranty

C. PART 2 - PRODUCTS

1. Gas Fired Unit Heaters
2. Infrared Heating Devices
3. Direct Fired Make-up Air Units
4. Indirect Fired Make-up Air Units

D. PART 3 - EXECUTION

1. Installation
2. Gas Fired Unit Heaters
3. Infrared Heating Devices
4. Make-up Air Units
5. Owner Training

1.2 RELATED WORK

A. Section 23 11 00 - Facility Fuel Piping
B. Section 23 05 23 - General-Duty Valves for HVAC Piping
C. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
D. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
E. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
F. Section 23 51 00 - Breechings, Chimneys, and Stacks.

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A.	AGA	American Gas Association
B.	ANSI Z83.4	Direct Gas Fired Makeup Air Heaters
C.	ANSI Z83.6	Gas Fired Infrared Heaters
D.	GAMA	Gas Appliance Manufacturers Association
E.	NEC	National Electrical Code

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions.

1.6 SUBMITTALS

A. Refer to division 1, General Conditions, Submittals.

B. Include specific manufacturer and model numbers, equipment identification corresponding to project drawings and schedules, dimensions, capacities, materials of construction, ratings, weights, power requirements and wiring diagrams, filter information and information for all accessories.

1.7 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.8 WARRANTY

A. Gas fired unit heaters heat exchangers warranted for five years. Remainder of unit heater components warrated for 1 year from startup.

B. Radiant heat tubes warranted against internal corrosion for 10 years. Remainder of infrared radiant heater components warranted for 1 year from date of startup.

C. Direct fired make-up air units warranted for 12 months from date of startup.

D. Indirect fired make-up air units warranted for 12 months from date of startup.

PART 2 - PRODUCTS

2.1 GAS FIRED UNIT HEATERS

A. Manufacturers: Modine, Reznor, Sterling or Trane

B. Horizontal discharge, direct vent sealed combustion type. AGA certified for use with natural gas. Minimum annual fuel utilization efficiency (A.F.U.E.) of 80. All wiring shall comply with the National Electrical Code.

C. Construct casing of cold rolled steel with baked enamel finish. Direct drive propeller type fan statically and dynamically balanced and including fan safety guard and adjustable vertical and horizontal louvers for control of air diffusion on discharge of unit. Aluminized steel burners, electronic spark ignition with electronic flame supervision and timed lockout control. Heavy gauge stainless steel heat exchanger and factory installed induced draft blower for heat exchanger prepurge and combustion gas venting. Provide a hinged access panel on the bottom of the unit to access the burner or provide side access (pull out drawer) to burner assembly. Single point power connection. Unit must be approved for vertical or side wall venting

D. Provide spark ignited intermittent pilot system with electronic flame supervision

E. AGA gas controls, including manual main shut-off valve, 24 volt redundant combination gas control valve with 100 percent safety shut-off valve and main gas pressure regulator.

F. Provide fan controls and limit safety controls including but not limited to:

1. Pressure switch to verify combustion/exhaust gas airflow
2. High limit controls
3. Fan time delay to delay the fan start until the heat exchanger reaches a predetermined temperature and to allow the fan to operate, after burner shut down, to remove heat exchanger residual heat.

G. Refer to Section 23 09 14 for temperature control work.

H. This Contractor shall provide all temperature control and interlocking necessary to perform the specified control sequence. All relays, transformers and controls are to be in enclosures. Provide factory installed 24 volt control transformer along with 24 v wall mounted thermostat. All wiring shall be in conduit in accordance with Division 26 00 00 - Electrical and comply with the NEC.

I. Provide an air inlet/vent termination assembly and threaded hanger connections.

2.2 INFRA-RED HEATING DEVICES

A. Manufacturers: Ambi-Rad, Roberts-Gordon (Co-Ray-Vac) or Combustion Research Corp(Reflect-O-Ray).

B. The entire system shall be AGA certified "Gas Infrared Heaters" conforming to ANSI standard Z83.6. All wiring shall comply with the National Electrical Code.

C. System configuration and performance as indicated on the drawings and/or equipment schedules.

D. Overall system and sub-systems certified for use with natural gas, as indicated on the drawings. Each comprised of burner unit, outside air inlet, combustion pipe, radiant pipe, reflectors, support brackets, vacuum fan(s) (separate from burner unit), exhaust pipe, thermostats and safety controls. Provide gas regulator, automatic gas valves and safety interlocks on gas train.

E. Unit is to be non-condensing type.

F. Burner and associated controls shall include, direct spark ignition, electronic flame monitoring, "power on" and "burner on" indicator lights, 100% gas safety shutoff in case of ignition failure, pre purge and post purge of system and air flow switch to prove combustion air flow prior to firing burner.

G. The combustion pipe shall be constructed of 16 gauge stainless steel for a minimum of 10'. The radiant pipe shall be constructed of 16gauge stainless steel. Construct flexible connector between vacuum fan and pipe of stainless steel.

H. Direct drive 115 volt vacuum fan with stainless steel fan wheel to exhaust all combustion gases to the outdoors.

I. Provide polished aluminum or polished stainless steel reflectors over all heat exchanger piping including elbows, u-bends and fittings.

J. Provide single point 115v power connection at burner unit. Vacuum fan power to be field wired to burner. (Power wiring by Division 26 00 00 - Electrical contractor. Thermostat and control wiring by this contractor)

K. Furnish a low voltage or 115 volt wall mounted thermostat. If low voltage is used, then proved factory installed control transformer.

2.3 DIRECT FIRED MAKE-UP AIR UNITS

A. Manufacturers: Greenheck, Hastings, Reznor, Rupp, Sterling, Trane or Weather-Rite.

B. AGA certified for use with natural gas.

C. Indoor units cabinet constructed of 16 gauge aluminized steel with enamel finish or 18 gauge galvanized steel, gasketed access panels and doors for access to all components including blower, burner and electrical components.

D. Insulate cabinet with 1" thick foil faced fiberglass. Insulation facing erosion resistance as indicated in TIMA standard AHC 101-75, section D-4-10.

E. Provide centrifugal DWDI forward curved fan with statically and dynamically balanced wheels and one piece through shaft and heavy duty sealed ball bearings with extended grease fittings. Fan shall be isolated from unit with vibration isolators and flexible connectors to prevent vibration from transmitting to the building. As an option to internal vibration isolation provide isolators for floor mounting unit along with pipe flex connectors and duct flex connectors as indicated in section 23 05 48.

F. Motors shall be open drip proof with adjustable belt drives.

G. Modulating type direct fired burner shall be constructed of cast iron gas manifold connected to stainless steel mixing plates, turndown ratio of 25:1, suitable for heating air from –20 deg. F.

H. AGA certified gas controls, meeting FM requirements and meeting IRI requirements including flame safeguard relay with flame sensor, high & low gas pressure switches, intermittent spark or hot surface ignition system, manual main shut-off valve, electronic modulating gas valve, pilot controls, electric safety shut-off valve, main and pilot gas regulators suitable for inlet pressure indicated on the drawings.

I. Provide complete with the following electric controls: Factory installed motor starter with auxiliary contacts, control transformer, high temperature limit switch, low outlet temperature shut-off, high and low flow proving switches, automatic mild weather burner lockout. Contain all electrical in a NEMA 2 control box with fused disconnect,

J. Refer to Section 23 09 23 for temperature control work.

K. This Contractor shall provide all temperature control and interlocking necessary to perform the specified control sequence. All relays, transformers and controls are to be in enclosures. Provide factory installed 24 volt control transformer along with a remote control panel including summer/off/winter switch, blower on, burner on, and safety lockout indicator lights and temperature selector with discharge temperature sensor. All wiring shall be in conduit in accordance with Division 26 00 00 - Electrical and comply with the NEC.

L. Provide filter section with 2" thick 30% efficient throwaway filters. Provide dirty filter switch with indicating light. Filter section to be low velocity V-bank type.

M. Provide units complete with the following accessories:

1. Intake shut-off damper with motor and end switch.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units as shown on plans, as detailed and according to the manufacturer’s installation instructions.

B. Pipe vents from gas regulator to outside (where regulators are provided).

C. Install remote panels and thermostats where indicated on the drawings. Provide all wiring between remote panels/thermostats and the gas fired item.

3.2 GAS FIRED UNIT HEATERS

A. Install units and connect gas, combustion air and vent piping as instructed by the manufacture and in compliance with applicable code requirements. Suspend from building structure to maintain headroom beneath units as indicated in section 23 05 29. Connect combustion air and venting to outside of building as indicated on the drawings and terminate per the manufacturer's instructions.

3.3 INFRA-RED HEATING DEVICES

A. Suspend units from structure as indicated on the drawings, as instructed by the manufacturer and in compliance with applicable codes. Gas connections to burner shall be made with a flexible connector. Route combustion air and vent piping to outside as indicated on the drawings and terminate per the manufacturer’s instructions.

3.4 MAKE -UP AIR UNITS

A. Install on concrete housekeeping pad as indicated on the drawings and in section 23 05 29. Install per the manufacturer’s written instructions and in compliance with applicable codes.

3.5 OWNER TRAINING

A. All training provided for the owner will be videotaped and then transferred onto a DVD with 3 copies given to owner.

B. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 8 hours.

END OF SECTION 23 55 00

SECTION 23 62 13

PACKAGED AIR-COOLED REFRIGERANT COMPRESSOR AND CONDENSING UNITS

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section includes specifications for air cooled condensing units for use with split system type air conditioning. Included are the following topics:

B. PART 1 – GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Submittals
7. Operation and Maintenance Data
8. Delivery, Storage and Handling
9. Warranty

C. PART 2 – PRODUCTS

1. Units 6 to 15 Tons
2. Refrigerant Piping Specialties

D. PART 3 – EXECUTION

1. Installation
2. Startup
3. Agency Training

1.2 RELATED WORK

Section 23 05 00 - Common Work Results for HVAC
Section 23 11 00 - Facility Fuel Piping
Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

1.3 REFERENCE

A. Applicable provisions of Division 1 shall govern work under this section.

1.4 REFERENCE STANDARDS

ARI 210/240	Unitary Air Conditioning and Heat Pump Equipment
ARI 365	Commercial and Industrial Unitary Air Conditioning Condensing Units
ASHRAE 15	Safety Standard for Refrigeration Systems
ASHRAE 90.1	(2004 edition)Energy Standard for Buildings Except Low Rise Residential Buildings
NEC	National Electrical Code
ASTM B117	Standard Practice for Operating Salt Spray (fog) Apparatus

UL Underwriters Laboratory

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions.

B. Unit Energy Efficiency Ratio (EER), Coefficient of Performance (COP) and Integrated Part Load Value (IPLV) shall meet the minimum applicable requirements of ASHRAE 90.1(2004 edition). Units that are labeled ENERGY STAR® will be acceptable.

C. Rate unit performance in accordance with the latest edition of ARI Standard 365 or ARI Standard 210/240, whichever is applicable for the equipment.

D. Construct units in accordance with ASHRAE 15, UL standards and the NEC. Units shall carry the UL label.

E. Factory run test, units to see that each control device operates properly. Pressure test, evacuate, charge with holding charge of refrigerant and full oil charge prior to shipping from the factory.

1.6 SUBMITTALS

A. Refer to division 1, General Conditions, Submittals

B. Submit air cooled condensing unit shop drawings including the following information: specific manufacturer and model numbers, dimensional and weight data, required clearances, materials of construction, capacities and ratings, stages of unloading capacity achievable without hot gas bypass (and with hot gas bypass if applicable), refrigerant type and charge, component information, size and location of piping connections, electrical connections, wiring diagrams and information for all specialties and accessories.

C. Submit manufacturer's installation and start-up instructions, maintenance data, troubleshooting guide, parts lists, controls and accessories.

D. At substantial completion, submit warranty certificate and copy of start-up report.

1.7 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.8 DELIVERY, STORAGE AND HANDLING

A. Comply with manufacturer's instructions for storing, rigging, unloading, and transporting units. Protect units from physical damage. Leave factory-shipping covers in place until installation.

B. Ship units to jobsite fully assembled

1.9 WARRANTY

A. Provide a one year parts and labor warranty on the entire unit beginning upon substantial completion of project.

B. Provide a five year parts warranty on the compressor(s) beginning upon substantial completion of project.

PART 2 – PRODUCTS

2.1 UNITS 6 TO 15 TONS

A. Manufacturers: Carrier, Trane, York, McQuay or approved equal.

B. Provide factory assembled, outdoor mounted, air-cooled condensing unit suitable for on grade or rooftop installation. Include compressor(s), air cooled condenser, refrigerant, lubrication system, interconnecting wiring, safety and operating controls, motor starting components and additional features as specified herein or required for safe, automatic operation. Capacities, number of refrigeration circuits, steps of unloading and minimum capacity without hot gas bypass shall be as indicated in the equipment schedule. Refrigerant is to be R-134A. Provide hot gas bypass feature with associated accessories for low load operation.

C. CABINET

1. Construct cabinet of heavy gauge, galvanized steel coated with paint. Cabinet must meet the 500-hour salt spray exposure test in accordance with ASTM B117. Provide lifting holes to facilitate rigging and access panels to facilitate access to all-internal areas of unit that require service or repair.

D. COMPRESSORS

1. Provide scroll hermetic type or reciprocating type compressors.

a) Scroll compressors: Direct drive suction cooled motor with built in motor temperature and current protection. Provide oil pump with dirt separator, sight glass, liquid line filter dryer, crankcase heater, liquid line and gas line service valves with gage ports.

b) Reciprocating Compressors: Hermetic or semi hermetic compressors with built in temperature and current protection, liquid line, suction line and discharge line service valves with gage ports, liquid line filter drier, sight glass and crankcase heater. Provide oil level site glass on semi hermetic units. Mount compressors on vibration isolators.

E. CONDENSER

1. Provide condenser coils with aluminum alloy plate fins mechanically fastened to seamless copper tubing with integral subcooler. Construct coils with design working pressure suitable for the refrigerant.

2. Provide direct-drive statically and dynamically balanced propeller type fans with vertical discharge and guards constructed of heavy gage PVC coated wire or galvanized steel.

F. POWER WIRING

1. Provide factory installed 24-volt control circuit with fusing, control power transformer and all associated internal wiring. Provide a single point power connection to the unit(s). Provide factory installed magnetic contactors for compressor and condenser motors.

2. Electrical characteristics shall be as indicated in the equipment schedule.

G. CONTROLS

1. Provide a terminal strip for external control of compressor stages for field provided controls.

2. Provide high/low refrigerant pressure cutouts with manual reset and anti-shortcycle compressor timer.

3. Unit must be capable of operating down to ambient temperature of 40 deg F. Provide low ambient lockout to prevent compressor from operating below 40 degrees.

4. Provide "low ambient" controls and accessories needed so that unit is capable of operating down to ambient temperature of 35 F.

H. CONVENIENCE OUTLET

1. Outlet shall be factory-installed and internally mounted with easily accessible 115-v female receptacle. Outlet shall include 15 amp GFI (ground fault interrupter) receptacle with independent fuse protection. Voltage required to operate convenience outlet shall be provided by a factory-installed step-down transformer. Outlet shall be accessible from outside the unit.

2.2 REFRIGERANT PIPING SIZING

A. The unit manufacturer shall verify the *final refrigeration pipe sizing* process to insure conformance to specific unit requirements such as max lengths, refrigerant velocities, unloading considerations and proper oil return. This contractor shall provide refrigeration piping drawings from the field which details the way the piping will actually be installed.

2.3 REFRIGERANT PIPING ACCESSORIES

A. Provide all refrigerant piping specialties with a maximum working pressure of full vacuum to 450 psig and a maximum working temperature of 225 deg F. For systems using R-410A, provide all refrigerant piping specialties with a maximum working pressure of full vacuum to 850 psig and a maximum working temperature of 225 deg F.

B. Flexible pipe connectors: Double braided bronze hose flexible pipe connectors with solder end connections.

C. Filter Dryers: For circuits 15 tons and over provide angle pattern filter dryers with replaceable core. For circuits below 15 tons provide straight pattern filter dryers without replaceable core.

D. Sight glasses: Two piece brass construction with solder end connections. Include color indicator for sensing moisture.

E. Solenoid Valves: Two way normally closed with two piece brass body, full port, stainless steel plug, stainless steel spring, teflon diaphragm and solder end connections. Provide replaceable coil assembly.

F. Hot Gas Bypass Valves: Provide with integral solenoid valve, external equalizer connection and adjustable pilot assembly.

G. Thermostatic Expansion Valves: Brass body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

H. Charging Valves: Provide ¼” SAE brass male flare access ports with finger tight quick seal caps. Provide 2-inch long copper extension sections.

I. Check valves: Spring loaded type with bronze body, bronze disc, neoprene seat, bronze bonnet, stainless steel spring and solder end connections.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units, piping and accessories in accordance with the manufacturer’s written instructions and recommendations. Mount unit(s) on a reinforced pad on grade or on roof mounted curb as indicated on the drawings.

B. Maintain adequate service access and airflow clearances for all components as recommended by the manufacturer and as indicated on the drawings.

C. Charge unit(s) with full oil charge and refrigerant charge based on the entire refrigeration system pipe size and length.

D. Provide all control wiring in conduit in compliance with Section 23 0914 OR Section 23 09 15 and Division 26 00 00 - Electrical.

E. Coordinate power wiring requirements with the electrical trade.

3.2 STARTUP

A. Adjust units for maximum operating efficiency, adjust all controls to required final settings and demonstrate that all components are functioning properly. Submit four copies of a written startup report following the initial start up. Include in the report: work done to the system, all readings taken, a statement certifying that the refrigeration system(s) are leak free and a statement certifying that the unit(s) have been placed in proper running condition as recommended by the manufacturer and as intended in the drawings and specifications.

3.3 OWNER TRAINING

A. All training provided for the owner will be videotaped and then transferred onto a DVD with 3 copies given to owner.

B. Contractor to provide factory authorized representative and/or field personnel knowledgeable with the operations, maintenance and troubleshooting of the system and/or components defined within this section for a minimum period of 4 hours.

END OF SECTION 23 62 13

SECTION 23 73 13

MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 - GENERAL

1.1 SCOPE

A. This section includes specifications for indoor central station package air handling units. Included are the following topics:

B. PART 1 - GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Submittals
7. Operation and Maintenance Data
8. Design Criteria

C. PART 2 - PRODUCTS

1. Manufacturers
2. Casings
3. Fans
4. Coils
5. Filter Section
6. Access Sections
7. Filter/Mixing Box Section
8. Damper Section
9. Diffuser Section

D. PART 3 - EXECUTION

1. Installation
2. Owner Training

1.2 RELATED WORK

A. Section 23 05 13 - Common Motor Requirements for HVAC Equipment
B. Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment
C. Section 23 73 12 - Air Handling Unit Coils
D. Section 23 41 00 - Particulate Air Filtration
E. Section 23 33 00 - Air Duct Accessories

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this section.

1.4 REFERENCE STANDARDS

A. ARI 430 (latest edition) Standard for Central Station Air Handling Units
B. NFPA 90A Standard for Installation of Air Conditioning and Ventilation Systems

1.5 QUALITY ASSURANCE

A. Refer to Division 1, General Conditions, Equals and Substitutions.

1.6 SUBMITTALS

A. Refer to Division 1, General Conditions, Submittals

B. Submit shop drawings including the following information: specific manufacturer and model numbers, submittal equipment identification corresponding to project drawings and schedules, unit dimensional and weight data, materials of construction, capacities and

ratings, fan curves, fan type, drive and motor information (ref. 23 05 13), vibration isolation, coil performance data, sound power levels, filter information (ref. 23 41 00), information for all accessories.

1.7 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content

1.8 DESIGN CRITERIA

A. Furnish factory fabricated packaged air handling units complete with fans, motors, drives, coils, drain pans, filter sections, access sections, damper sections, meeting the configuration shown on drawings and/or as scheduled.

B. Units to be tested, rated and certified in accordance with ARI Standard 430 and bear ARI certification label.

C. All material shall meet NFPA 90A flame spread and smoke develop rating requirements.

D. Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.

E. Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA Publication 203, Appendix L.

F. Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, provide any motor, drive and/or wiring changes required due to increased static pressure or baffling necessary to prevent uneven airflow or improve mixing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Carrier, McQuay, Trane, York.

2.2 CASINGS

A. Double wall construction with heavy gauge steel framework and panels throughout mounted on an integral base rail. Casing shall have 2" thick, non-compressed, 1-1/2 lb./cu. ft. fiberglass thermal insulation between solid exterior and solid interior steel panels for all sections. Panels shall be gasketed and removable without affecting integrity of casing structure. Casing shall be airtight, watertight, rust inhibited with baked enamel or mill galvanized finish.

B. Access doors shall be double wall, of same construction and thickness as casing, hinged, continuously gasketed, with metal cam-lock handles. Plastic handles will not be accepted. Door swing shall open in direction against pressure of unit. Provide access doors on both sides of casing for fan section, access sections, filter sections, damper sections and upstream and downstream of every coil. Provide windows in access doors and lights for fan sections on units above 10,000 CFM.

C. Double wall, insulated drain pans shall be located below cooling coil section. Pans shall be sloped for removal of condensate. Provide drain connection on both sides of casing.

2.3 FANS

A. Forward-curved fans shall have one double-width double-inlet (DWDI) fan wheel and scroll. They shall be constructed of galvanized steel with baked enamel. They shall be designed for continuous operation at the maximum rated fan speed and motor horsepower. Fans shall have an AMCA class rating corresponding to the static pressure at which the fan is designed to operate (Class I or II). Completed fan assembly shall be dynamically balanced in accordance with 1989 ARI Guideline G and ANSI S2.19- 1986 at design operating speed using contract drive and motor if ordered.

B. Fan assembly vibration shall not exceed 0.248 in. per second when mounted on active isolators. Vibration shall be measured in both vertical and horizontal directions at the specified fan operating speed using specified motor. Accelerometers shall be mounted on the motor near the bearing locations.

C. All fan sled components shall provide corrosion protection to pass 100-hour salt spray test per ASTM B-117.

D. Fan wheels shall be keyed to the shaft and shall be designed for continuous operation at maximum rated fan speed and motor horsepower. Fan wheels and shafts shall be selected with a maximum operating speed 25% below the first critical.

E. Belt drive fan motor shall be mounted within the fan section casing on slide rails equipped with adjusting screws. Motor shall be premium efficiency, open drip-proof or totally enclosed fan cooled NEMA Design A or B with size and electrical characteristics as shown on the equipment schedule. Motor shall be mounted on a horizontal flat surface and shall not be supported by the fan or its structural members. All three-phase motors shall have a ± 10% voltage utilization range and a 1.15 minimum service factor. Motor shall be compliant with the Energy Independence and Security Act (EISA) of 2007 where applicable. Single-phase motors shall be available up to and including 5 hp.

F. Performance Ratings: Fan performance shall be rated and certified in accordance with AHRI Standard 430, latest edition.

G. Sound Ratings: Manufacturer shall submit first through eighth octave sound power for fan discharge and casing radiated sound. Sound ratings shall be tested in accordance with AHRI 260.

H. Mounting: Fan scroll, wheel, shaft, bearings, drives, and motor shall be mounted on a common base assembly. The base assembly is isolated from the outer casing with factory-installed isolators and rubber vibration absorbent fan discharge seal. A canvas style duct connection between fan discharge and cabinet is not acceptable. Units shall use 2-in. deflection spring isolators.

I. Fan Accessories:

1. Forward-curved fans:

a. Belt guards.

b. Inlet screen.

J. Flexible Connection: The base assembly is isolated from the outer casing with factory-installed isolators and rubber vibration absorbent fan discharge seal. A canvas style duct connection between fan discharge and cabinet is not acceptable.

2.4 BEARINGS AND DRIVES

A. Bearings: Self-aligning, grease lubricated, anti-friction with lubrication fittings extended to drive side of fan section. Optional grease fittings extended to the exterior of the casing are available. All bearing life calculations shall be done in accordance with ABMA 9 for ball bearings and ABMA 11 for roller bearings.

1. Size 03 to 110 forward-curved fans: Cartridge type bearings for Class I fans. Heavy-duty pillow block type, self-aligning, regreasable ball or roller type bearings selected for a minimum average life (L50) of 200,000 hours or optionally for an (L50) of 500,000 hours.

B. Shafts: Fan shafts shall be solid steel, turned, ground, polished and coated with a rust inhibitor.

C. V-Belt Drive: Drive shall be designed for a minimum 1.2 service factor as standard with a 1.5 service factor option and/or a factory-supplied extra set of belts. Drives shall be

fixed pitch with optional variable pitch for motors 15 hp and less. All drives shall be factory mounted, with sheaves aligned and belts properly tensioned.

2.5 COILS

A. All direct expansion (DX) refrigerant coils shall be provided to meet the scheduled performance. All coil performance shall be certified in accordance with AHRI Standard 410. All direct expansion coils shall be tested at 450 psig air pressure. Direct expansion coils shall be designed and tested in accordance with ASHRAE/ANSI 15 Safety Code for Mechanical Refrigeration (latest edition). Factory-supplied 1/2-in. OD coils shall be covered under the standard product one-year limited warranty.

B. General Fabrication :

1. All refrigerant coils shall have minimum 1/2-in. OD copper tubes mechanically expanded into fins to ensure high thermal performance with lower total flow and pumping requirements. Minimum tube wall thickness shall be 0.016 inches. Optional tube wall thickness of 0.025 in. shall be supplied, if specified.

2. Aluminum plate fin type with belled collars.

3. Aluminum-finned coils shall be supplied with die-formed casing and tube sheets of mill galvanized steel or stainless steel as specified.

C. Refrigerant Coils:

1. Headers shall be constructed of copper with brazed joints.

2. Standard circuiting selections include:

a. Single distributor arrangement for sizes 03-17.

b. Row split intertwined, multiple distributor arrangement for sizes 03-110.

3. Replaceable nozzle, brass refrigerant distributors and seamless copper distribution tubes are supplied to ensure uniform flow.

4. Submittals must include a DX coil and condensing unit cross plot to show that the coil and condensing unit capacity match at the rated design conditions.

D. Blank off space between coil frames and air handling unit casing.

2.6 GAS HEATING SECTION

A. Indirect fired gas furnace section(s) shall have a minimum thermal efficiency of 80% and incorporate agency listed gas-fired duct furnace(s) per UL, CSA, or ETL for operation on natural or propane gas to the current edition of ANSI Z83.8 or Canadian CSA 2.6 Standard for Gas-Fired Duct Furnaces. Duct furnaces shall be installed on the positive pressure side of the supply fan only.

B. The duct furnace module(s) shall have:

1. 20 gauge galvanized steel heat exchanger cabinet.

2. 1 in. thick, minimum 11/2 lb/cu ft density thermal insulation for the heat exchanger cabinet.

3. Each furnace shall have an induced-draft fan for the removal of flue gases and to keep the heat exchanger at a negative pressure.

4. Air pressure switches to prove air supply for combustion before operation of gas valve.

5. Patented inshot gas burners with integral carryovers.

6. Direct-spark ignition of the gas burners with remote flame sensor to prove carryover across all burners.

7. A listed 24-vac redundant combination gas valve including two electric shutoff valves, gas pressure regulator, and a manual shutoff valve per furnace.

8. An automatic reset type high limit switch to limit maximum outlet air temperature to less than 250 F.

9. Manual reset flame rollout switches.

10. Minimum of one 40 va, 24 vac control transformer.

11. 1/8 in. NPT tapped test gage connection in the gas manifold for measuring gas pressure.

12. Union fitting downstream of gas control to facilitate installation and service.

13. Provision for attachment of a vent system to exhaust flue gases to the outdoors.

C. Gas-fired duct furnace(s) provided shall have an 18 gage tubular heat exchanger assembly suitable to withstand 3.0 in. wg total external static pressure without burner flame disturbance and constructed of either:

1. Type 409 stainless steel (0.044 minimum wall thickness) produced to ASTM A268.

2. Type 304L stainless tubes (0.047 minimum wall thickness) produced to ASTM A249.

D. Gas heating section modules shall be listed for application downstream of refrigeration and cooling systems and shall provide means for removal of condensate that occurs in the tubes during cooling operation. Heat exchanger tubes shall have (integral formed dimpled restrictors; formed tubulators) to provide for an unobstructed drainage path and tubes shall be formed to provide a positive pitch to promote condensate drainage. Drainage shall be configured so that burners and burner surfaces are not exposed to condensate.

E. Gas heating section shall incorporate a direct spark ignition control module listed by one of the following: US, CSA, or ETL.

F. Controls shall provide:

1. 100% safety shutoff.

2. A 15-second minimum pre-purge period prior to trial for ignition.

3. High-energy direct spark ignition of main burners.

4. Electronic flame supervision incorporating a 0.8-second flame failure response time.

5. Up to 2 additional ignition retrials preceded by an inter-purge period.

6. A minimum 30-second post-purge.

7. Automatic reset after one hour to initiate additional ignition trials if lockout occurs during heat call.

8. An LED indicator light to provide a flash code to identify the operating condition of the control.

G. Gas heating section shall be equipped for operation with 115 vac, single-phase, 60 Hz power supply.

H. All electrical components shall be listed or recognized by UL, CSA, or ETL.

I. Gas Furnace Control:

1. Single furnace — Operates from 10 to 100% of input from a single analog input of 0 to 10 vdc.

J. Electronic modulation — Operates from 10 to 100% of input from a single analog input of 0 to 10 vdc. Heat enable contact (supplied by others) initiates and ends heating cycles. Heating unit incorporates two-speed operation of combustion air blower and two-stage gas valve, signal amplifier and timer relay control.

K. Gas supply pressure to the gas valve inlet shall be 5.0 to 13.5 in. wg for natural gas or 11.0 to 13.5 in. wg for propane gas.

L. Units are orificed for operation up to 2000 ft above sea level unless specified for high altitude operation.

M. Duct furnaces shall be test-fired prior to shipment to verify proper ignition, operation and shutdown and satisfactory operation of all components.

N. Furnaces shall be provided with printed installation and maintenance instructions, burner operating and maintenance instructions, piping and wiring diagrams and installation start-up data sheet.

2.7 FILTER SECTION

A. Filters shall be provided in accordance with section 23 41 00.

B. Filter box section may be furnished by air handling unit manufacturer in accordance with specification requirements of section 23 41 00. Filter box sections furnished by air handling unit manufacturer shall be of same construction as casing specified above. Provide static pressure tips that are arranged to prevent damage to the filter elements during replacement. Provide minimum 2” gap between final and pre-filters for static pressure probes.

2.8 ACCESS SECTIONS

A. Same construction as casing with access doors as specified above on both sides of access section.

B. Provide access sections where shown on drawings.

2.9 FILTER/MIXING BOX SECTION

A. Same construction as casing with access doors as specified above on both sides of filter/mixing box section.

B. Filters shall be horizontal V-bank arrangement and shall meet specification requirements of section 23 41 00.

C. Outside air and return air dampers shall be parallel blade type with interconnecting linkage. Dampers shall be low leakage, not exceeding 5 cfm/sq. ft. at 1.0" w.g. Damper blades shall be double-skin airfoil type, with blade edge seals and metal compressible jamb seals. The damper blades shall be arranged so that the air streams are directed at one another to facilitate mixing. Damper linkage shall be extended outside the unit for external actuator mounting. Internal actuator mounting is not acceptable.

D. Reference drawings for damper arrangement top and rear.

E. Reference section 23 09 14 OR 23 09 15 for damper actuation.

2.10 DAMPER SECTION

A. Same construction as casing with access doors as specified above on both sides of damper section.

B. Outside air and return air dampers shall be parallel blade type with interconnecting linkage. Dampers shall be low leakage, not exceeding 5 cfm/sq. ft. at 1.0" w.g. Damper blades shall be double-skin airfoil type, with blade edge seals and metal compressible jamb seals. Damper linkage shall be extended outside the unit for external actuator mounting. Internal actuator mounting is not acceptable.

C. Reference drawings for damper arrangement top and rear.

D. Reference section 23 09 14 OR 23 09 15 for damper actuation.

2.11 DIFFUSER SECTION

A. Same construction as casing with access doors as specified above on both sides of diffuser section. Provide perforated diffuser plate at fan discharge to ensure uniform airflow downstream of diffuser plate.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install all air handling units and accessories as indicated on drawings and/or as scheduled and according to manufacturer's installation instructions.

B. Mount units at appropriate height above floor to insure proper condensate trap depth and condensate drainage.

C. Install air-handling unit to provide for adequate service access. Coordinate with other trades to assure air handling unit does not infringe upon access or service clearances of other equipment.

D. Lubricate fan bearings. Verify fan isolators have proper deflection.

E. Upon completion of installation of air handling units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning components, then retest to demonstrate compliance.

F. Furnish one spare set of fan drive belts.

3.2 OWNER TRAINING

A. All training provided for the owner shall comply with the format, general content requirements and submission guidelines specified under Section 23 05 00.

END OF SECTION

SECTION 23 82 00

HEATING AND COOLING TERMINAL UNITS

P A R T 1 - G E N E R A L

1.1 SCOPE

A. This section includes specification for heating and cooling terminal equipment using water and/or steam as the source. Included are the following topics:

B. PART 1 – GENERAL

1. Scope
2. Related Work
3. Reference
4. Reference Standards
5. Quality Assurance
6. Shop Drawings
7. Operation and Maintenance Data
8. Design Criteria

C. PART 2 – PRODUCTS

1. Electric Heaters

D. PART 3 – EXECUTION

1. Installation
2. Electric Heaters
3. Owner Training

1.2 RELATED WORK

Section 23 05 23 - General-Duty Valves for HVAC Piping
Section 23 05 13 - Common Motor Requirements for HVAC Equipment
Section 23 41 00 - Particulate Air Filtration
Section 23 36 00 - Air Duct Accessories

1.3 REFERENCE

A. Applicable provisions of Division 1 govern work under this Section.

1.4 REFERENCE STANDARDS

ARI 210 Standard for Unitary Air-Conditioning Equipment
CS 140

1.5 QUALITY ASSURANCE

A. Refer to division 1, General Conditions, Equals and Substitutions

1.6 SHOP DRAWINGS

A. Refer to division 1, General Conditions, Submittals.

B. Include dimensions, capacities, materials of construction, ratings, weights, wiring diagrams, and appropriate identification for all equipment in this section. Include color selection chart where applicable.

1.7 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.8 DESIGN CRITERIA

A. Forced Circulation Coils: Ratings certified in accordance with ARI 410.

B. Electrical Equipment and heaters shall be UL listed for the service specified.

C. Electrical components and work must be in accordances with National Electrical Code.

P A R T 2 - P R O D U C T S

2.1 ELECTRIC HEATERS

A. Manufacturers: Berko, Chromalox, Markel, Trane, or approved equal.

B. Use corrosion resistant heating elements, designed and spaced for even distribution of air across the heating element, and installed to prevent noise of expansion and contraction.

C. Provide units with necessary overheat protection, reset devices, air flow interlock switch, contactors, transformers, local non-fused disconnect switch that is prewired, and other controls as may be required by codes.

D. Fan powered units must be provided with thermostat and controls to maintain fan operation until residual heat in the heating elements has been dissipated. The fans and motors shall be balanced and mounted for vibration free operation.

E. Construct cabinets of 20 gauge steel, furnished exposed cabinets with a baked enamel finish in one of the manufacturer's standard colors, selected by Architect.

P A R T 3 - E X E C U T I O N

3.1 INSTALLATION

A. Install units in accordance with manufacturer's installation instructions.

B. Install branch water or steam/condensate piping to each unit with a minimum of three elbows to allow for expansion and contraction of the piping system.

C. Coordinate location of units with other trades to assure correct recess size for recessed units.

D. After installation, provide protective covers to prevent accumulation of dirt on units during balance of construction.

3.2 ELECTRIC HEATERS

A. Install units where indicated on the drawings and details. Where heaters are indicated to be installed in ductwork, provide manufacturers recommended upstream and downstream ductwork to prevent overheating preblems.

B. Electric heaters located in toilet and shower rooms must be installed at least 6” above the finished floor.

C. Units will be wired by the Electrical Contractor.

3.3 OWNER TRAINING

C. All training provided for the owner will be videotaped and then transferred onto a DVD with 3 copies given to owner.

END OF SECTION 23 82 00

SECTION 26 0500
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes general administrative and procedural requirements for electrical installations, and shall apply to all phases of the work specified, indicated on the drawings, or required to provide for complete installation of electrical systems for this project. The following administrative and procedural requirements are included in this Section to expand the requirements specified in Division 01:

1. Submittals
2. Record documents
3. Maintenance manuals
4. Rough-ins
5. Electrical installations
6. Cutting and patching
7. Warranties
8. Temporary
9. Coordination with local utilities

1.2 DEFINITIONS

A. The following definitions shall apply throughout the contract documents:

1. Architect/Engineer: Architect or Engineer
2. Code: All applicable local, state, and national codes - latest edition
3. Contractor: Any contractor performing work required by the Contract Documents
4. Electrical: All electrical work required by the contract documents
5. Furnish: Supply and deliver to the site ready for installation
6. Indicated: Noted, scheduled, or specified
7. Installed: Erected, mounted, secured, connected, and ready for use
8. Mechanical: All mechanical work required by the contract documents
9. Provide: Furnish, install, and connect, complete and ready for use

1.3 CODES AND STANDARDS

A. The electrical system shall comply with the following codes, and all other state, local, municipal, and national bureaus and departments which have authority over this project: anything in these contract documents notwithstanding. This shall not be construed as waiving compliance with any requirements of the plans and specifications that may be in excess of any requirements of any applicable code.

1. National Fire Protection Association (NFPA)
2. American National Standards Institute (ANSI)
3. Occupational Safety and Health Administration (OSHA)
4. Factory Mutual Research Corporation (FM)
5. Underwriters Laboratories Inc. (UL)

B. All systems and components shall be FM approved and listed and labeled by UL.

C. Where there is a conflict between the code and contract documents, the code shall have precedence only when it is more stringent than the contract documents. Items that are allowed by code, but are less stringent than those specified, shall not be substituted.

1.4 QUALITY ASSURANCE

A. Workmanship: The work shall be performed by competent craftsman, skilled in the trade involved, and shall be done in a manner consistent with the NECA National Electrical Installation Standards.

B. Permits: The contractor shall familiarize themselves with all requirements regarding all permits, fees, etc. and shall comply with them. The contractor at his expense shall obtain all permits, licenses, inspections, and arrangements required for the execution of the work. All utilities shall be installed in accordance with the local rules and regulations, and the contractor shall pay all charges.

1. All permits and certificates of inspection shall be turned over to Owner prior to request for final payment.

1.5 SUBMITTALS

A. General: Follow the procedures specified in Division 01 Section 01 3300, "Submittals," and as indicated in this section.

B. Where required by other sections of this specification/project manual, the contractor shall submit shop drawings, product data, or samples to the Architect/Engineer for review through the general contractor. If no general contractor is assigned, the contractor may submit directly to the Architect/Engineer.

C. Unrequired submittals will not be reviewed. Faxed, emailed, or incomplete submittals will not be reviewed.

D. Submittals shall be numbered consecutively and referenced to the section number of the specification section.

E. For shop drawings and product data submittals, the contractor shall submit a minimum of six copies for review to the Engineer through the General Contractor. If no general contractor is assigned the submittals may be sent directly to the Architect/Engineer for review.

F. Additional copies may be required by individual sections of these Specifications.

G. Shop drawings are drawings, diagrams, schedules, and other data specifically prepared for this project by the Contractor, or any manufacturer, supplier, or distributor to illustrate some portion of the work

H. Shop drawing shall be drawn to accurate scale and adequate size to illustrate required details. Maximum sheet size shall be 30" x 42". For each shop drawing sheet larger than 11" x 17", submit one drawing on reproducible media, and one blueline or photocopied print. The Architect/Engineer's action shall be indicated on the reproducible drawing, and that drawing shall be returned to the contractor.

I. Product data are illustrations, standard schedules, performance charts, instruction brochures, diagrams, and other information furnished by the contractor to illustrate a material, product, or system for some portion of the work.

J. Samples are physical examples furnished by the contractor to illustrate materials, equipment, or workmanship, and to establish the standards by which the work will be performed.

K. All submittals shall clearly indicate proposed items, capacities, characteristics, and details in conformance with the contract documents. All equipment items shall be marked with the same item number as used on the drawings or schedules. The manufacturer shall certify capacities, dimensions, and special features required.

L. Submittals shall indicate manufacturer's delivery time for the item after review by the Architect/Engineer.

M. The Architect/Engineer shall review or take other appropriate action upon receipt of the contractor's submittals such as shop drawings, product data and samples, but only to determine conformance with the design concept of the work and the information given in the contract documents.

N. The contractor shall not be relieved of responsibility for any deviation from the requirements of the contract documents by the Architect/Engineer's review of shop drawings, product data, or samples. The Contractor shall not be relieved from responsibility for errors or omissions in the shop drawings, product data, or samples by the Architect/Engineer's review of those drawings.

O. No portion of the work requiring submission of a shop drawing, product data, or sample shall commence until the Architect/Engineer has reviewed the submittal. All such portions of the work shall be in accordance with reviewed submittals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Where recommended by the equipment supplier, deliver equipment in fully enclosed vans after specified environmental conditions have been permanently established in spaces where equipment is to be placed. The products accepted on the site shall be wrapped in factory packing, and shall be inspected for damage prior to acceptance.

C. Store equipment in clean, dry with non-condensing environments that are controlled within manufacturer=s ambient tolerances for non-operating equipment. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

D. Handle equipment carefully to prevent damage, breaking, and scoring. The contractor shall not install damaged units or components; replace with new.

E. Equipment furnished by others. The contractor shall be responsible for receiving, uncrating, inspecting, storing, and installing of Division 26, 27, and 28 equipment listed as furnished by others.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTIES

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of one year after the date of substantial completion. Certain equipment shall be warranted at the time of final acceptance, or for longer periods of time as specified in those sections of the project manual.

B. The contractor shall repair or replace, at no additional cost to Owner, any item that may become defective within the warranty period.

C. Any manufacturer's warranties concerning any item installed shall be to the benefit of Owner.

D. The contractor agrees not to void or impair or to allow any sub-contractor to void or impair any warranties regarding products or items installed as part of this project.

E. The repair of faulty workmanship shall be considered to be included in the contract.

1.9 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 01 Section 01 7700, "Project Closeout." In addition to the requirements specified in Division 01, include the following information for equipment items:

1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
4. Servicing instructions and lubrication charts and schedules.

B. The Contractor shall prepare three Operating and Maintenance Manuals for the equipment furnished. Manuals shall be submitted to the Architect/Engineer for review and distribution to Owner within thirty (30) days prior to substantial completion of the project. The Architect/Engineer may reject manuals not meeting the following requirements:

1. Each manual shall be assembled in a three-ring binder with a hard cover and plastic finish. Binders shall not exceed 3" thick. Where more than one binder is required, the manuals shall be separated into logical groupings. Where loose-leaf inserts are used, the sheets shall be reinforced to prevent tearing from continuous usage. Each binder shall have the following information clearly printed on its cover:
   a. Project name and address.
   b. Portion of the work covered by each volume (if more than one volume is in the set). Where more than one volume is required, label each volume as "Volume ___ of ___."
   c. Name, address, and telephone number of the Contractor and all Sub-Contractors including night and emergency numbers.
2. The manual shall include, but shall not be limited to, the following:
   a. A complete index.
   b. Names, Addresses, and Telephone Numbers: The list shall include the manufacturer and local representative who stocks and furnishes repair parts for all items of equipment and shall be typed on a single page in the front of the binder.
   c. Start-Up, Operation, and Shutdown Procedures: Provide a written description of procedures for start-up, operation, and shutdown procedures for each electrical item or system. This description shall include switches to operate, buttons to push, etc., in proper sequence, and locations of buttons and switches. The description shall include item references or labels used in the contract documents unless otherwise instructed in advance by Owner.
   d. Equipment Accessory Schedule: Upon completion of the work, the Contractor shall furnish Owner with a complete equipment accessory schedule listing each piece of equipment and the related size, type, number required, and the manufacturer of all renewable items.
   e. Manufacturer's Operation and Maintenance Manuals and Parts List.
   f. Emergency Procedures: Provide a written description of emergency operating procedures or a list of service organizations (including

complete business address and telephone numbers) capable of rendering emergency services to the various parts of the system.

g. One copy of all shop drawings and product data, clearly marked for each item furnished using the designation label specified or indicated on the contract documents.

h. All manufacturers' warranty information.

i. Normal Maintenance Schedule: Include a listing of work to be performed at various time intervals (e.g., 30, 90, 180 days, yearly).

1.10 COORDINATION DRAWINGS

A. Prepare coordination drawings to a scale of ¼" = 1'-0" or larger, detailing major elements, components, and systems of electrical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:

1. Indicate the proposed locations of major raceway systems, equipment, and materials. Include the following:

   a. Clearances for servicing equipment, including space for equipment disassembly required for periodic maintenance
   b. Exterior wall and foundation penetrations
   c. Fire-rated wall and floor penetrations
   d. Equipment connections and support details
   e. Sizes and location of required concrete pads and bases

2. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
3. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
4. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communications systems components, sprinklers, and other ceiling-mounted devices.

1.11 RECORD DOCUMENTS

A. Contractor shall keep an up-to-date set of "as-installed," "red-lined" drawings kept current on a daily basis. Such drawings shall be available to Owner, Engineer, or Owner's representative at the job site at all times.

B. Upon completion of the contract, send to the Architect/Engineer, through the general contractor, one complete set of red-lined drawings showing all deviations.

C. In addition to the requirements specified in Division 01, indicate on the marked up drawings additional information for:

1. Major raceway systems, size and location, for both exterior and interior.
2. Locations of control devices
3. Distribution and branch electrical circuits
4. Switch, fuse, and circuit breaker size and arrangements
5. Equipment locations (exposed and concealed), dimensioned from prominent building lines
6. Approved substitutions, Contract Modifications, and actual equipment and materials installed

1.12 SITE EXAMINATION

A. Visit the site prior to submitting bids, examine the premises, and make a thorough survey of the conditions under which the installation is to be made.

B. The submission of a proposal will be construed as evidence that such an examination has been made, and later claims for labor, equipment, or materials required for difficulties encountered which could have been foreseen had such an examination been made, will not be recognized.

1.13 INTERPRETATION OF THE DOCUMENTS

A. Carefully compare the drawings and specifications, checking measurements and conditions under which this installation is to be made.

B. The interpretations of the intent of the plans shall rest solely with the Architect and the Architect's decision shall be considered final.

C. If questions arise during the bidding process regarding the meaning of any portion of the contract documents, the prospective bidder shall submit the questions to the Architect/Engineer for clarification. Any definitive interpretation or clarification of the contract documents will be published by addenda, properly issued to each person holding documents, prior to the bid date. Verbal interpretation or explanation, not issued in the form of an addendum, shall not be considered part of the bidding documents. When submitting questions for clarification, adequate time for issuance and delivery of addenda must be allowed.

1.14 ELECTRICAL SERVICE DISRUPTIONS

A. No electrical service disruptions may occur without permission of Owner.

B. Submit a written request for any work electrical outages before taking any operating electrical equipment out of service. Any work involving a task, which requires an electrical service disruption to any part of this facility, shall be closely coordinated with Owner prior to the disruption. All disruptions shall occur at times and of durations acceptable to Owner.

1.15 OVERTIME WORK

A. Construction work shall be done during regular working hours on regular working days unless specifically noted otherwise on the drawings, and as required by Owner. If overtime work, other than specified, is required on the project, it shall be performed as indicated under the special conditions of these contracts.

B. Pricing for required overtime work specified shall be included in the Base Bid.

C. Items requiring overtime work are:

1. Exposing any energized bus
2. Any work above, below, or adjacent to active, operating equipment that must remain in operation during normal hours
3. Replacement or modification to electrical service and distribution to the facility

1.16 SAFETY

A. The contractor shall take all steps necessary to ensure the safety of the occupants, students, Owner's employees, visitors, project related personnel, or any other authorized personnel, as well as their own forces, by adequately protecting any exposed energized cable, equipment, or devices throughout the course of this work.

B. Comply with NFPA 241 for safeguarding during construction and alteration operations. In addition, any openings in fire-rated separations between occupied and unoccupied (or operational and non-operational) areas shall be sealed at the end of each work day with

an appropriate fire-rated enclosure or sealant. Do not compromise existing security or fire alarm systems serving the occupied or operational areas.

1.17 INTERFERENCE WITH OCCUPANCY

A. If the existing building is occupied, then the work covered by these documents shall be executed with a minimum of inconvenience to the building occupants.

1.18 DAMAGE TO OTHER WORK

A. This contractor shall be responsible for damage to other work caused by this installation. Patching and repairing of damaged work done by this Division shall be part of the cost of this Division.

1.19 LAYOUT OF WORK

A. Layout work to be installed in coordination with other trades engaged on this project whenever their work is likely to affect the electrical installation. Be fully responsible for all dimensions and conflicts between this work and that of other trades, and make the necessary changes in the work without additional cost to Owner if the work does not comply properly with these requirements.

B. Compare contract documents with those of other trades before proceeding with the installation. Electrical wiring, conduits, or electrical equipment which has been installed without checking for interference and without thorough coordination with other trades shall be moved or relocated without additional expense to Owner.

C. Equipment shall be installed with ample space allowed for removal, repair, or change to the equipment. Ready accessibility to removable parts or equipment and to the wiring shall be provided without moving other equipment which is installed or which is already in place.

1.20 OPERATING TRAINING

A. Complete operating training for each system and item of equipment shall be provided to the Owner's designated personnel. The Operation and Maintenance Manuals must be reviewed and accepted by the Architect/Engineer and provided to the Owner prior to operating training. Training sessions shall consist of two 8-hour periods and shall be scheduled at the convenience of Owner. Training shall include instructions on the following:

1. Start-Up and Shutdown Procedures
2. Emergency Operation
3. Periodic Maintenance
4. Safety

B. In addition to the instructions required above, wherever possible the Contractor shall perform the operation being described in order to fully illustrate system operation.

C. At the completion of training, the Contractor shall turn over to Owner all required keys and special tools for the installed equipment. Each key or tool shall be labeled with its use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Unless otherwise specified, all materials and equipment shall be new, unused, and undamaged. Materials and equipment shall be the current and standard designs of manufacturers regularly engaged in their production.

2.2 MATERIALS AND EQUIPMENT FURNISHED BY OTHERS

A. Where materials and equipment are indicated as furnished by others and installed or connected under this contract, it shall be the Contractor's responsibility to verify installation details prior to proceeding with work.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 21, 22, 23, 26, 27, and 28 for rough-in requirements.

3.2 ELECTRICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
4. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the space.
5. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
6. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
7. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
8. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
9. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.

3.3 CUTTING AND PATCHING

A. General: Perform cutting and patching in accordance with Division 01 Section 01 7329, "Cutting and Patching." In addition to the requirements specified in Division 01, the following requirements apply:

1. Perform cutting, fitting, and patching of electrical equipment and materials required to:

   a. Uncover Work to provide for installation of ill-timed Work.
   b. Remove and replace defective Work.

c. Remove and replace Work not conforming to requirements of the Contract Documents.
d. Remove samples of installed Work as specified for testing.
e. Install equipment and materials in existing structures.
f. Upon written instructions from the Architect, uncover and restore Work to provide for Architect observation of concealed Work.

2. Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new Work.
3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.
5. Protection of Installed Work: During cutting and patching operations, protect adjacent installations.
6. Patch existing finished surfaces and building components using new materials matching existing materials and experienced installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.
7. Patch finished surfaces and building components using new materials specified for the original installation and experienced installers. Installers' qualifications refer to the materials and methods required for the surface and building components being patched.

3.4 TEMPORARY LIGHTING POWER, AND FIRE ALARM

A. Work Included

1. Electrical Contractor shall furnish and install temporary lighting, power, and fire alarm devices for this project as required and remove same at the end of the project.
2. Contractor shall install the above mentioned temporary services in a safe and workmanlike manner.
3. Provide temporary lighting and power as required in areas undergoing work during construction. Furnish and install one OSHA-approved pigtail socket with 150W lamp for every 500 square feet of floor space and a minimum one per room. The temporary lighting shall be left in place until permanent lighting is completely operational.
4. Furnish and install power outlets to a total one for every 2,000 square feet or part thereof of floor area. These shall be 15 amp, single phase receptacles for either 110 or 220 V as directed by the General Contractor. Coordinate for additional temporary power requirements with other trades and provide an adequate installation.

B. Contractor to coordinate temporary services with the following:

1. General Contractor
2. Mechanical Contractor
3. Owner/Owner Representative

3.5 COORDINATION WITH LOCAL UTILITIES

A. Utility Power Coordination

1. The Contractor shall perform all coordination and scheduling of local utility power company work effort. Any excess facilities charges will be paid by Owner

without mark-up. Contractor shall provide all work required for the new service as shown on the electrical drawings.

B. Local Telephone Provider

1. The Contractor shall coordinate the installation of the local telephone system into the building with the local service provider, including the scheduling of their work effort.

END OF SECTION

SECTION 26 0505
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Scope: The work specified in this section includes, but shall not be limited to, providing labor, material, equipment and services necessary for electrical work as shown on the drawings and as herein specified.

B. Section Includes: The work specified in this section includes, but shall not be limited to, providing the following:

1. Motor and Equipment Connections
2. Sleeves and Openings
3. Coring, Cutting, and Patching
4. Fire stopping
5. Electrical Identification
6. Hangers and Supports
7. Equipment Bases
8. Electrical Utility Services and Metering
9. Demolition
10. Warning Signs

1.2 DEFINITIONS

Not Applicable

1.3 CODES AND STANDARDS

A. The electrical system shall comply with the following codes, and all other state, local, municipal, and national bureaus and departments which have authority over this project: anything in these contract documents notwithstanding. This shall not be construed as waiving compliance with any requirements of the plans and specifications that may be in excess of any requirements of any applicable code.

1. National Fire Protection Association (NFPA)
2. American National Standards Institute (ANSI)
3. Occupational Safety and Health Administration (OSHA)
4. Factory Mutual Research Corporation (FM)
5. Underwriters Laboratories Inc. (UL)

B. All systems and components shall be FM approved and listed and labeled by UL.

C. Where there is a conflict between the code and contract documents, the code shall have precedence only when it is more stringent than the contract documents. Items that are allowed by code, but are less stringent than those specified, shall not be substituted.

1.4 QUALITY ASSURANCE

A. Contractor's Quality Assurance Responsibilities: The Contractor shall be solely responsible for quality control of the work.

B. Manufacturer's Qualifications: Firms shall be engaged in the manufacture of products and materials of types and sizes required, and whose products have been in satisfactory use in similar service for not less than five years.

C. Contractor's Qualifications: Firms shall have at least five years of successful installation experience with projects utilizing products and materials similar to that required for this Project.

D. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and Municipal authorities having jurisdiction. Obtain approvals from such authorities.

E. Installation: Comply with NECA National Electrical Installation standards for electrical construction methods.

1.5 SUBMITTALS

A. General

1. Submittals shall include, but shall not be limited to, equipment specifications sheets, schematic diagrams, wiring diagrams, sizes, mounting details (with required elevations), technical descriptions of components, and proper calculations to ensure specified performance of the systems.
2. Submittals shall be required for the following products listed in this specification:
   a. Utility Service Equipment
3. See Division 26 Section 26 0500, "Basic Electrical Requirements" for additional submittal requirements.

B. Product Data: Submit manufacturer's product information showing material proposed. Submit sufficient information to determine compliance with the drawings and specifications.

C. Shop Drawings: Submit complete shop drawings as required to determine acceptability.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products and materials properly packaged in factory fabricated containers and mounted on shipping skids.

B. Store products and materials in clean, dry, heated space. Protect from dirt, fumes, water, construction debris, and traffic. Where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle products and materials carefully to prevent internal damage, breakage, denting, and scoring enclosure finish. Do not install damaged products or materials. Replace and return damaged products or materials to manufacturer.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of one year after the date of substantial completion. Certain equipment shall be warranted at the time of final acceptance, or for longer periods of time as specified in those sections of the project manual.

B. The contractor shall repair or replace, at no additional cost, to Owner, any item that may become defective within the warranty period.

1.9 MAINTENANCE

Not Applicable

1.10 PROJECT CONDITIONS

A. Field Measurements: Verify that field measurements are as indicated on the shop drawings and as shown on the drawings.

B. Project Location Environment. Furnish and install materials suitable for the altitude, weather, and seismic requirements of the project location.

1.11 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

C. Coordinate electrical service connections to components furnished by utility companies.

1. Coordinate installation and connection of exterior underground and overhead utilities and services, including provision for electricity-metering components.
2. Comply with requirements of authorities having jurisdiction and of utility company providing electrical power and other services.

D. Coordinate location of access panels and doors for electrical items that are concealed by finished surfaces.

E. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

F. Where electrical identification markings and devices will be concealed by acoustical ceilings and similar finishes, coordinate installation of these items before ceiling installation.

PART 2 - PRODUCTS

2.1 QUALITY

A. Electrical equipment, devices and associated materials used on this project shall be UL listed and/or labeled.

B. Equipment and devices installed under this division and not constructed with enclosure suited for mounting and protecting all live parts shall be installed in approved metal cabinets.

2.2 MOTORS

A. All motors will be furnished and installed under other sections of the specification.

B. All motors shall be connected under this section.

1. Final connection shall be made with suitable length of Liquidtight flexible metallic conduit.
2. All motors shall be grounded with green grounding conductor as required.

C. Electrical characteristics of motors shall be as follows:

1. Motors ½ horsepower and smaller shall be rated for operation at 120 volt, single phase, 60 Hertz.
2. Motors ¾ horsepower and larger shall be rated for operation at 480 volts, 3 phase, 60 Hertz.

2.3 ELECTRICAL IDENTIFICATION

A. Identification Devices: A single type of identification product for each application category. Use colors prescribed by ANSI A13.1, NFPA 70, and these Specifications.

B. Raceway and Cable Labels: Comply with ANSI A13.1, Table 3, for minimum size of letters for legend and minimum length of color field for each raceway and cable size.

1. Type: Pretensioned, wraparound plastic sleeves. Flexible, preprinted, color-coded, acrylic band sized to suit the diameter of the item it identifies.
2. Type: Preprinted, flexible, self-adhesive, vinyl. Legend is over laminated with a clear, weather- and chemical-resistant coating.
3. Color: Black letters on orange background.
4. Legend: Indicates voltage.

C. Colored Adhesive Marking Tape for Raceways, Wires, and Cables: Self-adhesive vinyl tape, not less than 1" wide by 3 mils thick (25 mm wide by 0.08 mm thick).

D. Underground Warning Tape: Permanent, bright-colored, continuous-printed, vinyl tape with the following features:

1. Not less than 6" wide by 4 mils thick (150 mm wide by 0.102 mm thick)
2. Compounded for permanent direct-burial service
3. Embedded continuous metallic strip or core
4. Printed legend that indicates type of underground line

E. Tape Markers for Wire: Vinyl or vinyl-cloth, self-adhesive, wraparound type with preprinted numbers and letters.

F. Color-Coding Cable Ties: Type 6/6 nylon, self-locking type. Colors to suit coding scheme.

G. Engraved-Plastic Labels, Signs, and Instruction Plates: Engraving stock, melamine plastic laminate punched or drilled for mechanical fasteners 1⁄16" (1.6-mm) minimum thickness for signs up to 20 in^2 (129 cm^2) and 1⁄8" (3.2-mm) minimum thickness for larger sizes. Engraved legend in black letters on white background for normal systems and white letters on red background for emergency systems.

H. Interior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Preprinted, aluminum, baked-enamel-finish signs, punched or drilled for mechanical fasteners, with colors, legend, and size appropriate to the application.

I. Exterior Warning and Caution Signs: Comply with 29 CFR, Chapter XVII, Part 1910.145. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396" (1-mm), galvanized-steel backing, with colors, legend, and size appropriate to the application. 1⁄4" (6-mm) grommets in corners for mounting.

J. Fasteners for Nameplates and Signs: Self-tapping, stainless-steel screws or No. 10/32 stainless-steel machine screws with nuts and flat and lock washers. Self adhesive backing alone is not allowed.

2.4 HANGERS AND SUPPORTS

A. Surface Mounted Cabinets: Secure cabinets directly to wall using suitable wall anchors, or provide a suitable frame for mounting and supporting the cabinets using "Unistrut" type supports as required.

B. Free Standing Motor Starters and Safety Switches: Provide suitable "Unistrut" racks with sheet steel mounting plates for this equipment.

C. Hanger Rods:

1. Provide hanger rods of proper length for electrical items requiring same

2. Minimum rod diameter shall be ⅝" for cable trays, and racks supporting more than 8" of total conduit diameter
3. Hanger rods shall be zinc plated or galvanized steel

D. Cable Supports: Riser cables shall be supported by means of O.Z./Gedney Co, Thomas and Betts, or Joslyn cable supports at each panel and pull box in accordance with Code requirements.

E. Conduit Supports and Hangers:

1. Individually suspended conduits shall be supported with galvanized pipe clamps, from threaded steel rods, spaced 5'-0" on centers.
2. The steel rods shall be affixed to the building structure by means of inserts in concrete slab or beam clamps affixed to the steel structure.
3. Where multiple conduits are installed adjacent to each other, a trapeze hanger consisting of galvanized P-l000 unistrut suspended from at least two threaded steel rods, shall be used. The conduits shall be affixed to the unistrut with galvanized split pipe clamps, Nos. P-1109 through P-1126, for rigid conduit and Nos. P-l425 through P-1431, for EMT.
4. Hangers and clamps shall be as manufactured by Unistrut, B-Line or as approved by Engineer.

2.5 EQUIPMENT BASES

A. The Contractor shall provide concrete pedestals, bases, pads, curbs, anchor blocks, anchor bolts, slab inserts, hangers, channels, cradles, saddles, etc., for installation of equipment and apparatus shown on the drawings.

B. Concrete pads shall be 4" (102 mm) high, unless otherwise indicated, complete with steel reinforcing and necessary bolts, anchors, etc. Where concrete pad is set directly on concrete floor, provide dowels in floor to tie base to floor. These pads shall be extended at least 4" (102 mm) beyond the equipment outlined on all four sides.

C. Provide concrete as required to install electrical work.

1. Concrete mix shall conform to the requirements of Division 03 Section 03 3000, "Cast-in-Place Concrete," however, if no specification is available, the mix shall not be less than 3,500 psi (20 684 kPa) metal reinforced. Pad shall be level to ⅛" per 3' in any direction.

2.6 EQUIPMENT TOUCH-UP PAINT

A. The Contractor shall provide the types and brands furnished by manufacturers for all components. Furnish a minimum of one (1) gallon of the manufacturer's paint for future touch up painting to the Owner.

B. Repair damage to factory applied paint finishes with the appropriate touch-up paint.

2.7 EQUIPMENT FOR UTILITY COMPANY'S ELECTRICITY METERING

A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.

B. Meter Sockets: Comply with requirements of electrical power utility company.

PART 3 - EXECUTION

3.1 DEMOLITION

A. Examination

1. The contractor shall visit the site and examine areas under which the work is to be performed and notify the Owner in writing of any conditions detrimental to the proper and timely completion of the work. Contractor shall not proceed with work until satisfactory conditions have been corrected.
2. Verify field measurements and circuiting arrangements for devices shown on drawings.
3. Demolition drawings are based on casual field observation and existing record drawings. Report discrepancies to Owner before disturbing existing installation.
4. Commencement of demolition means acceptance of existing conditions.

B. Preparation

1. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
2. Coordinate utility service shut-down with the utility company.
3. Notify the Owner at least 48 hours before disabling any electrical system.
4. Provide temporary wiring and connections to maintain existing systems in service during construction. Experienced personnel shall be used when working on energized equipment or circuits.
5. Existing electrical service: maintain existing system in service until new service is complete and ready for service. Disable system only to make switchovers and connections. Obtain permission from Owner at least 48 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
6. Maintain existing fire alarm system in service until new system is accepted. Disable system only to make switchovers and connections. Notify Owner at least 48 hours before partially or completely disabling system. Where fire alarm devices must be removed to accommodate the removal of walls, notify the Owner and Engineer in writing with locations of devices.

C. Demolition and Extension of Existing Electrical Work

1. Remove, relocate, and extend existing electrical work as indicated on the drawings and as noted herein.
2. Remove abandoned wiring back to source of supply.
3. Where source of supply is a panelboard, re-label protective device as “Spare.” After demolition is complete, submit revised panelboard schedules indicating “Spares” to Owner and Engineer.
4. Remove exposed abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors and patch surfaces.
5. Remove and disconnect abandoned outlets and associated devices.
6. Disconnect and remove abandoned panelboards and distribution equipment.
7. Disconnect and remove electrical devices and equipment that is no longer in use.
8. Disconnect and remove abandoned lighting fixtures. Remove brackets, stems, hangers, and other accessories.
9. Repair adjacent construction and finishes damaged during demolition and extension of work

D. Cleaning, Repair, and Replacement

1. General: Clean and repair existing materials and equipment that will remain or are to be reused.
2. Panelboards: Clean exposed surfaces and tighten all electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed schedule showing revised circuiting information.

3. Lighting fixtures: Remove existing lighting fixtures for cleaning. Use mild detergent to clean exterior and interior surfaces, rinse clean with clean water, and wipe dry. Replace existing lamps and ballasts with new.

E. Disposal

1. Owner shall have right to retain any equipment or materials that have been demolished prior to disposal or removal from site.
2. Any equipment or materials not wanted by the Owner shall become the property of the contractor and removed from site.
3. Contractor shall comply with environmental laws and regulations for disposal of demolished materials and equipment.

3.2 MOTOR CONNECTIONS AND INSTALLATIONS

A. Building utility motors such as fans, etc., and certain starting and controlling equipment for same, as indicated on the drawings, will be furnished under Division 20 or 23 of the specifications for the mechanical work and delivered to the building site.

B. Motors which are delivered to the building site independent of their driven equipment shall be set, aligned, and secured under Division 20 of the specifications.

C. Motors and electrical apparatus which are delivered to the building site factory set, assembled and attached to their driven machinery or apparatus:

1. The machinery or apparatus will be moved into position along with its attached electrical apparatus under the responsible mechanical trade section of the specifications.
2. The necessary line side electrical connections shall be provided under this section of the specifications. Furnish all labor and material to place all necessary electrical equipment in satisfactory operating condition.

D. Furnish all branch circuits for motors to the starting equipment and then to the motors, complete with control wiring for automatic and remote control where required. Conduits to motors shall terminate in the conduit fittings on the motors, the final connection being made with short length of flexible conduit. Motors shall be bonded with a green equipment grounding conductor.

E. Consult the specifications for the various branches of the mechanical work and ascertain the exact requirements of the various systems of automatic control. Install and connect up same to leave in satisfactory operating condition.

F. Provide all necessary labor and material to completely connect all ventilation equipment including motors, controls, etc., including all alarm and shutdown systems, as specified here and in the mechanical section.

G. The temperature control panel and components shall be provided under Division 23 of the specifications, including the connection of electrical items. Provide adequate slack wire for this purpose as required.

3.3 PHASE SEQUENCE, ROTATION AND IDENTIFICATION

A. Transformers, switchgear, feeders, panelboards, motor branch circuits, etc., shall be completely phased out for sequence and motor rotation. Phase identification shall be permanently identified in all equipment including conductors by use of all temperature adhesive markers or colored tape similar to Minnesota Mining #35 vinyl tape or as approved.

B. Phase sequence shall be A-B-C (viewed from front):

1. Left to right

2. Top to bottom
3. Front to rear

3.4 SLEEVES AND OPENINGS

A. Provide openings and sleeves in walls and floor as required for this work.

B. Sleeves shall be galvanized steel conduit or schedule 40 black steel pipe, unless otherwise noted. Aluminum conduit shall not be used.

C. Unless specific sizes are indicated on the drawings, sleeves shall be sized to provide ½" clearance around outside surface of the item for which they are installed.

D. Annular space between sleeve and surface of item protruding shall be suitably provided with fire stop as hereinafter specified.

E. Sleeves shall be cut flush with wall surfaces and shall extend 1½" above finished floors unless otherwise indicated.

3.5 CORING, CUTTING, AND PATCHING

A. Necessary coring or cutting in walls, floors, and ceilings shall be neatly and carefully done and repaired in an approved and workmanlike manner.

B. No cutting into the structural work of the building shall be done without the approval of the Engineer/Architect.

3.6 FIRE STOPPING

A. Provide fire and cold smoke stopping construction, as specified, for all through penetrations in rated fire construction (and smoke barriers) in accordance with UL fire resistance directory under categories XHCR and XHEZ. These guides have specific requirements for core and opening sizes based on the size of the penetrating item.

B. Fire and smoke stopping compounds shall be by 3M, or approved equal.

C. Conduit penetrations through fire rated gypsum and concrete construction shall be filled with 3M Fire Barrier CP 25WB+ Caulk according to UL and 3M guides.

3.7 ELECTRICAL IDENTIFICATION

A. Install at locations for most convenient viewing without interference with operation and maintenance of equipment.

B. Coordinate names, abbreviations, colors, and other designations used for electrical identification with corresponding designations indicated in the Contract Documents or required by codes and standards. Use consistent designations throughout Project.

C. Self-Adhesive Identification Products: Clean surfaces before applying.

D. Identify raceways and box covers with color banding or painting as follows:

1. For all EMT conduits sizes ¾" to 2" nominal size, provide the distinctive color conduit identification listed below:

a. Red – Fire Alarm System
b. Orange – Life Safety System
c. Yellow – Nurse Call
d. Green – Grounding System
e. Blue – Communications/Telephone and HVAC Control Systems
f. Purple – Security Systems
g. White – Critical Power Systems
h. Silver – All other systems, with color codes identification listed below

2. Painting: For silver conduits and conduits above 2″ nominal size, paint conduits with identifying colors listed below. Make each color band 2″ (51 mm) wide, completely encircling conduit.
3. Bands: Pre-tensioned, snap-around, colored plastic sleeves or colored adhesive marking tape. Make each color band 2″ (51 mm) wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side.
4. Conduit Band Locations: At changes in direction, at penetrations of walls and floors, at 20′ maximum intervals in straight runs, and at 10′ maximum intervals in congested areas.
5. Junction Boxes and Pull Boxes: Paint only the outside of boxes and covers, with the identifying color.
6. Colors as follows:

Krylon Cat. #	Color	Raceway System
	No Color	120/208V Normal Power
52411	Pumpkin Orange	Life Safety Emergency
51501	Gloss White	Critical Emergency System
51608	Smoke Gray	Equipment System
51510	Gold	480/277 Volts Normal Power
52016	Emerald Green	Ground
52108	Banner Red	Fire Alarm Systems
52108/51910	Scarlet Red/Regal Blue (Stripe)	Voice Command Systems
52108/53540	Scarlet Red/Bahama Sea (Stripe)	Duct Smoke System
52108/53354	Scarlet Red/Ballet Slipper (Stripe)	Door Holders & Dampers
52108/51501	Scarlet Red/Glossy White (Stripe)	Tamper Valve System
51910	Regal Blue	Communications/Telephone
53532	Tomato	Code Blue Emergency Alarms
51013	Purple	Security Alarms
53540	Bahama Sea	HVAC Controls
53354	Ballet Slipper	Signal Alarms

E. Tag and label circuits designated to be extended in the future. Identify source and circuit numbers in each cabinet, pull and junction box, and outlet box. Color-coding may be used for voltage and phase identification.

F. Color-code 208/120V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Black
2. Phase B: Red
3. Phase C: Blue
4. Neutral: White
5. Equipment Ground: Green

G. Color-code 480/277 V system secondary service, feeder, and branch-circuit conductors throughout the secondary electrical system as follows:

1. Phase A: Yellow
2. Phase B: Brown
3. Phase C: Orange
4. Neutral: Gray
5. Equipment Ground: Green

H. For conductors not manufactured with integral color, use conductors with black insulation or jacket and then use color coding tape at intervals not exceeding 5', and at all terminations and splices.

I. Install engraved-laminated emergency-operating signs with white letters on red background with minimum ⅜" (9 mm) high lettering for emergency instructions on power transfer, load shedding, and other emergency operations.

J. Provide identification and markings for various items furnished and installed under this division of the specifications as follows:

1. White Phenolic nameplate with black cut letters ⅜" high:
   - a. Disconnect switches and individually mounted starters with number or designation of equipment served
   - b. Panelboards: Identification on the outside of the cabinet door
   - c. Switchboards & Switchgear: Name, sections, breaker and switch designations
   - d. Individual starter housing
   - e. Transformers
   - f. Non-emergency transfer switches
   - g. Remote Status Panels
2. White Phenolic nameplate with black cut letters ⅛" high:
   - a. Pilot light identification
   - b. Toggle switch identification
   - c. Hand-Off-Auto selector switch identification
3. Red Phenolic nameplate with white cut letters ⅜" high:
   - a. Fire Alarm Equipment
   - b. Emergency Generator and Transfer Switches
   - c. UPS
4. Dymo Tape labels:
   - a. Light fixtures
   - b. Light Switches
   - c. Receptacles
   - d. Disconnects
   - e. Where otherwise specifically indicated

K. Voltage characteristics shall be indicated on each piece of equipment, and at each panel.

L. All panelboards shall be provided with a typed panel board schedule. Include source of power (upstream panel source and breaker or switch).

M. For special ground systems (such as telecommunication facility grounding) provide engraved brass nameplates for all ground conductors at both terminations.

3.8 WARNING SIGNS

A. Install warning, caution, and instruction signs where required to comply with 29 CFR, Chapter XVII, Part 1910.145, and where needed to ensure safe operation and maintenance of electrical systems and of items to which they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions are needed for system or equipment operation. Install metal-backed butyrate signs for outdoor items.

B. Provide "DANGER - 480 VOLTS" warning signs on all 480 volt equipment.

C. Flash Protection Warning Signs

1. The electrical contractor shall provide all flash protection warning signs as required by the NEC Article 100.16. Warning signs shall conform to the requirements of NFPA 70E.

   a. All electrical equipment such as switchboards, panelboards, control panels, meter socket enclosures, and motor control centers, that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electrical hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

   b. All warning signs MUST be installed before owner's personnel are trained on the use of the equipment.

END OF SECTION

SECTION 26 0519
CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Scope: The work specified in this section includes, but shall not be limited to, providing labor, materials, equipment, and services necessary for the electrical work as shown on the drawings and as herein specified.

B. Section includes: building wires, cables, and associated connectors, splices, and terminations for wiring systems rated 600 V and less

1.2 DEFINITION

A. THHN: Heat-resistant thermoplastic insulation

B. THWN: Moisture and heat-resistant thermoplastic insulation

C. XHHW: Moisture-resistant thermoset

1.3 CODES AND STANDARDS

A. NEMA WC3: Rubber-insulated wire and cable for the transmission and distribution of electrical energy

B. NEMA WC5: Thermoplastic-insulated wire and cable for the transmission and distribution of electrical energy

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or 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 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.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products and materials properly packaged in factory fabricated containers and mounted on shipping skids.

B. Store products and materials in clean, dry, heated space. Protect from dirt, fumes, water, construction debris, and traffic. Where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle products and materials carefully to prevent internal damage, breakage, denting, and scoring enclosure finish. Do not install damaged products or materials. Replace and return damaged products or materials to manufacturer.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of one year after the date of substantial completion.

B. The contractor shall repair or replace, at no additional cost to Owner, any item that may become defective within the warranty period.

C. The contractor agrees not to void or impair or to allow any sub-contractor to void or impair any warranties regarding products or items installed as part of this project.

D. The repair of faulty workmanship shall be considered to be included in the contract.

1.9 MAINTENANCE

Not Applicable

1.10 PROJECT CONDITIONS

A. Field Measurements: Verify that field measurements are as indicated on the shop drawings and as shown on the drawings

B. Project Location Environment: Furnish and install materials suitable for the altitude, weather, and seismic requirements of the project location.

PART 2 - PRODUCTS

2.1 QUALITY

A. Electrical equipment, devices and associated materials used on this project shall be UL listed and/or labeled.

B. Equipment and devices installed under this division and not constructed with enclosure suited for mounting and protecting all live parts shall be installed in approved metal cabinets.

2.2 WIRE AND CABLE (600 V OR LESS)

A. Acceptable Manufacturers

1. General Cable Corporation (BICC)
2. Southwire
3. Okonite
4. Rome

B. Wire and cable used in this installation shall be copper and shall have 600 V insulation unless otherwise noted.

C. The wires used in this installation shall be run in conduits or approved raceways, unless specifically indicated otherwise.

D. Conductors shall conform to the latest requirements of the Code and meet ICEA Specifications. Submit the name of manufacturer for the Engineer/Architect and Owner's approval, before work is started.

E. Wire and cable shall be delivered to the project in complete coils with the manufacturer's name and approval tag attached thereto, indicating wire size and type of insulation, and be labeled and listed.

F. Unless otherwise noted, conductors for lighting and power circuits shall be #12 AWG minimum size.

G. Wire for control circuits may be #14 AWG.

H. Wire of #8 AWG size and larger shall be stranded. Wire of #10 and smaller shall be solid.

I. All conductors shall be rated 90°C for dry/wet locations.

J. AC branch circuit wiring shall be installed with color-coded conductors throughout the installation as specified in the identification sections of this specification.

2.3 WIRE CONNECTIONS

A. Acceptable Manufacturers

1. Thomas and Betts
2. Hy-Press Corporation
3. FCI Burndy Products

B. All wire connections shall be made by means of solderless connectors.

C. Clean conductor surfaces before installing lugs and connectors. Apply "no-ox" compound.

D. Branch circuit joints or splices for wires #10 and smaller shall be made with 3M brand Scotchlok electrical spring connectors. No splices shall be made in a conductor except at outlet boxes, junction boxes, or in splice boxes.

E. Control wires shall be made by 3M Scotchlok crimp connectors.

F. Use high press long barrel, cast copper, compression connectors for splices and joints for wires #8 and higher.

G. Wires and cables that terminate onto a bus bar shall be made by cast copper, two hole, long barrel lug, two crimps of fifteen ton compression, hex lugs. Lug bolts shall have lock washers.

H. The phases of all feeders shall be marked at all taps, joints, splices, and near the lugs at each end with permanently colored tapes. Tapes shall be Minnesota Mining #35 vinyl tape or as approved. Tape un-insulated conductors to 150% of insulation rating of conductor.

2.4 FISH WIRE

A. Conduits which are left empty shall contain fish wire of such a gauge required to pull in wire or cable to fill the conduit as determined by Code.

B. Each length of conduit which is to be used for the telephone system shall contain a #l4 gauge nylon fish wire.

C. Terminations of empty conduits shall be properly tagged.

PART 3 - EXECUTION

3.1 CONDUCTOR AND INSULATION APPLICATIONS

A. Service Entrance: Type THHN-THWN, single conductors in raceway or XHHW, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN, single conductors in raceway.

C. Feeders Concealed in Concrete, Below Slabs-on-Grade, and in Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN, single conductors in raceway.

F. Branch Circuits Concealed in Concrete and Below Slabs-on-Grade: Type THHN-THWN, single conductors in raceway.

G. Underground Feeders and Branch Circuits: Type XHHW, single conductors in raceway.

H. Fire Alarm Circuits: Type THHN-THWN, in raceway or power-limited, fire-protective, signaling circuit cable per manufacturer's direction.

I. Class 1 Control Circuits: Type THHN, in raceway.

J. Class 2 Control Circuits: Type THHN, in raceway or power-limited cable, concealed in building finishes, or power-limited tray cable, in cable tray per manufacturer's direction.

3.2 INSTALLATION

A. All wires and cables shall be installed in conduits unless noted otherwise.

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. Identify and color-code conductors and cables according to Division 26 Section 26 0505, "Basic Electrical Materials and Methods," Electrical Identification.

3.3 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.

3.4 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing.

1. After installing conductors and cables and before electrical circuitry has been energized, test for proper installation and polarization.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Scope: The work specified in this section includes providing labor, material, equipment, and services necessary for a complete grounding system as shown on the drawings and as herein specified.

B. Grounding Section Includes: The work specified in this section includes, but shall not be limited to, providing grounding of the following:

1. Underground metal water piping
2. Underground metal structures
3. Metal building frames
4. Building perimeter ground ring
5. Electrical power systems
6. Electrical metallic raceways
7. Service entrance equipment
8. Metal enclosures
9. Lighting fixtures
10. Equipment requiring power
11. Transformer secondaries
12. Telecommunications systems

C. Bonding Section Includes: The work specified in this section includes, but shall not be limited to, providing bonding of the following:

1. Interior metal piping systems
2. Natural gas piping
3. Metallic waste, vent, and drain piping

1.2 DEFINITIONS

Not Applicable

1.3 CODES AND STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. If the referenced publications have been revised prior to Contract award, the latest edition/revision shall be submitted for the referenced document.

C. ASTM International (ASTM)

1. ASTM B 8 – "Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft"
2. ASTM B 33 – (Revised 1985), "Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes"

D. Institute of Electrical and Electronics Engineers (IEEE)

1. ANSI/IEEE 80 – "Guide for Safety in AC Substation Grounding" (copyrighted by IEEE, ANSI approved)
2. ANSI/IEEE 81 – "Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System" (copyrighted by IEEE, ANSI approved)

3. ANSI/IEEE 142 – "Recommended Practice for Grounded of Industrial and Commercial Power Systems" (copyrighted by IEEE, ANSI approved)

E. Insulated Cable Engineers Association (ICEA)

1. ICEA 5-68-516 – "Ethylene Propylene Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy"

F. National Fire Protection Association (NFPA)

1. NFPA 70 – "National Electrical Code (hereinafter referred to as NEC).
2. NFPA 780 – "Installation of Lighting Systems"

G. Underwriters Laboratories, Inc. (UL)

1. UL ECMD – "Electrical Construction Materials Directory"
2. UL 467 – "Grounding and Bonding Equipment"
3. UL 486A – "Wire Connectors and Soldering Lugs for Use with Copper Conductors, Seventh Edition"

H. American National Standards Institute, Electronic Industries Alliance/Telecommunications Industry Alliance (ANSI/EIA/TIA), ANSI/EIA/TIA-607 Grounding and Bonding.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms shall be engaged in manufacture of grounding and bonding products, of types, sizes required, and ancillary grounding materials, including stranded cable, copper braid and bus, grounding electrodes, and bonding jumpers, and whose products have been in satisfactory use in similar service for not less than five years.

B. Installer's Qualifications: Firms shall have at least five years of successful installation experience with projects utilizing grounding systems similar to that required for this Project.

C. Compliance: Comply with applicable local electrical code requirements, NEC, ANSI/IEEE 142, and applicable UL requirements.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's product data showing material proposed. Product data shall include, but shall not be limited to, the following:

1. Conductors
2. Cables
3. Bus bars
4. Connectors
5. Ground rods

B. Shop Drawings: Submit complete shop drawings as required to determine acceptability. Shop drawings shall consist of a complete list of materials, including manufacturer's descriptive and technical literature, catalog cuts, drawings, and installation instruction. Shop drawings shall include, but shall not be limited to, the following:

1. Special fabricated components, which are not a manufactured standard product.

C. Proof of Compliance: Where materials or equipment are specified to comply with requirements of UL, proof of such compliance shall be submitted.

D. Test Reports: Submit ground testing test report as specified.

E. Operation and Maintenance Manuals: Prepare and deliver complete operating and maintenance manuals. Provide information pertinent to the equipment for preventive

maintenance and for replacement of expendable components. Manuals shall include the items listed below and other information recommended by the manufacturer:

1. Cables
2. Bus bar
3. Complete list of parts with reordering numbers
4. Electrical characteristics of components
5. Recommended spare parts list
6. Complete set of shop drawings

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Materials and components shall be properly packaged, stored, and handled to prevent damage or breakage.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of one year after the date of substantial completion. Certain equipment shall be warranted at the time of final acceptance, or for longer periods of time as specified in those sections of the project manual.

B. The contractor shall repair or replace, at no additional cost to Owner, any item that may become defective within the warranty period.

C. The repair of faulty workmanship shall be considered to be included in the contract.

1.9 MAINTENANCE

Not Applicable

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work, include, but shall not be limited to, the following:

1. Adalet-PLM Division; Scott Fetzer Co.
2. Burndy Corporation
3. Cadweld Division; Erico Products, Inc.
4. Crouse-Hinds Division; Cooper Industries
5. Joslyn Corporation
6. OZ Gedney Division; General Signal Corp.
7. Thomas and Betts Corp.
8. Eritech; Erico Products, Inc.

2.2 CONDUCTORS

A. General: Grounding and bonding conductors shall be bare and insulated copper as shown on the drawings or required by other sections of this specification.

B. Conductivity: Copper conductors shall have a conductivity of not less than 98 percent at 75 degrees C. Conductor resistance values shall be in accordance with the value in ICEA S-68-516.

C. Cable Sizes: Cable sizes shall be as shown on the drawings or as required by this specification.

D. Insulation: Insulated grounding and bonding conductors shall have an insulation equal to the current carrying conductors.

2.3 GROUND RODS

A. Ground rods shall be copper-clad with a minimum of 10 mil thickness of copper bonded to a steel core.

B. Rod shall be non-rusting and shall not be covered with enamel or a non-conducting coating.

C. Size shall be ⅝″ diameter by 10 feet length or as shown on the drawings.

2.4 GROUND BUSES

A. General: Ground buses shall be solid copper, ¼″ by 2″ or ¼″ by 4″ rectangular cross section and the length as shown on the drawings.

B. Isolators: Provide ground bus isolators for isolating ground bus from structures and walls. Isolators shall support ground bus a minimum of 1″ from the mounting strap attached to the wall or structure.

2.5 CONNECTORS

A. Exothermic Welds: Exothermic welds shall be a thermite reaction system employing copper oxide and aluminum powder reaction to melt and fuse copper conductors into welded connections.

B. Metal Pipe Connectors: Connectors shall be copper alloy, U-bold type.

C. Ground Bushings: Bushings shall be malleable iron, zinc plated, insulated throat with screw type wire connector.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which the work is to be installed, and notify the Architect/Engineer 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.

3.2 COORDINATION

A. Coordinate with other work to ensure that installation is not vulnerable to physical damage.

3.3 APPLICATION

A. General: The entire electrical system and building structure shall be grounded. The following items of equipment, appurtenances, and as required by Article 250 of NEC, shall be grounded:

1. Electrical service, equipment, and enclosures
2. Conduits and raceways
3. Neutral and ground conductors
4. Switches and panels
5. Motor frames, control cabinets, and lighting fixtures

B. All metallic conduits, supports, cabinets, and all the other electrical equipment shall be permanently and effectively grounded. All grounded shall be in accordance with the applicable code, and shall meet the approval of the local Inspection Department.

C. All metallic raceways shall be mechanically and electrically continuous. Where non-conductive raceways are installed, provided separated equipment grounding conductors bonded to pull and/or junction boxes at each end of each conduit run.

D. Furnish and install a separate equipment grounding wire with each branch circuit conduit, routed with the phase and neutral wires, NEVER in a separate conduit.

E. Equipment grounding wire to be routed in conduit along the phase and neutral wires (NEVER in separate conduit) per code.

F. Installation of the equipotential grounding system shall be as detailed in in NFPA-70 Articles #517 and 660, and NFPA #99. The required equipment and associated panels are indicated on the electrical design drawings.

G. Exothermic Welds

1. Provided exothermic welds for the following:

a. Ground rod to cable
b. Cable to cable (below grade)
c. Cable to structural steel

2. Comply with AWS Code for procedures, appearance, and quality of welds, and for methods used in correcting welding work. The manufacturer's specific instructions and molds shall be used for every weld.

H. Connectors: Provide mechanical connections for the following:

1. Cable-to-pipe
2. Cable-to-ground bus or as otherwise noted on the drawings

I. Bonding Jumpers: Bonding jumpers shall be installed where continuity of piping or metal must be maintained or as required by NEC.

3.4 INSTALLATION

A. Install grounding systems as indicated, in accordance with equipment manufacturer's written instructions and with recognized practices. Comply with applicable requirements of UL 467, UL 486A, NFPA 78 ANSI/IEEE 80, and applicable NEMA standards, to ensure that products fulfill requirements.

B. Connectors

1. Provide mechanicals connections as specified.
2. Remove non-conductive coatings such as paint, lacquer, and enamel on surfaces of equipment to be grounded.
3. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with tightening torque values specified in UL 468A to assure permanent and effective grounding.
4. Apply corrosion-resistant finish to field connections, buried metallic grounding and bonding products, and places where factory-applied protective coatings have been destroyed, which are subjected to corrosive action.
5. No connections below grade shall be covered before inspection by the Architect/Engineer.

C. Bonding Jumpers: Install on water meters and where expansion joints or dielectric unions are used.

D. Ground Bushings: Where a conduit enters a metal enclosure without a ground bus, a ground bushing shall be provided to terminate ground conductor.

E. Switchgear: Switchgear shall be grounded with a minimum No. 4/0 bare copper conduct to the building ground system or as shown on the drawings.

END OF SECTION

SECTION 26 0533

RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes raceways, fittings, pull boxes, outlet boxes, floor fittings, surface and tele/power pole raceways, enclosures, and cabinets for electrical wiring.

1.2 DEFINITIONS

A. EMT: Electrical metallic tubing

B. RMC: Rigid metal conduit (heavy wall steel)

C. FMC: Flexible metal conduit

D. IMC: Intermediate metal conduit

E. LFMC: Liquidtight flexible metal conduit

F. RNC-40: Rigid non-metallic conduit, schedule 40 PVC

G. Fittings: Conduit connection or coupling

H. Body: Enlarged fittings with opening allowing access to the conductors for pulling purposes only

I. Mechanical Spaces: Enclosed areas, usually kept separated from the general public, where the primary use is to house service equipment and to route services. These spaces generally have exposed structures, bare concrete and non-architecturally emphasized finishes.

J. Finished Spaces: Enclosed areas where the primary use is to house personnel and the general public. These spaces generally have architecturally emphasized finishes, ceilings and floors.

K. Concealed: Not visible by the general public. Often indicates a location either above the ceiling, in the walls, in or beneath the floor slab, in column coverings, or in the ceiling construction.

L. Above Grade: Not directly in contact with the earth. For example, an <u>interior</u> wall located at an elevation below the finished grade shall be considered above grade but a wall retaining earth shall be considered below grade.

M. Slab: Horizontal pour of concrete used for the purposes of a floor or sub-floor

1.3 CODES AND STANDARDS

A. American National Standards Institute (ANSI)

1. ANSI C80.1 – Rigid Steel Conduit, Zinc-Coated
2. ANSI C80.3 – Electrical Metallic Tubing, Zinc-Coated and Fittings
3. ANSI C80.4 – Fittings for Rigid Metal Conduit
4. ANSI C80.6 – Intermediate Metal Conduit, Zinc-Coated
5. ANSI/NEMA OS-1 – Sheet Steel Outlet Boxes, Device Box Covers and Bottom Supports
6. ANSI/NEMA OS-2 – Non-Metallic Outlet Boxes, Device Boxes, and Box Support

B. Federal Specifications (FS)

1. WC-586 – Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical Cast Metal

2. WC-408 – Fittings for Conduit, Metal, Rigid, (Thick-Wall and Thin-Wall [EMT] Type)
3. WC-1904A – PVC Rigid Non-Metallic Conduit
4. WC-563A – Electrical Metallic Tubing
5. WC-566 – Specification for Flexible Metal Conduit
6. WC-581E – Specification for Galvanized Rigid Conduit

C. NECA "Standard of Installation"

D. National Electrical Manufacturers Association (NEMA)

1. ANSI/NEMA FB 1 – Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies
2. RN 2 – Packaging of master bundles for Steel Rigid Conduit, Intermediate Metal Conduit, and Electrical Metallic Tubing
3. TC 2 – Rigid Non-Metallic Conduit, PVC Schedule 40 (EPC-40) and Schedule 80 (EPC-80) PVC
4. TC 3 – Rigid Non Metallic Conduit and electrical Non-Metallic Tubing Fittings
5. TC 6 – PVC and ABS Plastics Utilities Duct for Underground Installation
6. TC-8 – Extra-Strength PVC Plastic Utilities Duct for Underground Installation
7. TC-9 – PVC and ABS Plastic Utilities Duct and Fittings for Underground Installation
8. TC 10 – PVC and ABS Plastic Communications Duct and Fittings for Underground Installation
9. TC 13 – Electrical Non-Metallic Tubing
10. TC 14 – Filament-Wound Reinforced Thermosetting Resin Conduit and Fittings
11. TC 18 – Packaging of Master Bundles for EPC 40 (Polyvinyl Chloride) Conduit
12. NEMA 250 – Enclosures for Electrical Equipment (1,000 volts maximum)

E. National Fire Protection Association (NFPA)

1. ANSI/NFPA 70 – National Electrical Code

F. Underwriters Laboratories (UL): Applicable Listings

1. UL 1 – Flexible Metal Conduit
2. UL 6 – Rigid Metal Conduit
3. UL 360 – Liquid Tight Flexible Steel Conduit
4. UL 514-B – Fittings for Conduit and Outlet Boxes
5. UL 651-A – Type EB and a PVC Conduit and HDPE Conduit
6. UL 797 – Electrical Metal Tubing
7. UL 1242 – Intermediate Metal Conduit

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

C. Contractor's Quality Assurance Responsibilities: The Contractor shall be solely responsible for quality control of the work.

D. Manufacturer's Qualifications: Firms shall be engaged in the manufacture of products and materials of types and sizes required, and whose products have been in satisfactory use in similar service for not less than five years.

E. Contractor's Qualifications: Firms shall have at least five years of successful installation experience with projects utilizing products and materials similar to that required for this Project.

F. Regulatory Requirements: Comply with applicable requirements of the laws, codes, ordinances, and regulations of Federal, State, and Municipal authorities having jurisdiction. Obtain approvals from such authorities.

G. Installation: Comply with NECA National Electrical Installation standards for electrical construction methods.

1.5 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: Show fabrication and installation details of components for raceways, fittings, enclosures, cabinets, floor boxes, pull boxes, and outlet boxes.

C. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:

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

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products and materials properly packaged in factory fabricated containers and mounted on shipping skids.

B. Store products and materials in clean, dry, heated space. Protect from dirt, fumes, water, construction debris, and traffic. Where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle products and materials carefully to prevent internal damage, breakage, denting, and scoring enclosure finish. Do not install damaged products or materials. Replace and return damaged products or materials to manufacturer.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of one year after the date of substantial completion.

B. The contractor shall repair or replace, at no additional cost to Owner, any item that may become defective within the warranty period.

C. The contractor aggress not to void or impair or to allow any sub-contractor to void or impair any warranties regarding products or items installed as part of this project.

D. The repair of faulty workmanship shall be considered to be included in the contract.

1.9 MAINTENANCE

Not Applicable

1.10 PROJECT CONDITIONS

A. Field Measurements: Verify that field measurements are as indicated on the shop drawings and as shown on the drawings.

B. Project Location Environment: Furnish and install materials suitable for the altitude, weather, and seismic requirements of the project location.

1.11 COORDINATION

A. Coordinate chases, slots, inserts, sleeves, and openings with general construction work and arrange in building structure during progress of construction to facilitate the electrical installations that follow.

1. Set inserts and sleeves in poured-in-place concrete, masonry work, and other structural components as they are constructed.

B. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Rigid Steel Conduit: (Heavy Wall), hot-dipped galvanized with threaded fittings

B. IMC: zinc-coated steel, with threaded fittings

C. Plastic-Coated Steel Conduit: NEMA RN 1, with threaded fittings

D. Plastic-Coated IMC: NEMA RN 1, with threaded fittings

E. EMT: zinc-coated steel, with insulated throat compression fittings (no set screw)

F. FMC: Zinc-coated steel, with insulated throat squeeze-type connectors

G. LFMC: Zinc-coated steel with sunlight-resistant and mineral oil-resistant PVC jacket

H. Fittings: compatible with conduit and tubing materials

2.2 NONMETALLIC CONDUIT AND TUBING

A. RNC: Schedule 40 and Schedule 80 PVC

B. RNC Fittings: match to conduit or tubing type and material

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Available manufacturers:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. Appleton Electric Company
3. Erickson Electrical Equipment Co.
4. Hoffman
5. Hubbell, Inc.; Killark Electric Manufacturing Co.
6. O-Z/Gedney; Unit of General Signal
7. RACO; Division of Hubbell, Inc.
8. Spring City Electrical Manufacturing Co.
9. Thomas & Betts Corporation
10. Walker Systems, Inc.; Wiremold Company (The)
11. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary

B. Construction:

1. Sheet Metal Outlet and Device Boxes: Galvanized Steel
2. Cast-Metal Outlet and Device Boxes: Type FD, with gasketed cover
3. Floor Boxes: Cast metal, fully adjustable, rectangular
4. Small Sheet Metal Pull and Junction Boxes: Screwcover or hinged as shown on the electrical drawing

5. Cast-Metal Pull and Junction Boxes: Cast aluminum with gasketed cover
6. Cabinets: Galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.4 PULL BOXES

A. Provide pull boxes as shown on the plans and where necessary to meet code and specification requirements for proper installation of associated wiring systems.

B. Pull boxes shall be sized in accordance with the National Electric Code, NFPA 70.

C. Boxes indicated on the plans are not intended to be drawn to scale.

D. Conduit runs of more than 100 feet or with more than the equivalent of three 90 degree bends shall have suitable pull boxes installed in convenient intermediate locations. Such pull boxes shall be shown on the shop drawings and construction record drawings.

E. Pull boxes over 100 cubic inches shall be supported independently of the conduits.

F. Pull boxes shall be accessible after completion of installation.

2.5 OUTLET BOXES

A. Boxes for Suspended or Bracket Mounted Lighting Fixtures: Ceiling outlets and bracket outlets which are to support lighting fixtures shall be equipped with a ⅜" malleable iron fixture stud securely fastened into the outlet box.

B. Flush Mounted Boxes (in plaster, drywall, poured concrete, smooth tile):

1. Outlet boxes for duplex receptacles, single and two-gang toggle switches, shall be a minimum of 4" square by 1½" deep.
2. Outlet boxes for other devices installed under similar conditions shall be a minimum of 4" square 1½" deep.
3. Where more than two conduits enter an outlet box, a 2 ⅛" deep box shall be used, except in columns.
4. Where three or more gangs of devices are required, solid gang boxes a minimum of 4 ½" high by 1⅝" deep shall be used.
5. Provide suitable plaster rings as required.
6. Provide minimum of ½" deep tile covers as required.

C. Flush Mounted Data/Telephone or Clock Outlet Boxes: Outlet boxes which are to be used as data/telephone outlets or clock outlets shall conform to the requirements of switch and receptacle outlets, employing a single gang opening in the plaster cover, unless noted otherwise on the electrical drawings.

D. Capped Outlet Boxes: Outlet boxes which are indicated as capped outlet boxes shall employ flat metal cover plates, fastened to the outlet box with screws.

E. Surface Mounted Outlet Boxes: Where outlet boxes are to be installed exposed on ceiling or wall surfaces, the boxes shall be specifically designed for such a type of installation and shall be square or rectangular as required. Device plates shall match the contour of the boxes and shall be of the type manufactured for these particular type boxes. In finished areas, all boxes shall be flush mounted unless specifically noted otherwise.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors:

1. Exposed: Rigid steel or IMC
2. Concealed: Rigid steel or IMC
3. Underground, concrete encased beyond 5′0″ of building: RNC-40
4. Underground, non-concrete encased beyond 5′0″ of building: RNC-80
5. Connection to Vibrating Equipment (including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC
6. Boxes and Enclosures: NEMA 250, Type 3R or Type 4

B. Indoors:

1. Exposed Dry Locations: EMT
2. Concealed in Interior Partition: EMT
3. Connection to Vibrating Equipment (including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations
4. Damp or Wet Locations: RMC or IMC
5. Concealed in Concrete or Block Walls: RMC or IMC
6. Mechanical Rooms and Penthouses: RMC or IMC
7. Imbedded in Concrete Slabs: RMC or IMC
8. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
    a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel

C. Minimum Raceway Size: ¾″ trade size (DN 21).

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

3.2 INSTALLATION

A. Keep raceways at least 6″ (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

B. Complete raceway installation before starting conductor installation.

C. Support raceways as specified in Division 26 Section 26 0505, "Basic Electrical Materials and Methods."

D. Install temporary caps to prevent foreign matter from entering raceways.

E. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

F. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

H. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2″ (50 mm) of concrete cover.

1. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
2. Space raceways laterally to prevent voids in concrete.
3. Run conduit larger than 1″ trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
4. Change from nonmetallic tubing to Schedule 80 nonmetallic conduit, rigid steel conduit, or IMC before rising above the floor.

I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.
2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

J. Join raceways with fittings designed and approved for that purpose and make joints tight.

K. Terminations:

1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength.

M. Telephone and Signal System Raceways, 2″ Trade Size (DN 53) and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet (45 m) and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

N. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-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

O. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6″ (150 mm) above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

P. Flexible Connections: Use maximum of 72″ (1830 mm) of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

Q. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

R. Bushings

1. Provide bushings wherever IMC, RMC, or EMT conduit is terminated, including stub-outs, and locations not provided with connection fittings or boxes.
2. Insulated Bushings
   a. Provide insulated bushings or connections for IMC, RMC, or EMT conduit terminations.
   b. Insulated bushings shall be OZ/Gedney Co., Type PBP for rigid conduit or Type "SBT" for EMT, or approved equal.
3. Grounded Type Insulated Bushings
   a. Provide grounded type insulated bushings for all electric service and distribution feeder conduits, including stub-outs.
   b. Bushings shall be properly grounded and/or bonded.
   c. Ground type insulated bushings shall be OZ/Gedney Co. Type "BLG" or approved equal.
4. Insulating Bushings
   a. Provide insulating bushings where cables pass through walls of metal enclosures. Bushings shall be OZ/Gedney Co. Type "BBL" or "ABB" or approved equal.
   b. Insulated bushings shall be used at ends of threaded rigid conduits and threaded fittings. Provide double locknuts when terminated in enclosure.
   c. Bushings shall be OZ/Gedney Co. Type "A" or approved equal.

S. Rigid Conduit Fittings and Couplings

1. Running threads shall not be used on conduit for connection at couplings.
2. IMC and RMC conduits shall be joined by approved threaded couplings.
   a. Threadless couplings and connectors are not acceptable.
   b. Set screw couplings are not acceptable.
   c. Split couplings are not acceptable.
3. Joints in conduit which are installed under or in the floor slab, or in exterior walls shall be made watertight by using T&B Kopr-shield thread compound on each joint.

T. Electric Metallic Tubing (EMT) Conduit Fittings and Couplings

1. Only insulated throat type compression fittings shall be used.
2. Only compression-type fittings shall be used, set screw fittings and couplings are not acceptable.

U. Couplings and unions shall be mechanically strong and shall be so installed to make a continuous bond between the conduits connected.

3.3 PULLING COMPOUND

A. If it is desired to use a pulling compound on wire and cable, first obtain the approval of the Engineer/Architect before employing such compounds. Compound shall be UL listed and compatible with conductor insulation covering.

B. Conduits shall be swabbed until moisture and dirt are removed and before wires are pulled or cables are installed.

3.4 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.

3.5 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION

SECTION 26 2200
DRY TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes general-purpose and specialty dry-type transformers with windings rated 600 V or less.

1.2 DEFINITIONS

Not Applicable

1.3 CODES AND STANDARDS

Not Applicable

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A firm experienced in manufacturing components that comply with the requirements of these Specifications and that have a record of successful in-service performance.

B. Testing Agency Qualifications: Full-member company of the International Electrical Testing Association (NETA).

C. Comply with NFPA 70 "National Electrical Code," current edition or version adopted by local authorities having jurisdiction.

D. Comply with IEEE C2 "National Electrical Safety Code."

E. Listing and Labeling: Products are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the "National Electrical Code," Article 100
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product data for each product specified, including dimensioned plans, sections, elevations, weight, temperature rating, impedance, and quantity of voltage taps. Show minimum clearances and installed features and devices.

C. Sound Level Test Reports: Certified copies of manufacturer's sound level tests applicable to equipment for this Project.

D. Operation and maintenance data for materials and products to include in the "Operating and Maintenance Manual" specified in Division 01.

E. Acceptance and Field Test Reports: Indicate and interpret test results for tests specified in Part 3.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Temporary Heating: Apply temporary heat according to manufacturer's recommendations within the enclosure of each ventilated type unit throughout periods during which equipment is not energized and is not in a space that is continuously under normal control of temperature and humidity.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

Not Applicable

1.9 MAINTENANCE

Not Applicable

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Transformers:

a. General Electric Co.
b. Square D
c. Cutler Hammer

2.2 TRANSFORMERS, GENERAL

A. Transformers: Factory-assembled and tested, ambient air-cooled and ventilated, indoor type units, three phase, 60 cycle, with primary/secondary voltages, and sizes as indicated on drawings.

B. Cores: High grade, grain-oriented, nonaging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Magnetic flux densities shall be kept well below the saturation point. The core laminations shall be clamped together with steel angles. The completed core and coil shall then be bolted to the base of the enclosure but isolated from the base by means of rubber vibration absorbing mounts. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable NEMA and NEC requirements.

C. Coils: Continuous wire wound construction, impregnated with non-hygroscopic, thermo setting varnish and cured to reduce hot spots and seal out moisture. Current carrying parts shall be copper.

D. Internal Coil Connections: Brazed or pressure type.

E. Insulation: Transformers shall incorporate a 220C insulation system. Winding temperature rise shall be 80C.

F. Transformer Lugs: Provide compression lugs suitable for copper conductors rated for 90C.

G. Seismic Rating: Transformers shall be seismic rated for the location of the project.

2.3 GENERAL-PURPOSE, DRY-TYPE TRANSFORMERS

A. Comply with NEMA Standard ST 20 "Dry-Type Transformers for General Applications."

B. Transformers: Two-winding type, 3-phase units using 1 coil per phase in primary and secondary.

C. Windings: Copper.

D. Low Sound Level Units: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE Standard C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

E. Enclosure: Indoor, ventilated, NEMA 2 drip proof. The enclosure shall be constructed of code gauge steel. The enclosure shall have removable panels to permit access to the

terminals. A threaded ground stud shall be provided on the exterior of the enclosure to conform to the requirements of NEC Section 250.

F. Taps: For transformers 15 KVA through 500 KVA: Six 2.5% taps, 2 above and 4 below rated high voltage.

G. K-Factor Rating: Transformers indicated to be K-factor rated on the drawings shall be listed to comply with UL 1561 requirements for nonsinusoidal load current handling capability to the degree defined by the designated K-factor.

1. Transformer design prevents overheating when carrying full load with harmonic content corresponding to the designated K-factor
2. Nameplate states the designated K-factor of the transformer
3. 200% neutral capacity
4. Electrostatic Shielding

H. Electrostatic Shielding: Each winding is independently single shielded with a full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Coil leads and terminal strips are arranged to minimize capacitive coupling between input and output connections.
2. Shield Terminal: Separate; marked "Shield" for grounding connection.
3. Capacitance: Shield limits capacitance between primary and secondary to a maximum of 33 picofarads over a frequency range of 20 Hz to 1 MHz.
4. Common-Mode Noise Attenuation: Minus 120 dB minimum, 0.5 to 1.5 kHz; minus 65 dB minimum, 1.5 to 100 kHz.
5. Normal-Mode Noise Attenuation: Minus 52 dB minimum, 1.5 to 100 kHz.

2.4 FINISHES

A. Indoor Units: Manufacturer's standard paint over corrosion-resistant pretreatment and primer.

2.5 SOURCE QUALITY CONTROL

A. Factory Tests: Design and routine tests conform to referenced standards.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project where specified sound levels are below standard ratings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Arrange equipment to provide adequate spacing for access and for cooling air circulation.

B. All connections to transformers shall be made with LFMC conduit per Division 26 Section 26 0505, "Basic Electrical Materials and Methods." Do not support raceway systems from transformer enclosure.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not furnished, use those specified in UL 486A and UL 486B.

D. Identify transformers in accordance with Division 26 Section 26 0505, "Basic Electrical Materials and Methods."

3.2 GROUNDING

A. Separately Derived Systems: Comply with NFPA 70 Article 250 requirements for connecting to grounding electrodes and for bonding to metallic piping near the transformer.

3.3 FIELD QUALITY CONTROL

A. Test Objectives: To ensure transformer installation is operational within industry and manufacturer's tolerances, install according to Contract Documents, and suitable for energizing.

B. Testing Agency: Contractor will engage a qualified independent testing agency to perform field quality control testing.

C. Tests: Perform field tests and inspections in accordance with manufacturer's instructions and the latest version of the NETA Acceptance Testing Specifications.

D. Report: Submit a written report of inspections and tests.

E. Test Failures: Correct deficiencies identified by tests and retest. Verify that equipment meets the specified requirements.

3.4 ADJUSTING

A. After completing installation, cleaning, and testing, touch up scratches and mars on finish to match original finish.

B. Adjust transformer taps to provide optimum voltage conditions at utilization equipment throughout the normal operating cycle of the facility. Record voltages and tap settings to submit to Owner.

3.5 CONCRETE BASE

A. Floor mounted transformers shall be provided with 4" high concrete base. The base shall overlap the transformer's footprint by 3", all around. See specification 26 0505 for additional requirements.

END OF SECTION

SECTION 26 2413
SWITCHBOARDS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes the following:

1. Service and distribution switchboards rated 600 V and less
2. Transient voltage suppression devices
3. Disconnecting and overcurrent protective devices
4. Instrumentation
5. Control power
6. Accessory components and features
7. Identification
8. Mimic bus

B. If indicated on drawings as furnished by Owner, then contractor shall coordinate to receive, store, set in place, install, adjust and test the main switchboard as specified and noted.

1.2 DEFINITIONS

A. EMI: Electromagnetic interference

B. GFCI: Ground-fault circuit interrupter

C. RFI: Radio-frequency interference

D. RMS: Root mean square

E. SPDT: Single pole, double throw

F. TVSS: Transient voltage surge suppressor

1.3 CODES AND STANDARDS

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. Comply with NEMA PB 2

C. Comply with NFPA 70

D. Comply with UL 891

1.4 QUALITY ASSURANCE

A. Contractor Qualifications

1. Firms shall have at least five years experience with similar projects utilizing switchboards similar to that required for this project.
2. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Manufacturer's Qualifications

1. Firms shall be engaged in the manufacture of switchboards of types and sizes required, and whose products have been in satisfactory use in similar service for not less than five years.
2. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Testing Agency Qualifications: Testing agency shall be a member company of the InterNational Electrical Testing Association (NETA) and that is acceptable to the authorities having jurisdiction.

D. Listing and Labeling: Provide switchboard assemblies specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" as defined in OSHA Regulation 1910.7.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboard equipment, including clearances between switchboard and adjacent surfaces and items. Comply with indicated maximum dimensions.

1.5 SUBMITTALS

A. Product Data: Submit product information for each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment:

1. Show dimensioned plans and elevations, including required clearances and service space, component and device lists, and a single-line diagram showing main- and branch-bus current ratings and short-time and short-circuit ratings of switchboard.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Utility company metering provisions with indication of approval by utility company.
7. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components
8. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
   a. Time Current Curves: For all circuit breakers in switchboard provide time vs. current curves on 11 x 17 sized log/log paper. Curves provided on 8½ x 11 size paper are not acceptable.
9. Include schematic and wiring diagrams for power, signal, and control wiring.
10. Wiring Diagrams: Details of wiring for power and control and differentiating between manufacturer-installed and field-installed wiring.

C. Qualification Data: For firms and persons specified in "Quality Assurance" article.

D. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces for the area zone of installation. Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Reports of Field Tests and Observations: Certified by testing agency. 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

F. Manufacturer field service report.

G. Certificates for field testing agency, signed by Contractor, certifying that testing agency complies with requirements specified in “Quality Assurance” article.

H. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, Section 01 7823, "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver in shipping splits of lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards.

C. Store so condensation will not occur on or in switchboards. Provide temporary heaters as required to avoid condensation. Install temporary electric heating to prevent condensation.

D. Handle switchboards according to NEMA PB 2.1. Use only factory-installed lifting provisions.

E. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

F. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weather tight, wet work in spaces is completed, dry work above switchboards is completed, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.7 SPARE PARTS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: Equal to 10% of quantity installed for each size and type, but no fewer than two of each size and type.
2. Control-Power Fuses: Equal to 10% of quantity installed for each size and type, but no fewer than two of each size and type.

3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10% of quantity installed for each size and type, but no fewer than three of each size and type.
4. Fuses for Fused Power-Circuit Devices: Equal to 10% of quantity installed for each size and type, but no fewer than three of each size and type.
5. Indicating Lights: Equal to 10% of quantity installed for each size and type, but no fewer than one of each size and type.

1.8 WARRANTY

A. Warranty shall be a minimum of one year from acceptance testing.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1.9 MAINTENANCE

Not Applicable

1.10 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Cutler-Hammer Products: Power R Line
2. Square D Co. QED-2
3. General Electric Electrical Distribution
4. Erickson Electrical Equipment Co.
5. Approved local switchboard builder

2.2 MANUFACTURED UNITS

A. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted
2. Branch Devices: Panel mounted
3. Sections front and rear aligned

B. Front- and Side-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted
2. Branch Devices: Panel mounted
3. Sections front and rear aligned

C. Front- and Rear-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted
2. Branch Devices: Fixed, individually mounted

3. Sections front and rear aligned

D. Short Ratings: 65,000 amps minimum fully rated or as noted on the electrical drawings.

1. Short circuit ratings shall meet or exceed the ratings calculated under Division 26 Section 26 0573, "Overcurrent Protective Device Coordination Study" of these specifications.

E. Nominal System Voltage: 480Y/277 V, 3 Phase, 4 wire, 60 Hz.

F. Main and Distribution Bus Continuous Rating: As noted on the electrical drawings.

2.3 FABRICATION AND FEATURES

A. Indoor Enclosure: NEMA 250 Type 1, metal, totally enclosed, dead-front, freestanding.

1. Enclosure Finish: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

B. Barriers: Between adjacent switchboard sections.

C. Isolation and isolation of main bus of main section and main and vertical buses of feeder sections.

D. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

E. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.

F. Feeder Distribution Sections: Distribution sections shall consist of three sections, a front circuit breaker or fused switch section, an intermediate busing compartment, and a rear load side feeder cable/lug compartment. There shall be glass polyester barriers between the three sections.

G. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

A. Removable, Hinged Rear Doors and Compartment Covers: Secured by captive thumb screws, for access to rear interior of switchboard. Door shall have a provision for one padlock on each door.

B. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

C. Protective Device Mounting: Circuit breakers and fused switches shall be individually mounted with line load bus connections. Devices shall be removable from the front.

D. Lugs: Lugs shall be compression type or two-hole long barrel high press type, tin-plated cooper suitable for copper cables rated at 90C and accessible from the rear. Lugs shall be sized for cable shown on the drawings.

E. Pull Box on Top of Switchboard: Include the following features:

1. Adequate ventilation to maintain air temperature in pull box within same limits as switchboard.
2. Set back from front to clear circuit-breaker removal mechanism.

3. Removable covers forming top, front, and sides. Top covers at rear are easily removable for drilling and cutting.
4. Bottom of insulating, fire-resistant material with separate holes for cable drops into switchboards.
5. Cable supports arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

F. Buses and Connections: 3 phase, 4 wire, except as otherwise indicated. Features as follows:

1. Phase, Neutral, and Ground Bus Material: Hard-drawn copper of 98% conductivity silver or tin-plated.
2. Load Terminals: Silver or tin-plated copper bus extensions equipped with two-hole high-pressure connectors for outgoing circuit conductors.
3. Ground Bus: ¼″ x 2″ (6 x 50-mm) minimum size, equipped with high press two-hole connectors for feeder- and branch-circuit ground conductors.
4. Contact Surfaces of Buses: Silver or tin-plated.
5. Bus Ampacity: Uniform capacity the entire length of the switchboard main and distribution sections. 1000 amps per square inch and compliance with UL 891.
6. Neutral and Ground Buses: 100% of the ampacity of the phase buses, except as indicated, and equipped with approved pressure connectors for outgoing circuit neutral and equipment ground cables.
7. Bus provisions shall be made for future splicing of additional sections from either end of the switchboard.

G. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit breaker compartment.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Main Breaker: Enclosed, Power Breaker per ANSI C37 and 100% rated. Minimum interrupting rating of 100,000 amps and a minimum short time (30 cycle) rating of 65,000 amps.

1. Drawout circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Microprocessor-based trip units with interchangeable rating plug, LED trip indicators, and the following field-adjustable settings:
   a. Long time pick up and delay adjustments
   b. Short-time time pick, delay and I2t response adjustments
   c. Instantaneous Pickup
   d. Ground-fault pickup level, time delay, and I2t response
4. Remote trip indication and control.
5. Key Off: Key to lock circuit-breaker operation in off; key shall be removable only when circuit breaker is in off position.
6. Control Voltage: 120VAC.

B. Branch Feeder Breakers: Enclosed, Molded-Case Circuit Breaker: NEMA AB 1, handle lockable.

1. Characteristics: Frame size, trip rating, number of poles, and auxiliary devices as indicated and interrupting capacity rating to meet available fault current.
2. Application Listing: Appropriate for application, including switching fluorescent lighting loads or heating, air-conditioning, and refrigerating equipment.
3. Continuous Current Rating: Breakers 600 amps and larger shall be 100% rated.

4. Circuit Breakers, 250 A and Smaller: Thermal magnetic trip unit and inverse time-current characteristics.
5. Circuit Breakers, 400 A and Larger: Microprocessor based RMS trip units with following characteristics:
    a. Long time pick up (x of plug)and delay adjustments
    b. Short-time time pick, delay and I2t response adjustments
    c. Instantaneous Pickup
    d. Ground-fault pickup level, time delay, and I2t response
    e. LCD ammeter
6. Shunt Trip: Where indicated.

C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, 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 400 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic trip circuit breakers with RMS sensing; field-replaceable rating plug or field-replicable electronic trip; and 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. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
6. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
    a. Standard frame sizes, trip ratings, and number of poles.
    b. Lugs: Mechanical or compression style, suitable for number, size, trip ratings, and conductor material.
    c. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
    d. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
    e. Communication Capability: Universal-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 26 Section "Electrical Power Monitoring and Control."
    f. Shunt Trip: 120V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
    g. Undervoltage Trip: Set to operate at 35% to 75% of rated voltage without intentional time delay.
    h. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.5 SURGE PROTECTION DEVICES (TVSS)

A. Manufacturers: Subject to compliance with requirements, provide devices as manufactured by the fabricator.

B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, plug-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:

1. Fuses, rated at 200 kA interrupting capacity
2. Fabrication using bolted compression lugs for internal wiring
3. Integral disconnecting means
4. Redundant suppression circuits
5. Redundant replaceable modules
6. Arrangement with wire connections to phase buses, neutral bus, and ground bus
7. LED indicator lights for power and protection status
8. Audible alarm, with silencing switch, to indicate when protection has failed
9. Form-C contacts rated at 5 A and 250VAC, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
10. Six-digit, transient-event counter set to totalize transient surges

C. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase

D. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 Line to Ground: 800 V for 480Y/277Neutral to Ground: 800 V for 480Y/277

F. TVSS shall use MOV technology and provide protection for L-G, L-L, L-N, and N-G modes.

G. EMI/RFI Filter: TVSS shall include a high performance EMI/RFI noise filter which provides a minimum of noise attenuation of 50 dB at 100 kHz.

2.6 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:

1. Potential Transformers: Secondary voltage rating of 120V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
2. Current Transformers: Ratios as indicated and accuracy class and burden suitable for connected relays, meters, and instruments.
3. Control Power Transformers: Dry type, mounted in separate compartments for units larger than 3kV.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Ground/neutral sensor current transformers located as indicated. Connect secondary to ground overcurrent relays to provide selective tripping of bus tie

and main breaker or switch. Coordinate with feeder breaker/switch ground-fault protection.

B. Multifunction Digital Power Metering Monitor. Provide a main power meter for the switchboard. Microprocessor-based RMS unit with on board memory suitable for 3- or 4-wire systems and with the following features:

1. Switch selectable digital display of the following values with maximum accuracy tolerances as indicated:

a.	Phase Currents, Each Phase:	±1%
b.	Phase-to-Phase & Phase-to-Neutral Voltages:	±1%
c.	MegaWatts:	±1%
d.	MegaVars:	±2%
e.	Power Factor:	±2%
f.	Frequency:	±0.5%
g.	Megawatt Demand:	±1%

(1) Demand interval programmable from 5 to 60 minutes.

2. Accumulated Energy, Kilowatt Hours: ±1%. Accumulated values unaffected by power outages up to 72 hours.
3. Min and Max values for amps, volts, and power.
4. Programmable Analog Output: 4-20ma.
5. Programmable Output Contacts: 2 form C.

C. Mounting: Display and control unit flush or semi-flush mounted in instrument compartment door.

2.7 CONTROL POWER

A. Control Circuits: 120 VAC, supplied through secondary disconnect devices from control power transformer.

B. Control Power Fuses: Primary and secondary fuses for current limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, complete with bundling, lacing, and protection. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.8 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items as required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: Arranged to permit testing of all functions of solid-state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

C. Circuit-Breaker Removal Apparatus: Portable, floor-supported, roller-base, elevating carriage arranged for movement of breakers in and out of compartments for present and future breakers.

D. Lifting Eyes: Provide switchboard sections with lifting eyes.

2.9 IDENTIFICATION

A. Nameplates and label products are specified in Division 26 Section 26 0505, “Basic Electrical Materials and Methods.”

B. Mimic Bus: Continuously integrated mimic bus factory applied to front of switchboard. Arrange in single-line diagram format, using symbols and letter designations consistent with final mimic-bus diagram.

C. Coordinate mimic-bus segments with devices in switchboard sections to which they are applied. Produce a concise visual presentation of principal switchboard components and connections.

D. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive switchboard for compliance with installation tolerances and other conditions affecting performance of switchboards.

1. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Verify dimensions by field measurements.

B. Determine suitable path for moving switchboard into place considering Project conditions.

C. Verify clearance requirements. Locate switchboard to meet installation tolerances.

D. Revise locations and elevations from those indicated as required to suit Project conditions. Obtain written approval from Architect/Engineer before making any significant (more than 6") changes.

E. Install switchboards level and plumb as indicated, according to manufacturer's written instructions and NEMA PB 2.1. Comply with all applicable requirements of electrical installations in the seismic zone of the project.

F. Support switchboards on concrete housekeeping bases, 4" (100-mm) nominal thickness.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18" (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

G. Install anchor bolts to elevations required for proper attachment to switchboards

H. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

I. Operating Instructions: Frame and mount printed, basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on the front of switchboards.

J. Install filler plates in unused spaces of panel-mounted sections.

K. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Subparagraph below assumes that settings are indicated on Drawings or a coordination report is available for Contractor to use.

a. Set field-adjustable switches and circuit-breaker trip ranges.

3.3 CONNECTIONS

A. Connect switchboards and components to wiring systems and to ground as indicated and instructed by manufacturer.

1. Tighten electrical connectors and terminals, including screws and bolts, according to manufacturer's published torque tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 IDENTIFICATION

A. Identify field-installed wiring and components and provide warning signs as specified in Division 26 Section 26 0505, "Basic Electrical Materials and Methods."

B. Identify field-installed wiring and components and provide warning signs as specified.

C. Install compartment nameplates.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Make insulation-resistance tests of each switchboard bus, component, and connecting supply, feeder, and control circuits.
2. Make continuity tests of each circuit.

B. Testing Agency: Contractor will provide the services of a qualified independent testing agency to perform specified acceptance testing.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections

D. Acceptance Testing: After installing switchboards and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. 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. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove all panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.

c. Instruments and Equipment:

(1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Switchboard will be considered defective if it does not pass tests and inspections.

F. Retain paragraph below if tests and inspections are performed by Contractor or manufacturer's field-service representative engaged by Contractor.

1. Prepare test and inspection report, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken and observations after remedial action.

3.6 ADJUSTING

A. It is the responsibility of the installing contractor to provide an electrical system coordination study that includes settings for all field adjustable circuit breakers and bolted pressure switches. Settings shall include, but are not limited to:

1. Long time pick-up
2. Short time pick-up
3. Instantaneous pick-up
4. Ground fault pick-up level, time delay and I^2T response

B. The electrical system coordination study shall be submitted to the Engineer for review at least two weeks prior to the acceptance testing and power start-up. Study shall include all time current curves on 11x17 sized log paper for all adjustable breakers to be installed on project.

C. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

D. Set field-adjustable circuit-breaker trip ranges as calculated in the "Overcurrent Protective Device Coordination Study."

3.7 CLEANING

A. Upon completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

3.8 DEMONSTRATION

A. Startup Services: Engage a factory-authorized service representative to demonstrate and train Owner’s maintenance personnel as specified below:

1. To identify each switchboard location
2. To instruct in function, operation, and maintenance of each component
3. To instruct in each distinct procedure and schedule related to servicing and preventive maintenance

3.9 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer’s written instructions.

END OF SECTION

SECTION 26 2416
PANELBOARDS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Scope: The work specified in this section includes, but shall not be limited to, providing labor, material, equipment, and services necessary for panelboards as shown on the drawings and as herein specified.

B. Section Includes: The work specified in this section includes, but shall not be limited to, providing the following:

1. Power distribution panelboards
2. Lighting panelboards
3. Branch circuit panelboards
4. Surge Suppression Device

1.2 DEFINITIONS

A. DP or PP: Power Distribution Panel

B. LP: Lighting Panel

C. RP: Branch Circuit Panel

D. TVSS: Transient Voltage Surge Suppressor

1.3 CODES AND STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

C. Federal Specifications (FS):

1. FS W-C-375B "Circuit Breakers, Molded Case, Branch Circuit and Service"
2. FS W-F-870 "Fuseholders and Fuse clips (for Plug and Enclosed Cartridge Fuses)"
3. FS W-P-115C "Panel, Power Distribution," Type 1, Class 1
4. FS W-S-865 "Switch Box (Enclosed), Surface Mounted"

D. National Electrical Manufacturers Association (NEMA):

1. NEMA 250 "Enclosures for Electrical Equipment (1000 Volts Maximum)" (copyrighted by NEMA, ANSI approved)
2. NEMA AB 1 "Molded Case Circuit Breakers and Molded Case Switches"
3. NEMA KS 1 "Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)" (copyrighted by NEMA, ANSI approved)
4. NEMA PB 1 "Panelboards" (copyrighted by NEMA, ANSI approved)
5. NEMA PB 1.1 "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less"

E. National Fire Protection Association (NFPA):

1. NFPA 70 "National Electrical Code" (copyrighted by NFPA, ANSI approved) - hereinafter referred to as NEC

F. Underwriters Laboratories, Inc. (UL):

1. UL 50 "UL Standard for Safety – Cabinets and Boxes" (copyrighted by UL, ANSI approved)
2. UL 67 "UL Standard for Safety – Panelboards" (copyrighted by UL, ANSI approved)
3. UL 486A "UL Standard for Safety - Wire Connectors and Soldering Lugs for Use with Copper Conductors"
4. UL 869 "UL Standard for Safety - Service Equipment" (copyrighted by UL, ANSI approved)

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

B. Manufacturer's Qualifications: Firms shall be engaged which are in manufacture of panelboards of types and sizes required, and whose products have been in satisfactory use in similar service for not less than five years.

C. Contractor's Qualifications: Firms shall have at least five years of successful installation experience with projects utilizing panelboards similar to that required for this Project.

D. Compliance: Comply with applicable requirements of FS, NEMA and UL standards referenced in Article 1.2 - References, and with NEC.

E. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.5 SUBMITTALS

A. General: Submit the following in accordance with Conditions of the Contract and Division 1 - General Requirements.

B. Product Data: Submit manufacturer's product data showing material proposed. Product data shall include manufacturer's technical data and cut sheets on features, performance, electrical characteristics, ratings and finishes.

C. Shop Drawings: Submit complete shop drawings for each panelboard and related equipment as required to determine acceptability. Shop drawings shall include, but shall not be limited to, the following:

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1. Include finish and mounting types.
3. Detail bus configuration, voltage, ampere, AIC, and integrated interrupting ratings. Include Main, neutral, equipment ground, isolated ground bus drawings and lug configuration.
4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective devices (OCPD), rated 100 amps and above, included in panelboards; for OCPD devices rated 250 amps and above, submit on translucent log-log graft paper. Include selectable ranges for each type of overcurrent protective device.
8. UL and NEMA labeling for applications required
9. Nameplate details

10. Lock hardware
11. Number and size of spare switches or breakers
12. Cut sheets on breakers with model numbers highlighted
13. Technical data and cut sheets on TVSS devices

D. Qualification Data: Submit company name that is a qualified testing agency.

E. Operating and Maintenance Manuals: Prepare and deliver complete operating and maintenance manuals. Provide information pertinent to the equipment for preventive maintenance and for replacement of expendable components. Include the items listed below and other features as may be recommended by the equipment manufacturer:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments
3. Catalog information of the unit installed
4. Capacity and installation details
5. Wiring diagrams of electrical components
6. Complete list of parts with reordering numbers
7. Recommended spare parts list

F. Panel Board Schedules: For installation in panelboard. Submit final versions after load balancing in field.

G. Submit signed receipt showing keys have been turned over to Owner.

H. 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

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle panelboards to avoid damage to materials, components, and finish.

B. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

C. Handle and prepare panelboards for installation according to NEMA PB 1.

D. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weather tight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

1.7 SPARE PARTS

A. Keys and Locks: Provide six (6) spares of each type of panelboard lock and key.

B. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

C. Circuit Breakers: Furnish 10% spare circuit breakers of each type and rating installed. If drawings indicate more spares, provide the quantity as shown on the drawings.

1.8 WARRANTY

A. Panelboards shall be warranted for a minimum period of five years from date of Substantial Completion, or longer if the manufacturer's warranty allows.

1.9 MAINTENANCE

Not Applicable

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric
5. Erickson Electrical Equipment Company
6. Pre-Approved Local panelboard fabricator

B. Manufacturer Model: See specifications below for specific manufacturer models to be used for each type of panelboard.

2.2 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Provide panelboards, enclosures, and ancillary components of types, sizes, and ratings as indicated in the panelboard schedules and where shown on the drawings.

B. Panel Rating: Panelboards shall be rated for the amperage, voltage, phase, equipment ground, and isolated ground requirements, shown on the drawings.

C. Enclosures: mounted cabinets as shown on the contract electrical drawings.

1. Provide rated for environmental conditions at installed location.

   a. Indoor Dry and Clean Locations: NEMA 250, Type 1
   b. Outdoor Locations: NEMA 250, Type 3R
   c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel
   d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4
   e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12

2. Construction: Panelboards shall comply with NEMA 1 requirements unless noted otherwise on drawings. Panelboards shall be enclosed in steel cabinets with the rigidity and gauge of steel complying with UL 50. Wiring gutter space shall comply with UL 67 and NEC and not be less than 5½" top, bottom and sides. Minimum width shall be 20".

3. Front: Secured to box with concealed trim clamps.

   a. Surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap the box by ¾" on all sides

b. Doors: Each panelboard front shall have a door and a flush cylinder tumbler-type lock. Doors over 48″ shall be equipped with a three-point latch. Fronts shall be code gage steel

4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
5. Directory Card: Inside panelboard door, mounted in transparent card holder.
6. Panelboard Identification: Each panelboard shall have a laminated bakelite nameplate attached to the outside of the panelboard per Division 26 Section 26 0510. The nameplate shall include panelboard designation, location, voltage, and phase.
7. Keys: Panelboard locks shall be keyed alike.

D. Interior: Interiors shall be factory-assembled. Interiors shall be designed such that switching and overcurrent protective devices can be removed without disturbing adjacent units or bus bars. Branch breakers shall be arranged using double row construction. Provision for future circuit breakers shall be located at the bottom of the panelboard.

E. Mains: All panelboards shall be provided with main circuit breakers, or main lugs only (MLO) as shown on the electrical drawings. Mains shall be field convertible for top or bottom feed.

F. Lugs: Lugs shall be copper compatible with the type and size conductors serving the panelboard and breaker.

1. Conductor Connectors: Suitable for use with conductor material and sizes.

a. Material: Hard-drawn copper, 98 percent conductivity
b. Main and Neutral Lugs: Compression type
c. Ground Lugs and Bus-Configured Terminators: Compression type
d. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device
e. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device
f. Gutter-Tap Lugs: **Compression** type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device
g. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus

G. Phase, Neutral, and Ground Buses:

1. General: Panelboard bus structure and main circuit breaker shall have the current ratings as shown on the drawings. Such rating shall be established by heat rise test with a maximum hot spot temperature on any conductor or bus bar not to exceed 65 degrees C rise above ambient. Test shall comply with UL 67.
2. Bus Capacity: Copper bus bars shall be of sufficient size to provide a current density which does not exceed 1,000 amperes per square inch of bus cross-section, and which does not exceed 200 amperes per square inch at bolted circuit breaker connections.
3. Main Bus: Panelboards shall be provided with a tin plated copper main bus. Bus shall be full length to accommodate the maximum number of overcurrent protective devices for which the panelboard is designed.

4. Neutral Bus: A full-sized (100% rated) neutral bar shall be included for panels shown with a neutral. Where required on drawings, panelboards shall be provided with a 100% or 200% rated tin-plated copper main neutral bus. The neutral bus (100 or 200%) shall be insulated from the cabinet and other parts shall be provided with solderless cable connectors for each circuit breaker.
5. Equipment Ground Bus: Panelboards shall be provided with a solid copper rectangular cross-section equipment ground bus. Equipment ground bus shall be independent of the neutral bus.
6. Isolated Ground Bus: Where called for on the drawings, panelboards shall be provided with a solid copper rectangular cross-section isolated ground bus. Isolated ground bus shall be independent of the neutral and equipment ground bus, and shall be electrically isolated from the cabinet.

H. Short Circuit Ratings: Panelboard short circuit rating shall be as indicated on schedules or the drawings and specified herein. The short circuit rating of the assembled panelboard shall be determined by utilizing the lowest interrupting rating assigned to any circuit breaker installed in that panelboard. Series-rated panelboards are not acceptable.

I. Circuit Breakers: Circuit breakers shall comply with NEMA AB 1 and FS W-C-375. Circuit breakers shall have over-center toggle, mechanism with quick-make, quick-break action. Circuit breakers shall have a handle position indicator and a common trip for two-pole and three-pole breakers. Circuit breakers shall be bolt-on type (plug in is not acceptable) and equipped with individually insulated, braced, and protected connectors. Circuit breakers shall be flush with each other when assembled in the panelboard. Trip ratings shall be as indicated on panelboard schedules or the drawings. Breakers shall be listed for appropriate applications: SWD for fluorescent lighting, HID for high intensity discharge lighting, and HCAR for heating air conditioning and refrigeration equipment.

J. Spare Circuit Breakers: Where a compartment is shown as spare it shall be provided with a circuit breaker of the size, trip and interrupting capacity, and type shown on the drawings.

K. Space: Where space is shown on the drawings, it shall be provided with mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

L. Auxiliary Protection Functions: Where indicated on the drawings, provide breakers with auxiliary protective functions or devices such as ground fault equipment protection (GFEP), ground fault interruption (GFIC), or arc fault interruption (AFIC), shunt trip, lockouts, or aux switches.

M. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

N. Seismic Rating: Panelboards shall be rated for the seismic zone of the location for of the project.

2.3 POWER DISTRIBUTION PANELBOARDS.

A. Product: Subject to compliance with requirements, provide one of the following products:

1. Type Power –R-Line 4: Eaton Electrical Inc.; Cutler-Hammer Business Unit
2. Spectra Series: General Electric Company
   Type I-Line: Square D; a brand of Schneider Electric

B. Short Circuit Ratings: Panelboard short circuit rating shall be as indicated on schedules or the drawings, but not less than 65k AIC amps fully rated. The short circuit rating of the assembled panelboard shall be determined by utilizing the lowest interrupting rating assigned to any circuit breaker installed in that panelboard. Series-rated panelboards are not acceptable.

C. Circuit Breakers: Trip ratings shall be as indicated on panelboard schedules or the drawings. The interrupting rating for circuit breakers shall be equal to the full rating of the panelboard as indicated on the drawings and not less than 65k AIC amperes symmetrical. Circuit breakers shall be thermal-magnetic with inverse time current characteristics and UL listed for the application shown on the drawings. Circuit breakers frames above 400 amps and above shall be equipped with microprocessor based adjustable LSIG trips, shunt trip, and interchangeable rating plugs. Circuit breakers frames 400 amp and above shall be 100% rated.

D. Fusible Switches: Switch and fuse sizes shall be as indicated on the panelboard schedules on the drawings. The interrupting rating for each switch shall be equal or greater than the full rating of the panelboard as indicated on the electrical drawings, but not less than 100k AIC amperes symmetrical. Refer to Division 26 Section 26 2813, "Fuses" for fuse specification.

2.4 LIGHTING PANELBOARDS (480Y/277 VOLT)

A. Product: Subject to compliance with requirements, provide one of the following products:

1. "AE," General Electric Co.
2. "Type NF," Square D Co.
3. "Type Power-R-Line 2a," Cutler-Hammer

B. Short Circuit Ratings: Panelboard short circuit rating shall be as indicated on schedules or the drawings, but not less than 65k AIC amps fully rated. The short circuit rating of the assembled panelboard shall be determined by utilizing the lowest interrupting rating assigned to any circuit breaker installed in that panelboard. Series-rated panelboards are not acceptable.

C. Circuit Breakers: Trip ratings shall be as indicated on panelboard schedules or the drawings. The interrupting rating for circuit breakers shall be equal to the full rating of the panelboard as indicated on the drawings but not less than 65k AIC amperes symmetrical. Breakers shall have inverse time tripping characteristics calibrated for operation in 104F ambient. Breakers shall be UL listed as SWD, HID type, and HACR type as required by code.

2.5 BRANCH CIRCUIT PANELBOARDS (208Y/120 VOLT)

A. Product: Subject to compliance with requirements, provide one of the following products:

1. "AQ," General Electric Co.
2. "Type NQOD," Square D Co.
3. "Type Power-R-Line 1a," Cutler-Hammer

B. Short Circuit Ratings: Panelboard short circuit rating shall be as indicated on schedules or the drawings, but not less than [22k AIC amps fully rated. The short circuit rating of the assembled panelboard shall be determined by utilizing the lowest interrupting rating assigned to any circuit breaker installed in that panelboard. Series-rated panelboards are not acceptable.

C. Circuit Breakers: Trip ratings shall be as indicated on panelboard schedules or the drawings. The interrupting rating for circuit breakers shall be equal to the full rating of the panelboard as indicated on the drawings and not less than 22k AIC amperes symmetrical. Breakers shall have inverse time tripping characteristics calibrated for operation in 104F ambient. Breakers shall be UL listed for SWD, HID, and HACR type as required by code.

2.6 SURGE SUPPRESSION DEVICES – PANELBOARD MOUNTED

A. Where indicated on drawings, panelboards shall incorporate a surge suppression device (TVSS) device within the panel enclosure.

B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Current Technology; a subsidiary of Danahar Corporation
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution
4. Liebert Corporation
5. Siemens Energy & Automation, Inc.
6. Square D; a brand of Schneider Electric

C. Surge Protection Device: IEEE C62.41-compliant, integrally mounted, solid-state, parallel-connected, non-modular type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the panelboard short-circuit rating, and with the following features and accessories:

1. Accessories:

a. LED indicator lights for power and protection status
b. Audible alarm, with silencing switch, to indicate when protection has failed
c. One set of dry contacts rated at 5Amps, 250-Vac, for remote monitoring of protection status

D. Peak Single-Impulse Surge Current Rating: 120 kA per mode/240 kA per phase.

E. Minimum single-impulse current ratings, using 8-by-20-mic.sec. Waveform described in IEEE C62.41.2.

1. Line to Neutral: 70,000 A
2. Line to Ground: 70,000 A
3. Neutral to Ground: 50,000 A

F. Protection modes and UL 1449 SVR for grounded wye circuits with **480Y/277** and **208Y/120**V, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 and 400 V for 208Y/120V.
2. Line to Ground: 800 V for 480Y/277 and 400 V for 208Y/120V.

G. TVSS shall use MOV technology, provide protection for all modes of the panel, and be directly coupled to the bus.

H. TVSS shall be listed under UL 1449 and UL 1283

I. TVSS EMI/RFI suppression: Minimum 50 dB @ 100 kHz

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine areas and conditions under which the work is to be installed, and notify Owner in writing of any conditions detrimental to the proper and timely completion of the work.

D. Do not proceed with the work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate installation of panelboards and enclosures with cable and raceway installation work.

3.3 APPLICATION

A. When a circuit is removed or added to an existing panel, the Contractor shall verify that the remaining load is equally balanced on the existing bus. The Contractor shall ensure that the existing and new circuits are not loaded over 80% percent of capacity. If above conditions exist, then the Contractor shall immediately notify Owner and take corrective action to rectify the condition.

3.4 INSTALLATION

A. General: Install panelboards as indicated, in accordance with equipment manufacturer's written instructions and with recognized industry practices. Comply with applicable requirements of NEC, UL, and NEMA standards to ensure that products fulfill requirements. Comply with all applicable requirements of electrical installations in seismic zones.

B. Mounting: Panelboards shall be installed with the panelboard top 6 feet (72 inches) above finished floor or as otherwise indicated on the schedules or drawings. Panelboards shall be installed plumb and level. Mount and anchor in accordance with local seismic zone.

C. Flush Mount: Panelboards shall be rigidly secured and set so that the trim shall be flush with the wall surface. Flush type cabinets shall be fastened to structural member of the walls.

D. Surface Mount: Panelboards shall be rigidly secured by bolting to walls and structures. Provide marine grade plywood installed on wall with panel installed on wood backboard.

E. Spare Raceways in Flush Mounted Panels: Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future.

F. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.

G. Provide one empty ¾" conduit for every three spare branch breakers or bussed spaces available in each recessed panelboard. Stub the conduit to an accessible location 6" above the ceiling.

H. Wiring: Panelboard wiring shall have rounded corners and shall be tied off in bundles with cable ties.

I. Grounding: Provide equipment grounding connections for panelboards. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

J. Install filler plates in unused spaces.

3.5 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 26 0510; “Identification."

B. Create a directory to indicate installed circuit loads [after balancing panelboard loads]; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 26 0510; “Identification."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 26 0510; “Identification."

3.6 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.
3. Testing Agency: [Owner will engage] [Contractor shall engage] a qualified testing agency to perform tests and inspections.
4. Perform tests and inspections.
   a. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
5. Acceptance Testing Preparation:
   a. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   b. Test continuity of each circuit.
6. Tests and Inspections:
   a. Testing: After installing panelboards and after electrical circuitry has been energized, demonstrate product capability and compliance with manufacturer’s requirements.
      (1) Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5.1.1 for switches, air, low voltage; and Section 7.6.1.1 for circuit breakers, air, insulated-case/molded case. Certify compliance with test parameters.
   b. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
7. Panelboards will be considered defective if they do not pass tests and inspections.
8. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Panelboard locks and trims shall be adjusted and operated properly. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Lugs, bolts, clamps, and screws shall be tightened to manufacturer's recommendation and shall comply with UL 486A.

C. Set field-adjustable circuit-breaker trip ranges as specified in Division 26 Section 26 0573 "Overcurrent Protective Device Coordination Study." Send schedule or table of breaker trip settings to engineer for review at least two weeks before acceptance testing. Include in the schedule or table each breaker and the type and setting adjustments available. Include all time current curves for each type of breaker from manufacturer.

D. Balancing Loads: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes as follows:

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data-processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20% between phase loads within a panelboard is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.8 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air. Repair exposed surfaces to match original surface.

3.9 FLASH PROTECTION WARNING SIGNS

A. The electrical contractor shall provide all flash protection warning signs as required by the NEC Article 100.16. Warning signs shall conform to the requirements of NFPA 70E.

1. All electrical equipment such as switchboards, panelboards, control panels, meter socket enclosures, and motor control centers, that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electrical hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.
2. All warning signs MUST be installed before owner's personnel are trained on the use of the equipment.

END OF SECTION

SECTION 26 2726
WIRING DEVICES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Scope: The work specified in this section includes, but shall not be limited to, providing labor, materials, equipment, and services necessary for the electrical work shown on the drawings and as herein specified.

B. Section includes: receptacles, dimmer switches, toggle switches, and finish plates.

1.2 DEFINITIONS

A. GFI: Ground-fault circuit interrupter.

1.3 CODES AND STANDARDS

A. FS W-C-596 – Electrical Power Connector, Plug, Receptacle, and Cable Outlet

B. FS W-S-896 – Switch, Toggle

C. NEMA WD 1 – General Color Requirements for Wiring Devices

D. NEMA WD 6 – Wiring Devices – Dimensional Requirements

E. UL 1472 – Solid State Dimming Controls

F. UL 943 – Standard for Ground Fault Circuit Interrupters

G. UL 498 – Standard for Attachment Plugs and Receptacles

H. UL 20 – Standard for General Use Snap Switches

I. DSCC W-C-896F – General Specification for Electrical Power Connector

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

B. Comply with NFPA 70.

1.5 SUBMITTALS

A. Product Data: For each product specified

B. Shop Drawings: Legends for receptacles and switch plates

C. Samples: For devices and device plates for color selection and evaluation of technical features

D. Maintenance Data: For materials and products to include in maintenance manuals specified in Division 01

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products and materials properly packaged in factory fabricated containers and mounted on shipping skids.

B. Store products and materials in clean, dry, heated space. Protect from dirt, fumes, water, construction debris, and traffic. Where necessary to store outdoors, store above grade and enclose with watertight wrapping.

C. Handle products and materials carefully to prevent internal damage, breakage, denting, and scoring enclosure finish. Do not install damaged products or materials. Replace and return damaged products or materials to manufacturer.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of one year after the date of substantial completion. Certain equipment shall be warranted at the time of final acceptance, or for longer periods of time as specified in those sections of the project manual.

B. The contractor shall repair or replace, at no additional cost to Owner, any item that may become defective within the warranty period.

C. Any manufacturer's warranties concerning any item installed shall be to the benefit of Owner.

D. The contractor agrees not to void or impair or to allow any sub-contractor to void or impair any warranties regarding products or items installed as part of this project.

E. The repair of faulty workmanship shall be considered to be included in the contract.

1.9 MAINTENANCE

Not Applicable

1.10 PROJECT CONDITIONS

A. Field Measurements: Verify that field measurements are as indicated on the shop drawings and as shown on the drawings.

B. Project Location Environment. Furnish and install materials suitable for the altitude, weather, and seismic requirements of the project location.

1.11 COORDINATION

A. Sequence, coordinate, and integrate installing electrical materials and equipment for efficient flow of the Work. Coordinate installing large equipment requiring positioning before closing in the building.

B. Where electrical identification devices are applied to field-finished surfaces, coordinate installation of identification devices with completion of finished surface.

C. Receptacles for Owner-Furnished Equipment: Match plug configurations.

1. Cord and Plug Sets: Match equipment requirements.

PART 2 - PRODUCTS

2.1 SWITCHES AND RECEPTACLES

A. Provide the various switches and receptacles shown on the plans.

B. In general, the color of all devices shall be brown or ivory. UPS protected receptacles shall have an orange nylon face, emergency system receptacles shall have a red nylon face, and surge suppression shall have a blue nylon face.

C. All devices shall be Underwriters' Laboratories listed, Federal specification listed, heavy-duty type. Receptacles shall be grounding type.

D. Devices shall be manufactured by the following:

1. Duplex receptacles, 20 Ampere, 125 Volt

a. Standard duplex Ivory

(1) P&S/Legrand #5362
(2) Hubbell #HBL5352
(3) Leviton #5362

(4) Cooper #5362

b. Ground Fault Circuit Interrupter (GFI) Ivory = Normal; Red = Emergency

(1) P&S/Legrand #1591 (Hospital Grade # 2091-HG)
(2) Hubbell #GF5362 (Hospital Grade # HFG 8300)
(3) Leviton #6899-HG (Hospital Grade #6898-HG)
(4) Cooper #GF20 (Hospital Grade #HGF20)

c. Surge Protection Blue

(1) P&S/Legrand #5362BLSP
(2) Hubbell #HBL-5362SAS
(3) Leviton #5380-B
(4) Cooper #1210BL

2. Toggle switches 20A, 120-277V Ivory = Normal; Red = Emergency

a. Single Pole

(1) Hubbell 1221
(2) P&S/Legrand #20AC1
(3) Leviton #1221
(4) Cooper #2221

b. Double Pole

(1) Hubbell 1222
(2) P&S/Legrand #20AC2
(3) Leviton #1222
(4) Cooper #2222

c. Three Way:

(1) Hubbell 1223
(2) P&S/Legrand #20AC3
(3) Leviton #1223
(4) Cooper #2223

d. Four Way: HBL1224

(1) Hubbell 1224
(2) P&S/Legrand #20AC4
(3) Leviton #1224
(4) Cooper #2224V

2.2 DIMMER SWITCHES:

A. Modular, full-wave, solid-state units with integral, quiet on/off switches and audible and electromagnetic noise filters.

1. Control: Continuously adjustable slide, toggle. Single-pole or three-way switch to suit connections.
2. Incandescent Lamp Dimmers: Modular, 120 V, 60 Hz with continuously adjustable slide; single pole with soft tap or other quiet switch; electromagnetic filter to eliminate noise, RF, and TV interference.
3. Fluorescent Lamp Dimmers: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming to a maximum of 1 percent of full brightness.

2.3 DEVICE PLATES

A. Device plates shall be of same manufacture as device, and shall be flat surface type.

B. Device plates in mechanical and electrical equipment rooms and unfinished areas shall be cadmium-plated steel.

C. Device plates in finished areas shall be Nylon, brown or ivory, to match device.

D. All multi-gang plates shall be one piece.

E. Plates for outlet boxes shall contain a label for identifying circuit number and panel source. See specification Division 26 Section 26 0505, "Electrical Identification," for additional information.

2.4 POWER OUTLETS

A. Power outlets for equipment requiring outlets other than standard duplex receptacle configurations shall match the "NEMA" rating of the equipment to be served or as specified on the electrical drawings.

B. Manufacturers of power outlets shall match those specified under duplex receptacles.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and assemblies plumb and secure.

B. Install wall plates when painting is complete.

C. Install wall dimmers to achieve indicated rating after derating for ganging as instructed by manufacturer.

D. Do not share neutral conductor on load side of dimmers.

E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

F. Protect devices and assemblies during painting.

G. Adjust locations at which floor service outlets and telephone/power service poles are installed to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Electrical Identification."

B. Comply with Division 26 Section 26 0505, "Basic Electrical Materials and Methods."

1. Switches: Where three or more switches are ganged, and elsewhere as indicated, identify each switch with approved legend engraved on wall plate.
2. Receptacles: Identify panelboard and circuit number from which served. Use machine-printed, pressure-sensitive, abrasion-resistant label tape on face of plate and durable wire markers or tags within outlet boxes.

3.3 CONNECTIONS

A. Connect wiring device grounding terminal to outlet box with bonding jumper.

B. Connect wiring device grounding terminal to branch-circuit equipment grounding conductor.

C. Isolated-Ground Receptacles: Connect to isolated-ground conductor routed to designated isolated equipment ground terminal of electrical system.

D. 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.

3.4 FIELD QUALITY CONTROL

A. Test wiring devices for proper polarity and ground continuity. Operate each device at least six times.

B. Check TVSS receptacle indicating lights for normal indication.

C. Test GFCI operation with both local and remote fault simulations according to manufacturer's written instructions.

D. Replace damaged or defective components.

3.5 CLEANING

A. Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

END OF SECTION

SECTION 26 2813
FUSES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes the following:

1. Cartridge fuses, rated 600V and less, for use in switches, panelboards, switchboards, controllers, and motor control centers; and spare fuse cabinets.
2. Cable limiters for use on service entrance applications where multiple cables per phase are installed.

1.2 DEFINITIONS

A. Fuse: A safety device that protects an electric circuit from excessive current, consisting of or containing a metal element that melts when current exceeds a specific amperage, thereby opening the circuit.

1.3 CODES AND STANDARDS

A. UL 198C: High-Interrupting Capacity Fuses; Current Limiting Types

B. UL 198E: Class R Fuses

C. FS W-F-870: Fuseholders (For Plug and Enclosed Cartridge Fuses)

D. NEMA FU 1: Low Voltage Cartridge Fuses

E. NFPA 70: National Electrical Code

1.4 QUALITY ASSURANCE

A. Source Limitations: Provide fuses and cable limiters from a single manufacturer.

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. Comply with NEMA FU 1
2. Comply with NFPA 70

1.5 SUBMITTALS

A. Product Data: Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings for each fuse type indicated.

1.6 DELIVERY AND STORAGE

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Where recommended by the equipment supplier, deliver equipment in fully enclosed vans after specified environmental conditions have been permanently established in spaces where equipment is to be placed. The products accepted on the site shall be wrapped in factory packing and shall be inspected for damage prior to acceptance.

C. Store equipment in clean, dry with non-condensing environments that are controlled within manufacturer's ambient tolerances for non-operating equipment. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

D. Handle equipment carefully to prevent damage, breaking, and scoring. The contractor shall not install damaged units or components: replace with new.

1.7 SPARE PARTS

A. Furnish extra materials described below that match products installed and that are packaged in original cartons or containers and identified with labels describing contents.

1. Fuses: Quantity equal to 10% of each fuse type and size, but not fewer than three of each type and size
2. Provide two (2) fuse pullers to Owner

1.8 WARRANTY

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of one year after the date of substantial completion. Certain equipment shall be warranted at the time of final acceptance, or for longer periods of time as specified in those sections of the project manual.

B. The contractor shall repair or replace, at no additional cost to Owner, any item that may become defective within the warranty period.

1.9 MAINTENANCE

A. Replace failed fuses during period of construction. Replacement of blown fuses after substantial completion will be the responsibility of this contractor, thru the warranty period, using the Owner's spare fuses.

1.10 COORDINATION

A. Coordinate fuse ratings with HVAC, refrigeration equipment, and motor nameplate ratings for maximum fuse size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fuses, 30 through 600 amperes:
   a. Bussman #LPS-RK-SP
   b. Ferraz Shawmut #AMP TRAP 2000 RK1
   c. Little Fuse Power Gard #LLSRK-1D Series
2. Fuses, 601 through 6,000 amperes:
   a. Bussman #KRP-C-SP
   b. Ferraz Shawmut #AMP TRAP 2000 A4BQ
   c. Little Fuse Power Gard
3. Cable limiters, size 4/0 through 750 mcm cable:
   a. Bussman #KC Series
   b. Ferraz Shawmut #CP Series

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install cable limiter devices on both ends (at load side of service transformer and at line side of main switch) of incoming electrical service cables where multiple-cables-per-phase systems are installed.

3.3 IDENTIFICATION

A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION

SECTION 26 2816
SAFETY AND DISCONNECT SWITCHES/ENCLOSED CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes the following:

1. Equipment disconnects
2. Motor-circuit disconnects
3. Molded case circuit breaker in an individual enclosure

1.2 DEFINITIONS

Not Applicable

1.3 CODES AND STANDARDS

A. NEMA KS-1 – Enclosed Switches

B. NFPA 70 (NEC)

1.4 QUALITY ASSURANCE

A. Comply with codes for components and installation.

B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL) as defined in OSHA Regulation 1910.7.

C. Single-Source Responsibility: All enclosed switches and circuit breakers shall be the product of a single manufacturer.

1.5 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product data for switches and accessories specified in this Section.

C. Descriptive data and time-current curves for protective devices and let-through current curves for those devices with current-limiting characteristics. Include coordination charts and tables, and related data.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Where recommended by the equipment supplier, deliver equipment in fully enclosed vans after specified environmental conditions have been permanently established in spaces where equipment is to be placed. The products accepted on the site shall be wrapped in factory packing and shall be inspected for damage prior to acceptance.

C. Store equipment in clean, dry with non-condensing environments that are controlled within manufacturer's ambient tolerances for non-operating equipment. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

D. Handle equipment carefully to prevent damage, breaking, and scoring. The contractor shall not install damaged units or components; replace with new.

E. Equipment furnished by others. The contractor shall be responsible for receiving, uncrating, inspecting, storing, and installing of Division 26 equipment listed as furnished by others.

1.7 SPARE PARTS

Not Applicable

1.8 WARRANTY

A. Motor and circuit disconnects and breakers shall be warranted for a minimum period of one year after project completion, or longer if manufacturer's warranty allows.

1.9 MAINTENANCE

Not Applicable

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide enclosed switches and circuit breakers by one of the following:

1. Safety Switches:
   a. General Electric
   b. Square D
   c. Cutler-Hammer
2. Circuit Breakers:
   a. General Electric
   b. Square D
   c. Cutler-Hammer

2.2 GENERAL

A. Disconnect and Safety Disconnect Switches:

1. General: Provide heavy duty surface-mounted safety switches for motors and equipment unless otherwise indicated, of types, sizes, and electrical characteristics as indicated on the electrical drawings and equipment schedules.
2. Switch Interiors: Switches shall have switch blades which shall be fully visible in the off position when the enclosure door is open. Current carrying parts shall be plated copper and switch contacts shall be silver-tungsten. Lugs shall be removable and shall be UL-listed for 75 degrees C, copper wire.
3. Switch Operator: Switches shall be quick-made, quick-break type. The operating handle shall be an integral part of the enclosure base and shall be padlockable in the off position. The handle position shall indicate whether the switch is in the on or off position.
4. Interlock Contacts: Provide two Form C auxiliary, 10 ampere, 300V rated contacts. The contacts shall provide for two normally open and two normally closed contacts for switch open or closed position.

B. Circuit Breakers:

1. All circuit breakers shall comply with NEMA ABI and FSW-C-375.
2. Circuit breakers shall be securely bolted to the enclosure and be flush with the box assembly.
3. Circuit breakers shall have over center toggle mechanism with quick-make, quick break action, common trip for all pole positions, and a handle position

indicator with breaker rating imprinted in a location easily verified without removing the box cover.

4. Circuit breakers for heating, air conditioning, refrigeration and all motor loads shall be HCAR rated.
5. Circuit breaker size(s) shall be listed on the electrical plan drawings or equipment schedule.

2.3 ENCLOSURES

A. NEMA 1: Provide NEMA 1 general purpose enclosures for indoor installation unless otherwise indicated on the drawings. Enclosure covers shall be attached with pin type hinges. Enclosures shall have a gray baked enamel finish, electrodeposited on clean, phosphatized steel.

B. NEMA 3R: Provide NEMA 3R general purpose enclosures for outdoor installation unless otherwise indicated on the drawings. Enclosure cover shall be attached with pin type hinges and shall be securable in the open position. NEMA 3R enclosures shall be manufactured from galvanized steel. Enclosures shall have a gray baked enamel finish, electrodeposited on cleaned, phosphatized steel. Provide rainproof bolt-on hubs.

2.4 RATINGS

A. General: Provide heavy duty safety switches and circuit breakers with ampere rating as shown on the drawings.

B. Horsepower-Rated: Safety switches shall be horsepower-rated for 250, 480, and 600V, AC and DC, and shall be rated for the motor driven loads supplied by the switch.

C. Short Circuit Rating: Safety switches with Class RK1 or Class L fuses shall have a UL short circuit rating of 100,000 amperes RMS symmetrical minimum.

D. Circuit breakers shall have a UL short circuit rating of 65,000 amperes RMS symmetrical minimum.

2.5 FUSIBLE SWITCHES

A. Provide fusible disconnect switches as shown on the drawings.

B. Fusible disconnects rated 30 through 600 amperes shall have Class RK1 fuse clips. Refer to Division 26, Section 26 2813, "Fuses," for acceptable fuse manufacturers.

C. Disconnects rated 800 through 1200 amperes shall have Class L fuse clips. Refer to Division 26, Section 26 2813, "Fuses," for acceptable fuse manufacturers.

2.6 IDENTIFICATION

A. Each disconnect switch, circuit breaker, and shunt trip control panel shall have an engraved, laminated bakelite nameplate attached to the outside of the enclosure. The nameplate shall include the switch or breaker designation and the equipment it serves. Attach the nameplate by screws or rivets. See Division 26, Section 26 0505, "Basic Electrical Materials and Methods."

2.7 ELECTRICAL INTERLOCKS

A. Provide electrical interlock switches on disconnects as specified herein. The interlock switches shall open prior to the opening of the power switch and close only after the power switch has been enclosed. Provide two sets normally open (NO) and normally closed (NC) switches for each disconnect.

B. Provide the necessary control wiring to the interlock switch to disconnect the control circuit from the motor controller.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install enclosed switches, breakers, and control panels in locations as indicated, according to manufacturer's written instructions. Comply with all applicable requirements of electrical installations and for the seismic zone of this project.

B. Install enclosures level and plumb.

C. Install wiring between enclosed switches and control/indication devices as required.

D. Connect switches, breakers, panels, enclosures, and components to wiring system and to equipment ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

E. Mounting: Mount enclosures on building structures adjacent to equipment unless otherwise noted. Enclosures shall not be mounted on equipment served, unless it is a part of a preassembled control panel. If building structure is not adjacent to the equipment, provide a separate unistrut rack with supports, clear of equipment, for mounting of switch and breaker enclosure. Conduits shall not be used for the support means.

F. Location:

1. Disconnects and breaker enclosures shall be readily accessible and shall not interfere with removal of equipment parts or with standard maintenance. Disconnects and breaker enclosures shall be installed with their top at 5½ feet above the floor unless otherwise noted on the drawings.
2. Elevator shunt trip control panel shall be mounted at the location(s) specified by the elevator manufacturer's requirements. If no requirements are available, mount panel as close as possible to the latch side of the door, inside the elevator machine room.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will employ and pay an independent testing agency to perform specified field quality-control testing.

3.3 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

3.4 FLASH PROTECTION WARNING SIGNS

A. The electrical contractor shall provide all flash protection warning signs as required by the NEC Article 100.16. Warning signs shall conform to the requirements of NFPA 70E.

1. All electrical equipment such as switchboards, panelboards, control panels, meter socket enclosures, and motor control centers, that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electrical hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.\
2. All warning signs MUST be installed before owner's personnel are trained on the use of the equipment.

3.5 DEMONSTRATION

A. Train Owner's maintenance personnel on procedures and schedules for start-up and shutdown, troubleshooting, servicing, and preventive maintenance.

B. Review data in Division 01 Section 01 7823, "Operating and Maintenance Manual." Refer to Division 01 Section 01 7700, "Project Closeout."

C. Schedule training with Owner through the Architect with at least 7 days' advance notice.

END OF SECTION

SECTION 26 2913
MOTOR STARTERS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Scope: The work specified in this section includes, but shall not be limited to, providing labor, material, equipment and services necessary for motor starters as shown on the drawings and as herein specified. This section shall cover motor starters provided by Division 26 or equipment manufacturer's control panels.

B. Section Includes: The work specified in this section includes, but shall not be limited to, providing the following:

1. Full Voltage Manual starters
2. Full voltage non-reversing starters
3. Combination starters

1.2 DEFINITIONS

A. Motor Starter: An electrically operated switch that uses magnetic induction to provide the startup current for a motor

B. CPT: Control power transformer

C. MCCB: Molded-case circuit breaker

D. MCP: Motor circuit protector

E. N.C.: Normally closed

F. N.O.: Normally open

G. OCPD: Overcurrent protective device

H. SCR: Silicon-controlled rectifier

1.3 CODES AND STANDARDS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

B. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 74 "Test Code for Industrial Control (600 Volts or Less)"
2. ANSI/IEEE 518 "Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources" (copyrighted by IEEE, ANSI approved)

D. National Electrical Manufacturers Association (NEMA):

1. NEMA 250 "Enclosures for Electrical Equipment (1,000 Volts Maximum)" (Copyrighted by NEMA, ANSI approved)
2. NEMA ICS 1 "General Standards for Industrial Controls and Systems" (Copyrighted by NEMA, ANSI approved)
3. NEMA ICS 2 "Industrial Control Devices, Controllers and Assemblies" (Copyrighted by NEMA, ANSI approved)
4. NEMA ICS 3 "Industrial Systems" (Copyrighted by NEMA, ANSI approved)

5. NEMA ICS 4 "Terminal Blocks for Industrial Use" (Copyrighted by NEMA, ANSI approved)
6. NEMA ICS 6 "Enclosures for Industrial Control and Systems" (Copyrighted by NEMA, ANSI approved)

E. National Fire Protection Association (NFPA):

1. NFPA 70 "National Electrical Code" (Copyrighted by NFPA, ANSI approved) - hereinafter referred to as NEC

F. Underwriters Laboratories, Inc. (UL):

1. UL 294 "UL Standard for Safety - Access Control System Units" (Copyrighted by UL, ANSI approved)
2. UL 486A "UL Standard for Safety - Wire Connectors and Soldering Lugs for Use with Copper Conductors"
3. UL 508 "UL Standard for Safety - Industrial Control Equipment" (Copyrighted by UL, ANSI approved)
4. UL 698 "UL Standard for Safety - Industrial Control Equipment for Use in Hazardous (Classified) Locations" (Copyrighted by UL, ANSI approved)

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms shall be engaged in manufacture of motor starters of types and sizes required, and whose products have been in satisfactory use in similar service for not less than five years.

B. Contractor's Qualifications: Firms shall have at least five years of successful installation experience with projects utilizing motor starters similar to that required for this Project.

C. Compliance: Comply with applicable requirements of IEEE, NEMA and UL standards referenced in Article 1.3 - REFERENCES, and NEC.

D. Testing Agency Qualifications: Member Company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

E. 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.

F. Comply with NFPA 70.

1.5 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes. Include the following:

1. Horsepower
2. NEMA size
3. Enclosure type
4. Voltage
5. Phase
6. Fuse or circuit breaker type
7. Overload type and sizes
8. Control transformer

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:
    a. Each installed unit's type and details
    b. Factory-installed devices
    c. Nameplate legends
    d. Short-circuit current rating of integrated unit
    e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction
    f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers
2. Wiring Diagrams: For power, signal, and control wiring.
3. Qualification Data: For qualified testing agency.
4. Seismic Qualification Certificates: For enclosed controllers, accessories, and components, from manufacturer.
    a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
    b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
    c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
5. Field Quality-Control Reports
6. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. Include the following:
    a. Routine maintenance requirements for enclosed controllers and installed components.
    b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
7. Set of shop drawings
8. Wiring diagrams of electrical components
9. Electrical characteristics and ratings components
10. Recommended spare parts list
11. Complete list of parts

1.6 DELIVERY, STORAGE AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers.

1.7 SPARE PARTS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Power Fuses: Equal to ten percent (10%) of quantity installed for each size and type, but no fewer than three (3) of each size and type.
2. Control Power Fuses: Equal to ten percent (10%) of quantity installed for each size and type, but no fewer than two (2) of each size and type.
3. Indicating Lights: Two (2) of each type and color installed.

4. Auxiliary Contacts: Furnish one (1) spare for each size and type of magnetic controller installed.

B. Key: Furnish four (4) each to Owner.

1.8 WARRANTY

A. The contractor shall warrant all materials, workmanship, and equipment against defects for a period of one year after the date of substantial completion. Certain equipment shall be warranted at the time of final acceptance, or for longer periods of time as specified in those sections of the project manual.

B. The contractor shall repair or replace, at no additional cost to Owner, any item that may become defective within the warranty period.

C. Any manufacturer's warranties concerning any item installed shall be to the Benefit of Owner.

D. The contractor agrees not to void or impair or to allow any sub-contractor to void or impair any warranties regarding products or items installed as part of this project.

E. The repair of faulty workmanship shall be considered to be included in the contract.

1.9 MAINTENANCE

Not Applicable

PART 2 - PRODUCTS

2.1 PRODUCTS

A. Product: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution
3. Rockwell Automation, Inc.; Allen-Bradley brand
4. Siemens Energy & Automation, Inc.
5. Square D; a brand of Schneider Electric

2.2 GENERAL

A. Provide starters as shown on the drawings. Starters shall be the size, voltage and phase and contain overload heaters which are compatible with the motor provided and as specified herein.

B. All motor starters shall be NEMA rated. IEC devices are not acceptable.

C. Unless noted otherwise, starters shall be selected based on motors type as follows:

1. Single Phase Fractional HP Motors: Manual motor starter as specified below. If automatic control is required for the motor then a full voltage magnetic motor starter shall be used.
2. Three Phase Fractional HP Motors: Magnetic full voltage contactor with bimetallic overload relay as specified below.
3. Three Phase Integral HP Motors (1 hp and above): Magnetic full voltage contactor with solid state overload relay as specified below.

2.3 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: NEMA Type 1

2. Outdoor Locations: Type 3R
3. Wash-Down Areas: Type 4X, stainless steel
4. Other Wet or Damp Indoor Locations: Type 4
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12

2.4 FRACTIONAL HORSEPOWER MANUAL CONTROLLERS

A. "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped

B. Configuration: Non-reversing

C. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; **bimetallic type**.

D. Surface mounting

E. Red pilot light

F. Additional Nameplates: e.g. HIGH and LOW for two-speed controllers

2.5 GENERAL FULL VOLTAGE NON-REVERSING MAGNETIC STARTER REQUIREMENTS

A. Motor starters shall be solid state controlled, full voltage and sized in accordance with NEMA ICS 2. The starter unit shall consist of a base, molded from a high strength, arc track, and wear resistant material, mounted on a heavy gage steel mounting plate. The base shall support the coil, contacts and terminals. The starter shall be of the gravity dropout type.

B. Starter Size: Motor starters shall be rated in compliance with NEMA sizes and horsepower ratings. No starter smaller than NEMA Size 1, rated 10 horsepower at 480 volts, shall be used.

C. Contacts: Starters shall have double-break, weld-resistant cadmium silver oxide contacts. Contacts shall be capable of being inspected and removed without removing the line or load wiring.

D. Coils: Coils shall be molded construction. The coil position shall be indicated by an on-off position indicator. Starter coils shall be rated 120 VAC, 60 hertz.

E. Wiring: The starter shall have feed-through wiring.

F. Auxiliary Contacts: Each starter shall be provided with one normally open and one normally closed auxiliary contact.

G. Control Circuits: Provide a 120 VAC control power transformer for each starter. Transformer shall have a minimum of 100 VA extra capacity beyond that needed to operate pilot lights, indicating, and other control devices furnished as part of the starter.

1. Provide fuses on both sides of the control transformer primary and on the ungrounded side of the secondary. One side of the transformer secondary shall be grounded. Control devices and operating coil shall be connected to the ground side of the control circuit. Contacts of relays, limit switches and other control devices shall be connected in series on the line side of the control circuit.

H. Overload relays shall be selected based on motor size. Based on Section 2.2, C choose one of the following overload types:

1. Bimetallic Overload: Starter shall be furnished with a bimetallic type overload device. Overload to have adjustability, selectable manual or automatic reset,

single phase sensitivity, and isolated alarm contact, and trip indicator. Overload relays shall be Class10 relays and have a mechanical test function complete with heaters and external manual reset button.

2. Solid State Overload: Starters shall be furnished with solid state thermal overload relays. Trip current rating will be established by selection of overload relay and shall be adjustable. The overload shall be self powered, provide phase loss and phase unbalance protection, have a permanent tamper guard, and be ambient insensitive. It will also be available in Trip Class 10 and have a mechanical test function complete with heaters and external manual reset button. The overload relay shall be provided with one normally open auxiliary contact for status monitoring.

I. Accessories: Starters shall be furnished with heavy duty indicating lights (Red - Running & Green - Available), adjustable time delay relays, and Hand-Off-Automatic (H-O-A) selector switch.

J. N.C. isolated overload alarm contact.

K. External overload reset push button.

2.6 COMBINATION STARTERS

A. General: Combination starters shall consist of a starter unit (specified herein) and disconnect and circuit breakers as specified in Division 26 Section "Safety and Disconnect Switches/Enclosed Circuit Breakers," housed in a common enclosure.

B. Enclosure: Provide the NEMA-rated enclosure as shown in the drawings. The disconnect handle shall indicate whether the switch is in the on or off position. The disconnect shall have the capability of being locked in the open position. Provide defeater bypass for opening the door when the disconnect is in the open position.

C. Ratings: The combination starter shall have the interrupting rating as indicated on the drawings when furnished with a motor circuit protector.

D. Nonfusible Disconnecting Means

1. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position (switch in open position)
3. Auxiliary Contacts: N.O./N.C., arranged to activate before switch blades open

E. MCP Disconnecting Means

1. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position (switch in open position)
3. N.C. alarm contact that operates only when MCP has tripped
4. Current-limiting module to increase controller short-circuit current (withstand) rating to 100 kA

F. MCCB Disconnecting Means

1. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits

2. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger
3. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position (switch in open position)
4. N.C. alarm contact that operates only when MCCB has tripped

2.7 CONTROL DEVICES

A. Control devices provided with starter shall be heavy duty NEMA 13 type. Indicating lights shall be 120 VAC long life lamps, push-to-test transformer type.

B. Control relays shall have a minimum rating of 300 VAC, with a coil voltage of 120 V. Contacts shall be rated for 10 amperes. The relays shall be hermetically sealed with a polycarbonate case.

2.8 IDENTIFICATION

A. Motor starters shall have identification as specified in Division 26 Section "Basic Electrical Materials and Methods."

B. When starters are interlocked with other starters or controls, provide a label on the inside of the starter cover or enclosure indicating the control interlocking circuit.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 COORDINATION

A. Coordinate with other work including, but not limited to, motor and electrical wiring work as necessary to interface the installation of motor starters with other work.

3.3 APPLICATION

A. Thermal Overloads: Motor nameplates shall be checked for full load current rating and allowable temperature rise to determine and set correct overload thermal units for each motor.

3.4 INSTALLATION

A. Wall-Mounted Controllers: Starters shall be rigidly mounted and secured. Individual starters and combination starters shall be mounted with their tops at 5½ feet (1,676mm) above finished floor unless otherwise noted on the drawings. Bolt units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Division 26 Section "Basic Electrical Materials and Methods."

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install motor starters as indicated, in accordance with equipment manufacturer's written instructions. Comply with applicable requirements of NEC, UL and NEMA standards to ensure that products fulfill requirements.

D. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors.

Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A.

E. Location: Locate controllers within sight of motors controlled, unless otherwise indicated.

3.5 FIELD QUALITY CONTROL

A. Upon completion of installation of motor starters and after circuitry has been energized with normal power source, test motor starters to demonstrate capability and compliance with requirements. Replace malfunctioning equipment with new units and proceed with retesting.

B. Testing Agency: Contractor shall engage a qualified testing agency to perform tests and inspections.

C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

D. Acceptance Testing Preparation

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Construction Manager before starting the motor(s).
3. Test each motor for proper phase rotation.
4. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification, Sections 7.5.1.1 (switches), 7.6.1.1 (circuit breakers). Certify compliance with test parameters.
5. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

F. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

G. Enclosed controllers will be considered defective if they do not pass tests and inspections.

H. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum

settings do not allow starting of a motor, notify Construction Manager before increasing settings.

C. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.

D. Set field-adjustable circuit-breaker trip ranges, as specified in Division 26 Section "Overcurrent Protective Device Coordination Study."

3.7 FLASH PROTECTION WARNING SIGNS

A. The electrical contractor shall provide all flash protection warning signs as required by the NEC Article 100.16. Warning signs shall conform to the requirements of NFPA 70E.

1. All electrical equipment such as switchboards, panelboards, control panels, meter socket enclosures, and motor control centers, that are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electrical hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.
2. All warning signs MUST be installed before owner's personnel are trained on the use of the equipment.

3.8 MANUFACTURER'S FIELD SERVICE

A. Engage a factory-authorized service representative to inspect field-assembled components and equipment installation including pretesting and adjustment of starters.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers and to use and reprogram microprocessor-based, reduced-voltage solid-state controllers.

END OF SECTION

SECTION 26 5600
LIGHTING FIXTURES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes interior lighting fixtures, exterior site fixtures, lighting fixtures mounted on exterior building surfaces, lamps, ballasts, emergency lighting units, poles/supports, lighting fixtures, structures and accessories.

1.2 DEFINITIONS

A. Lighting Unit: A lighting fixture or an assembly of lighting fixtures complete with a common support including pole, post or other structure, and mounting and support accessories.

B. Lighting Fixture: A complete lighting device consisting of lamp(s) and ballast(s), when applicable, together with parts designed to distribute light, to position and protect lamps, and to connect lamps to power supply.

C. Fixture: A complete lighting unit, exit sign, or emergency lighting unit. Fixtures include lamps and parts required to distribute light, position and protect lamps, and connect lamps to power supply. Internal battery-powered exit signs and emergency lighting units also include a battery and the means for controlling and recharging the battery. Emergency lighting units include ones with and without integral lamp heads.

1.3 CODES AND STANDARDS

A. ANSI C82.1: American National Standard for Fluorescent Lamp Ballast – Line Frequency Fluorescent Lamp Ballast.

B. ANSI C82.11: High Frequency Fluorescent Lamp Ballasts.

C. ANSI C82.4: High-Intensity Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type).

D. ANSI C82.6: Ballasts for HID Lamps – Method Measurement.

E. NEMA LE 2: H-I-D Lighting System Noise Criterion (LS-NC).

F. NFPA 70: National Electricity Code (NEC).

G. UL 935: Standard for Fluorescent Lamp Ballasts.

1.4 QUALITY ASSURANCE

A. Electrical Component Standard: Provide components that comply with National Electrical Code - NFPA-70 and that are listed and labeled by Underwriters Laboratory where available.

B. Listing and Labeling: Provide fixtures, emergency lighting units, and accessory components specified in this Section that are listed and labeled for their indicated use and installation conditions on Project.

C. Special Listing and Labeling: Provide fixtures for use in damp or wet locations, underwater, and recessed incombustible construction that are specifically listed and labeled for such use. Provide fixtures for use in hazardous (classified) locations that are listed and labeled for the specific hazard.

1. The Terms “Listed” and “Labeled”: As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

1.5 SUBMITTALS

A. Product Data: For each type of lighting fixture indicated, submit each item in this Article according to the conditions of the contract and Division 01 specification section. Arrange in order of fixture designation. Include data on features, accessories, and the following:

1. Dimensions of fixtures.
2. Certified results of independent laboratory tests for fixtures and lamps for electrical ratings and photometric data.
3. Certified results of laboratory tests for fixtures and lamps for photometric performance.
4. Emergency lighting unit battery and charger.
5. Fluorescent and high-intensity-discharge ballasts.
6. Air and Thermal Performance Data: For air-handling fixtures. Furnish data required in "Submittals" Article in Division 15 Section "Diffusers, Registers, and Grilles."
7. Sound Performance Data: For air-handling fixtures. Indicate sound power level and sound transmission class in test reports certified according to ADC.
8. Types of lamps.

B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, method of field assembly, components, features, and accessories.

1. Wiring Diagrams: Detail wiring for fixtures and differentiate between manufacturer-installed and field-installed wiring.
2. Anchor Bolts: Anchor bolt templates keyed to specific poles and certified by the manufacturer.

C. Coordination Drawings: Reflected ceiling plans and sections drawn to scale and coordinating fixture installation with ceiling grid, ceiling-mounted items, and other components in the vicinity. Include work of all trades that is to be installed near lighting equipment.

D. Product Certificates: Signed by manufacturers of lighting fixtures certifying that products comply with requirements.

E. Dimming Ballast Compatibility Certificates: Signed by manufacturer of ballast certifying that ballasts are compatible with dimming systems and equipment with which they are used.

F. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 DELIVERY, STORAGE AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant treated skids at least 12" (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until just before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

D. Deliver, store, and handle lighting fixtures to avoid damage to housings, components, and finishes.

1.7 SPARE PARTS

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. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Battery and Charger For emergency lighting units: 1 for every 10 of each type and rating installed. Furnish at least one of each type.
4. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty for Batteries: Written warranty, executed by manufacturer agreeing to replace rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Special Warranty Period for Batteries: Manufacturer's standard, but not less than 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for last nine years.

C. Special Warranties for Fluorescent Ballasts: Written warranty, executed by manufacturer agreeing to replace fluorescent ballasts that fail in materials or workmanship within specified warranty period.

1. Special Warranty Period for Electronic Ballasts: Five years from date of manufacture, but not less than four years from date of Substantial Completion.
2. Special Warranty Period for Electromagnetic Ballasts: Manufacturer's standard warranty, but not less than two years from date of manufacture.

D. Special Warranty for Exterior Lighting Fixtures: Written warranty, signed by manufacturer and installer agreeing to replace external parts of lighting fixtures and poles exhibiting a failure of finish as specified below. This warranty is in addition to, and not a limitation of, other rights and remedies Owner may have under requirements of the Contract Documents.

1. Protection of Metal from Corrosion: Warranty against perforation or erosion of finish due to weathering.
2. Color Retention: Warranty against fading, staining and chalking due to effects of weather and solar radiation.
3. Warranty Period: Manufacturer's standard, but not less than three years from date of Substantial Completion.

1.9 MAINTENANCE

A. Lamp Seasoning

1. Operate all fluorescent and HID lamps for 100 hours prior to requesting final observation. Season fluorescent lamps at 3 hour on, 20 minute off cycle. Operate

dimming fluorescent lamps at 100% output during seasoning. Season HID lamps at an 11 hour on, 1 hour off cycle.

B. Relamping

1. Replace failed lamps at completion of work. Replacement of incandescent and other lamps burnouts after the warranty period starts shall be the responsibility of the Owner.

C. Adjusting and Cleaning

1. Align luminaries and clean lenses and diffusers at completion of work. Clean paint splatters, dirt, and debris from installed luminaries.
2. Touch up lighting fixture and pole finish at completion of work.

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, the products indicated on the Electrical Drawings.

B. Products: Subject to compliance with requirements, provide one of the products indicated for each designation on the Lighting Fixture Schedule.

2.2 FIXTURES AND FIXTURE COMPONENTS, GENERAL

A. Metal Parts: Free from burrs, sharp corners, and edges.

B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position.

D. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent
2. Specular Surfaces: 83 percent
3. Diffusing Specular Surfaces: 75 percent
4. Laminated Silver Metallized Film: 90 percent

E. Lenses, Diffusers, Covers, and Globes: 100 percent virgin acrylic plastic or annealed crystal glass, unless otherwise indicated.

1. Plastic: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.
2. Lens Thickness: 0.125" (3 mm) minimum, unless greater thickness is indicated.

F. Electromagnetic Interference Filters: Integral to fixture assembly. Provide one filter for each ballast. Suppress conducted electromagnetic interference filters as required by MIL-STD-461.

G. Air-Handling Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser boot assembly specified in Division 15 Section "Diffusers, Registers, and Grilles."

1. Sound-Pressure Levels: Certified according to ADC.
2. Air-Movement Performance Requirements: Certified according to ADC.

3. Supply Units: Equip with slots in one or both side trims and join with air-diffuser boot assemblies.
4. Heat Removal Units: An air path through lamp cavity.
5. Dampers: Operable from outside fixture for control of return-air volume.
6. Static Fixtures: Supply slots are blanked off, and fixture appearance matches active units.

2.3 OUTDOOR LIGHTING FIXTURES

A. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for lighting fixtures.

B. Metal Parts: Free from burrs, sharp corners, and edges.

C. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

D. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed lighting fixtures.

E. Doors, Frames, and Other Internal Access: Smooth operating, free from light leakage under operating conditions, and arranged to permit relamping without use of tools. Arrange doors, frames, lenses, diffusers, and other pieces to prevent accidental falling during relamping and when secured in operating position. Provide for door removal for cleaning or replacing lens. Arrange to disconnect ballast when door opens.

F. Exposed Hardware Material: Stainless steel.

G. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and ultraviolet radiation.

H. Reflecting Surfaces: Minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

I. Lenses and Refractors: Materials as indicated. Use heat- and aging-resistant, resilient gaskets to seal and cushion lens and refractor in lighting fixture doors.

J. Photoelectric Relays: As follows:

1. Contact Relays: Single throw, arranged to fail in the on position and factory set to turn light unit on at 1.5 to 3 fc (16 to 32 lx) and off at 4.5 to 10 fc (48 to 108 lx) with 15-second minimum time delay.
2. Relay Mounting: In lighting fixture housing.

K. High-Intensity-Discharge Ballasts: Comply with ANSI C82.4. Constant wattage autotransformer or regulating high-power-factor type, unless otherwise indicated.

1. Ballast Fuses: One in each ungrounded supply conductor. Voltage and current ratings as recommended by ballast manufacturer.
2. Single-Lamp Ballasts: Minimum starting temperature of minus 40 deg C.
3. Open-circuit operation will not reduce average life.
4. High-Pressure Sodium Ballasts: Equip with a solid-state igniter/starter having an average life in pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 deg C.
5. Noise: Uniformly quiet operation, with a noise rating of B or better.
6. Surge Protector: Hard-wired unit external to ballast case, rated for supply circuit line voltage, and encapsulated for circuit and moisture protection. Three-stage surge protection with three suppression modes provides 330 V peak clamping,

line to neutral, line to ground, and neutral to ground. Pulse life is 500 3KA-8x20 microsecond impulses, and response time is less than 1 nanosecond. Internal fuse takes device off line on failure and lights a light-emitting diode failure indicator.

L. Instant High-Pressure Sodium Restrike Starters: Solid-state, potted module, mounted inside lighting fixture.

1. Compatible with mogul-base high-pressure sodium lamps, ballasts, and sockets up to 150 watts.
2. Restrike Range: 105- to 130 VAC.

M. Auxiliary, Instant-on, Quartz System: Automatically switches quartz lamp on when lighting fixture is initially energized and when momentary power outages occur. Automatically turns quartz lamp off when high-intensity-discharge lamp reaches approximately 60 percent light output.

1. Mount control components internal to ballast.
2. Connect to ballast with tap so quartz lamp operates at 120 V.

N. Lamps: Comply with the standard of the ANSI C78 series that is applicable to each type of lamp. Provide lighting fixtures with indicated lamps of designated type, characteristics, and wattage. Where a lamp is not indicated for a lighting fixture, provide medium wattage lamp recommended by manufacturer for lighting fixture.

1. Metal-Halide Color Temperature and Minimum Color-Rendering Index: 3600 K and 70 CRI, unless otherwise indicated.

2.4 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Description: Comply with AASHTO LTS-3 for pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.

B. Wind-Load Strength of Total Support Assembly: Adequate to carry support assembly plus lighting fixtures at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of 100 mph (160 km/h) with a gust factor of 1.3. Support assembly includes pole or other support structures, brackets, arms, appurtenances, base, and anchorage and foundation.

1. Strength Analysis: For each pole type and lighting fixture combination, multiply the actual equivalent projected area of lighting fixtures and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

C. Finish: Match finish of pole/support structure for arm, bracket, and tenon mount materials.

D. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Will not cause galvanic action at contact points.
2. Mountings: Correctly position lighting fixture to provide indicated light distribution.
3. Anchor Bolts, Nuts, and Washers: Hot-dip galvanized after fabrication unless stainless-steel items are indicated.
4. Anchor-Bolt Template: Plywood or steel.

E. Pole/Support Structure Bases: Anchor type with hold-down or anchor bolts, leveling nuts, and bolt covers.

F. Pole Bases: Hinged-anchor type with hold-down or anchor bolts, leveling nuts, and bolt covers.

G. Pole Bases: Embedded type with underground cable entry.

H. Steel Poles: Tubing complying with ASTM A 500, Grade B, carbon steel with a minimum yield of 46,000 psig (317 MPa); one-piece construction up to 40 feet (12 m) in length with access handhole in pole wall.

1. Intermediate Handhole and Cable Support: Locate at midpoint of pole height. Weather-tight 3″ x 5″ (76- by-127-mm) handhole with cover provides access to internal welded attachment lug for electric cable support grip.
2. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.

I. Aluminum Poles: Fabricated from seamless, extruded structural tube complying with ASTM B 429, 6063-T6 alloy with access handhole in pole wall.

J. Aluminum Poles: Fabricated from ASTM B 209 (ASTM B 209M), 5052-H34 marine sheet alloy with access handhole in pole wall.

1. Grounding Provisions for Metal Pole/Support Structure: Welded ½″ (12-mm) threaded lug, accessible through handhole and listed for copper conductor connection.

K. Aluminum Mast Arms: Tapered oval arms continuously welded to pole attachment plate with span and rise as indicated.

L. Steel Mast Arms: Fabricated from NPS 2 (DN50) black steel pipe, continuously welded to pole attachment plate with span and rise as indicated.

M. Metal Pole Brackets: Match pole metal. Provide cantilever brackets without underbrace, in sizes and styles indicated, with straight tubular end section to accommodate lighting fixture.

N. Pole-Top Tenons: Fabricated to support lighting fixture or lighting fixtures and brackets indicated, and securely fastened to pole top.

O. Lowering System for Lighting fixtures: Include lighting fixture mounting assembly, lowering device, lowering cable, and portable winch.

1. Coordinate with pole and lighting fixture manufacturers for assembly details, wind-loading and vibration analysis, and compatibility of materials for electrolysis-free attachment and connection.
2. Structural and Mechanical Design: Use a safety factor of 5.0 for static and dynamic loading of load-bearing components, including cable.
3. Lowering Device: Weatherproof, cast-aluminum housing with multi-pin, plug-receptacle assembly.
4. Lowering Cable: Stainless-steel aircraft cable.
5. Portable Winch: Electric drive with cord and plug and 120 V, weatherproof receptacle mounted in pole base.

P. Concrete for Pole Foundations: Comply with Division 3 Section “Cast-in-Place Concrete.”

1. Design Strength: 3000-psig (20.7-MPa), 28-day compressive strength.

2.5 FLUORESCENT LAMP BALLASTS

A. General Requirements: Unless otherwise indicated, features include the following:

1. Designed for type and quantity of lamps indicated at full light output.

2. Sound Rating: A, except as otherwise indicated.
3. Type: Class P, High Power Factor, except as otherwise indicated.

B. Electronic Ballasts: Unless otherwise indicated, features include the following, besides those in "General Requirements" Paragraph above:

1. Certified Ballast Manufacturer Certification: Indicated by label. (ETL and CBM)
2. Encapsulation: Without voids in potting compound.
3. Parallel Lamp Circuits: Multiple lamp ballasts connected to maintain full light output on surviving lamps if one or more lamps fail.
4. Total Harmonic Distortion & Voltage less than or equal to 10% THD, instant start with dual voltage (120/277v).

C. Ballasts for Lamps in Recessed Fixtures: Unless otherwise indicated, additional features include the following:

1. Type: Electronic, fully encapsulated in potting compound.
2. Power Factor: 95%, minimum.
3. Operating Frequency: 20 kHz or higher.
4. Flicker: Less than 5%.
5. Lamp Current Crest Factor: Less than 1.7.
6. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

D. Ballasts for Lamps in Non-recessed Fixtures: Unless otherwise indicated, additional features include the following:

1. Power Factor: 95%, minimum.
2. Ballast Coil Temperature: 65 deg C, maximum.
3. Transient Protection: Comply with IEEE C62.41 for Category A1 locations.
4. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.

E. Ballasts for Dimmer-Controlled Fixtures: Comply with general and fixture-related requirements above for electronic ballasts.

1. Compatibility: Certified by manufacturer for use with specific dimming system indicated for use with each dimming ballast.

F. Ballasts for Low-Temperature Environments: As follows:

1. Temperatures 0F (-17C) and Above: Electronic type rated for 0F (-17C) starting temperature.
2. Temperatures -20F (-29C) and Above: Electromagnetic type designed for use with high-output lamps.

G. Ballasts for Low Electromagnetic Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C for limitations on electromagnetic and radio-frequency interference for consumer equipment.

H. Acceptable Manufacturers: Advance; Osram/Sylvania; Lutron; Motorola or approved equal.

2.6 HIGH-INTENSITY-DISCHARGE LAMP BALLASTS

A. General: Comply with ANSI C82.4. Unless otherwise indicated, features include the following:

1. Type: Constant wattage autotransformer or regulating high-power-factor type, unless otherwise indicated.
2. Operating Voltage: Match system voltage.
3. Minimum Starting Temperature: -22F (-30C) for single lamp ballasts.
4. Normal Ambient Operating Temperature: 104F (40C).
5. Open-circuit operation that will not reduce average life.
6. Auxiliary, Instant-on, Quartz System: Automatically switches quartz lamp on when fixture is initially energized and when momentary power outages occur. Automatically turns quartz lamp off when high-intensity-discharge lamp reaches approximately 60 percent light output.

B. Encapsulation: Manufacturer's standard epoxy-encapsulated model designed to minimize audible fixture noise.

C. High-Pressure Sodium Ballasts: Equip with a solid-state igniter/starter having an average life in pulsing mode of 10,000 hours at an igniter/starter case temperature of 90 deg C.

1. Instant Restrike Device: Solid-state, potted module, mounted inside high-pressure sodium fixture and compatible with high-pressure sodium lamps, ballasts, and sockets up to 150 W.

a. Restrike Range: 105 to 130VAC.
b. Maximum Voltage: 250V peak or 150VAC RMS.

2.7 EXIT SIGNS

A. General Requirements: Comply with UL 924 and the following:

1. Sign Colors and Lettering Size: Comply with authorities having jurisdiction.

B. Internally Lighted Signs: As follows:

1. Lamps for AC Operation: Incandescent, two for each fixture, 50,000 hours rated lamp life.
2. Lamps for AC Operation: Fluorescent, two for each fixture, 20,000 hours rated lamp life.
3. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum rated lamp life.
4. Additional Lamps for DC Operation: Two minimum, bayonet-base type, for connection to external DC source.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from unit when circuit voltage drops to 80% of nominal or below. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.

2.8 EMERGENCY LIGHTING UNITS

A. General Requirements: Self-contained units. Comply with UL 924. Units include the following features:

1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.

3. Operation: Relay automatically turns lamp on when supply circuit voltage drops to 80% of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps, and battery is automatically recharged and floated on charger.
4. Wire Guard: Where indicated, heavy-chrome-plated wire guard arranged to protect lamp heads or fixtures.
5. Integral Time-Delay Relay: Arranged to hold unit on for fixed interval after restoring power after an outage. Provides adequate time delay to permit high-intensity-discharge lamps to restrike and develop adequate output.

2.9 EMERGENCY FLUORESCENT POWER SUPPLY UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit factory mounted within fixture body. Comply with UL 924.

1. Test Switch and Light-Emitting Diode Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
2. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum 10-year nominal life.
3. Charger: Fully automatic, solid-state, constant-current type.
4. Operation: Relay automatically energizes lamp from unit when normal supply circuit voltage drops to 80% of nominal voltage or below. When normal voltage is restored, relay disconnects lamp, and battery is automatically recharged and floated on charger.

B. External Type: Self-contained, modular, battery-inverter unit. Comply with UL 924.

1. Test Switch and Light-Emitting Diode Indicator Light: Visible and accessible without entering ceiling space.
2. Battery: Sealed, maintenance-free, nickel-cadmium type with minimum 10-year nominal life.
3. Charger: Fully automatic, solid-state, constant-current type.
4. Operation: Relay automatically energizes lamp from unit when normal supply circuit voltage drops to 80% of nominal voltage or below. When normal voltage is restored, relay disconnects lamp, and battery is automatically recharged and floated on charger.
5. Housing: NEMA 250, Class 1 enclosure.

2.10 LAMPS

A. Fluorescent Color Temperature and Minimum Color-Rendering Index: 3500 K and 85 CRI, unless otherwise indicated.

B. Fluorescent Lamp Life: Rated average is 20,000 hours at 3 hours per start when used on rapid-start circuits.

C. Metal-Halide Color Temperature and Minimum Color-Rendering Index: 3600 K and 70 CRI, unless otherwise indicated.

D. Acceptable Manufacturers: General Electric, Phillips or Sylvania.

2.11 FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Basic Electrical Materials and Methods," for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: ½" (12-mm) steel tubing with swivel ball fitting and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, ½" (12-mm) steel tubes with single canopy arranged to mount a single fixture. Finish same as fixture.

D. Rod Hangers: 3⁄16" (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

F. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

2.12 FINISHES

A. Fixtures: Manufacturer's standard, unless otherwise indicated.

1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
2. Metallic Finish: Corrosion resistant.

B. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
2. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium stain; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.
3. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 606.1 or AAMA 608.1.
   a. Color: Light bronze.
   b. Color: Medium bronze.
   c. Color: Dark bronze.
   d. Color: Black.
4. Gold Anodic Finish: AA-M32C22A43 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, impregnated color coating 0.018 mm or thicker) complying with AAMA 611; gold color.

C. Steel: Grind welds and polish surfaces to a smooth, even finish.

1. Galvanized Finish: Hot-dip galvanize after fabrication to comply with ASTM A 123.
2. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease and other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or SSPC-SP8, "Pickling."
3. Interior: Apply one coat of bituminous paint on interior of pole, or otherwise treat to prevent corrosion.
4. Polyurethane Enamel: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
   a. Color: As indicated by manufacturer's designation.
   b. Color: Match Architect's sample.

c. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fixtures: Set level, plumb, and square with ceiling and walls, and secure according to manufacturer's written instructions and approved submittal materials. Install lamps in each fixture. Support fixtures according to requirements of Division 26 Section 26 0505 Basic Electrical Materials and Methods.

B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.

1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6" (150 mm) from fixture corners.
2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner.
3. Fixtures of Sizes Less Than Ceiling Grid: Arrange as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two ¾" (20-mm) metal channels spanning and secured to ceiling tees.

C. Suspended Fixture Support: As follows:

1. Pendants and Rods: Where longer than 48" (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Continuous Rows: Suspend from cable installed according to fixture manufacturer's written instructions and details on Drawings.

D. Air-Handling Fixtures: Install with dampers closed.

E. Concrete Foundations: Construct according to Division 3 Section "Cast-in-Place Concrete."

1. Comply with details for reinforcement and for anchor bolts, nuts, and washers. Verify anchor-bolt templates by comparing with actual pole bases furnished.
2. Finish for Parts Exposed to View: Trowel and rub smooth. Comply with Division 3 Section "Cast-in-Place Concrete" for exposed finish.

F. Embedded Poles: Set poles to indicated depth, but not less than one-sixth of pole length below finish grade. Dig holes large enough to permit use of tampers the full depth of hole. Backfill in 6" (150-mm) layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.

G. Install poles as follows:

1. Use web fabric slings (not chain or cable) to raise and set poles.
2. Mount pole to foundation with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
3. Secure poles level, plumb, and square.
4. Grout void between pole base and foundation. Use non-shrinking or expanding concrete grout firmly packed in entire void space.
5. Use a short piece of ½" (13-mm) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

H. Lighting fixture Attachment: Fasten to indicated structural supports.

I. Lighting fixture Attachment with Adjustable Features or Aiming: Attach lighting fixtures and supports to allow aiming for indicated light distribution.

J. Lamp lighting fixtures with indicated lamps according to manufacturer's written instructions. Replace malfunctioning lamps.

3.2 CONNECTIONS

A. Ground equipment.

1. 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. Ground metal poles/support structures according to Division 26 Section 26 0505 "Grounding."

1. Nonmetallic Poles: Ground metallic components of lighting units and foundations. Connect lighting fixtures to grounding system with No. 6 AWG conductor.

3.3 FIELD QUALITY CONTROL

A. Inspect each installed unit for damage. Replace damaged units.

B. Advance Notice: Give dates and times for field tests.

C. Provide instruments to make and record test results.

D. Tests and Observations: Verify normal operation of lighting units after installing lighting fixtures by energizing circuits with normal power source, and performing the following:

1. Measure light intensities at night if specific illumination performance is indicated. Use photometers with calibration referenced to NIST standards.
2. Check intensity and uniformity of illumination.
3. Check excessively noisy ballasts.
4. Emergency Lighting: Interrupt electrical supply to demonstrate proper operation. Verify transfer to emergency/battery source and retransfer to normal.

E. Prepare a written report of tests, inspections, observations and verifications indicating and interpreting results.

F. Malfunctioning Fixtures and Components: Replace or repair, then retest. Repeat procedure until units operate properly.

3.4 CLEANING AND ADJUSTING

A. Clean fixtures internally and externally after installation. Use methods and materials recommended by manufacturer.

B. Adjust aimable fixtures to provide required light intensities.

END OF SECTION

SECTION 27 1300
TELEPHONE AND DATA CABLING SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes wire, cable, connecting devices, installation, and testing for wiring systems to be used as signal pathways for voice and high speed data transmission.

B. Furnish and install complete with all accessories a Campus Cabling System (CCS). The CCS shall serve as a vehicle for transport of data, video, and voice telephony signals throughout the network from designated demarcation points to outlets located at various desks, workarea, and other locations as indicated on the contract drawings and described herein.

C. Wiring utilized for Telephone Company central office voice service shall originate at a demarcation point determined by the utility. The interconnect wiring to the building or Main Telecommunications Room and the cross connect wiring will be provided by the telephone company. Installation, termination and identification of wiring between workstations and station outlets to the ER shall be considered part of the contractors work.

D. Wiring utilized for data, video, and voice communications shall originate at owner designated hubs and concentrator locations and shall be either wall mounted, in vertical free standing equipment racks, and/or enclosed wall mounted vertical equipment racks. These racks will be located at the Telecommunications Equipment Room (ER) location. Wiring, terminations, patch panels, terminal panels and punch down blocks required for a complete pathway system between these designated demarcation points and outlet locations designated on the contract drawings shall be considered part of the contract. Telecommunication Outlets (TO) shall be furnished, wired and installed by the CCS system contractor.

E. The system shall utilize a network of fiber optic, and unshieldedtwisted pair, plenum rated, EIA/TIA certified communication cables. Cables and terminations shall be provided and located as shown and in the quantities indicated on the drawings.

F. Fiber cables shall terminate on fiber patch panels and/or modular patch panels located in all demarcation and termination points shown on the drawings.

G. All cables and terminations shall be identified at all locations.

H. All cables shall be labeled with an alphanumeric sequence identifier at all termination locations.

I. All copper cable terminations shall comply with, and be tested to ANSI/TIA/EIA 568-B standards for Category 3 and Category 6 installations.

J. All cables at the workarea shall terminated on specified modular jacks and mounted on one, two or three gang wall plates equipped as shown on the drawings.

1.2 DEFINITIONS

A. Campus Cabling System (CCS): A CCS is defined as all required equipment, including all cabling with hardware, termination/punchdown blocks, fiber patch cables, and telecommunication outlets with specified modular jacks. All equipment shall be installed and configured to provide computer data, video capabilities, and voice connectivity from each workarea to the network file server or voice network/switch designated as the service point of the local area network.

B. Work Area: The connection point between the (TO) and the electronic equipment in the work area. It consists of cords, adapters, handsets, computers, printers, and other transmission electronics.

C. Horizontal Subsystem: The Horizontal system provides connections from the horizontal cross connect to the Telecommunication Outlets (TOs) in the workarea. It consists of the horizontal transmission media, the associated connecting hardware terminating this media and individual outlets in the workarea. Each floor of a building is served by its own Horizontal Subsystem.

D. EMI: Electromagnetic interference

E. IDC: Insulation displacement connector

F. LAN: Local area network

G. PVC: Polyvinyl chloride

H. UTP: Unshielded twisted pair

1.3 CODES AND STANDARDS

A. NECA/BICSI #568-2006 Installing Commercial Building Telecommunications Cabling

B. TIA/EIA-568-B.1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements – (May 2001)

C. TIA/EIA-568-B.1-1 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements - Addendum 1 – Minimum 4-Pair UTP and ScTP Patch Cable Bend Radius - (May 2001)

D. TIA/EIA-568-B.1-2 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements Addendum 2 – Grounding and Bonding Requirements for Screened Balanced Twisted-Pair Horizontal Cabling - (February 2003)

E. TIA/EIA-568-B.1-3 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements Addendum 3 – Supportable Distances and Channel Attenuation for Optical Fiber Applications by Fiber Type - (February 2003)

F. TIA/EIA-568-B.1-4 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements > Addendum 4 – Recognition of Category 6 and 850 nm Laser Optimized 50/125 µm Multimode Optical Fiber Cabling - (February 2003)

G. TIA/EIA-568-B.1-5 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements Addendum 5 – Telecommunications Cabling for Telecommunications Enclosures – (March 2004)

H. TIA/EIA-568-B.1-7 Commercial Building Telecommunications Cabling Standard Part 1: General Requirements Addendum 7 - Guidelines for Maintaining Polarity Using Array Connectors – (January 2006)

I. TIA/EIA-568-B.2 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components - (December 2003)

J. TIA/EIA-568-B.2-1 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 1 – Transmission Performance Specifications for 4-Pair 100 ohm Category 6 Cabling - (June 2002)

K. TIA/EIA-568-B.2-2 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 2 – Revision of Sub-clauses - (December 2001)

L. TIA/EIA-568-B.2-3 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 3 – Additional Considerations for Insertion Loss & Return Loss Pass/Fail Determination - (March 2002)

M. TIA/EIA-568-B.2-4 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 4 – Solderless Connection Reliability Requirements for Copper Connecting Hardware - (June 2002)

N. TIA/EIA-568-B.2-5 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 5 – Corrections to TIA/EIA-568-B.2 – (January 2003)

O. TIA/EIA-568-B.2-6 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 6 – Category 6 Related Component Test Procedures – (December 2003)

P. TIA/EIA-568-B.2-11 Commercial Building Telecommunications Cabling Standard Part 2: Balanced Twisted-Pair Cabling Components – Addendum 11 - Specification of 4-Pair UTP and SCTP Cabling – (December 2005)

Q. TIA/EIA-568-3 Optical Fiber Cabling Components Standard - (April 2002)

R. TIA/EIA-568-3.1 Optical Fiber Cabling Components Standard – Addendum 1 – Additional Transmission Performance Specifications for 50/125 μm Optical Fiber Cables – (April 2002)

S. TIA-569-B Commercial Building Standard for Telecommunications Pathways and Spaces -(October 2004)

T. TIA-598-C Optical Fiber Cable Color Coding - (January 2005)

U. TIA/EIA-606-A Administration Standard for Commercial Telecommunications Infrastructure - (May 2002)

V. J-STD-607-A Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications - (October 2002)

W. TIA-758-A Customer-owned Outside Plant Telecommunications Infrastructure Standard – August 2004

X. ANSI/TIA/EIA 862 Building Automation Systems Cabling for Commercial Buildings, April 11, 2002

Y. Underwriters Laboratories (UL®) Cable Certification and Follow Up Program.

Z. National Electrical Manufacturers Association (NEMA).

AA. American Society for Testing Materials (ASTM).

BB. National Electric Code (NEC®), Latest Issue

CC. Institute of Electrical and Electronic Engineers (IEEE).

DD. UL Testing Bulletin.

EE. American National Standards Institute (ANSI) X3T9.5 Requirements for UTP at 100 Mbps.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:

1. Firms shall be engaged in the manufacture of products and materials of types and sizes required, and whose products have been in satisfactory use in similar service for not less than five years.

2. The products specified in this specification shall be supplied by a single manufacturer, with the exception of data racks and other hardware that is not defined as part of the channel test configuration by ANSI/TIA/EIA 568-B.
3. Manufacturer shall be ISO 9001 Certified.

B. Contractor's Qualifications:

1. Firms shall have at least five years of successful installation experience with projects utilizing products and materials similar to that required for this Project.
2. An experienced installer and project manager who is a registered communication distribution designer certified by the Building Industry Consulting Service International (BICSI), and certified by the manufacturer for the installation of the cabling specified in this Section.
3. The selected contractor shall provide the installation of this system and shall be certified by the manufacturing company in all aspects of design, installation and testing of the products described herein.
4. The contractor shall utilize the authorized manufacturer components and distribution channels in provisioning this Project.
5. The contractor shall be in compliance with all federal, state and local statutes regarding qualifications of firms.
6. The contractor shall be experienced in all aspects of this work and shall be required to demonstrate direct experience on recent systems of similar type and size.
7. The contractor shall own and maintain tools and equipment necessary for successful installation and testing of optical systems, and Category 6 copper premise distribution systems.
8. The contractor shall have personnel who are adequately trained in the usage of such tools and equipment.
9. Contractor shall submit a resume of qualification with the Contractor's proposal indicating the following:
    a. A list of recently completed projects of similar type and size with contact names and telephone numbers for each.
    b. A list of test equipment proposed for use in verifying the installed integrity of metallic and fiber optic cable systems on this project.
    c. A technical resume of experience for the contractor's Project Manager and on-site installation supervisor who will be assigned to this project.
    d. A list of technical product training attended by the contractor's personnel that will install the CCS system.
    e. Any sub-Contractor, who will assist the CCS contractor in performance of this work, shall have the same training and certification as the CCS contractor.

C. Comply with NFPA 70 (latest edition).

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 SUBMITTALS

A. Product Data: Include data on features, ratings, and performance for each component specified.

B. Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C. Submittals shall include all items called for in PART 2 – PRODUCTS of this document and the manufacturers cut sheets for the following:

1. All fiber optic and copper cable: to include patch cords, cross connect wire and cross connect cordage.
2. All connectors and required tooling.
3. All termination system components for each cable type.
4. All ER equipment frame types, hardware (and LAN equipment if applicable).
5. All grounding and surge suppression system components.
6. All test equipment to be used for fiber and copper channels
7. A technical data sheet showing manufacturer's Guaranteed Channel Performance over the full swept frequency range.
8. Technical data sheets shall include the physical specifications as well as the following electrical and transmission characteristics:
    a. Mutual Capacitance
    b. Impedance
    c. DC Resistance
    d. Attenuation
    e. Worst Pair-to-Pair Near End Crosstalk
    f. Power Sum Near End Crosstalk
    g. ELFEXT
    h. Power Sum ELFEXT
    i. Return Loss
    j. Manufacturer's Instructions
9. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
10. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.
11. Pre-Qualification Certificate

D. Contractor shall submit the following documents with project proposal:

1. A letter of approval from the manufacturer indicating completion of pre-qualification requirements.
2. Training certificates for design, engineering and installation of the proposed products.

E. Vendor shall submit, to the Engineer/Owner, all factory test information prior to installation. If equivalent product(s) are substituted, the equivalent product(s) must show demonstrated and documented equivalence to the product(s) specified.

F. Shop Drawings: Include dimensioned plan and elevation views of components. Show access and workspace requirements.

1. System labeling schedules, including electronic copy of labeling schedules, as specified in Part 3, in software and format selected by Owner.

G. Samples: For workstation outlet connectors, jacks, jack assemblies, and faceplates for color selection and evaluation of technical features.

H. Product Certificates: Signed by manufacturers of cables, connectors, and terminal equipment certifying that products furnished comply with requirements.

I. Qualification Data: For firms and persons specified in "Quality Assurance" Article. Provide evidence of applicable registration or certification.

J. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

K. Maintenance Data: For products to include in maintenance manuals specified in Division 01.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Where recommended by the equipment supplier, deliver equipment in fully enclosed vans after specified environmental conditions have been permanently established in spaces where equipment is to be placed. The products accepted on the site shall be wrapped in factory packing, and shall be inspected for damage prior to acceptance.

C. Store equipment in clean, dry with non-condensing environments that are controlled within manufacturer=s ambient tolerances for non-operating equipment. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

D. Handle equipment carefully to prevent damage, breaking, and scoring. The contractor shall not install damaged units or components; replace with new.

E. Equipment furnished by others. The contractor shall be responsible for receiving, uncrating, inspecting, storing, and installing of Division 26 equipment listed as furnished by others.

1.7 SPARE PARTS

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. Cable: 1,000 feet of each size and type used for Project. Furnish on reels.
2. Patch Panel Units: One of each type for every six installed, but not less than one.
3. Connecting Blocks: One of each type for every 25 installed, but not less than one.
4. Cable Jacks: 10% of each type and color installed, but not less than one of each type or color.
5. Device Plates: 10% of each type installed, but not less than one.
6. Patch Cords: 10% of each type installed or provided to owner, but not less than one of each type.

1.8 WARRANTY

A. Material Guarantee: The wiring vendor (installer) shall guarantee at the time of the bid that all Category 6 and fiber optic cabling and components meet or exceed specifications (including installation) of ANSI/TIA/EIA-568-B.1, 568-B.2, 568-B.3 and 569.

B. Material Provided: The successful wiring vendor (installer) shall be certain that all correct parts are ordered per Products Section of this document and installed in accordance with manufacturers design and installation guidelines. Vendor shall submit complete parts and part numbers to Engineer/Owner prior to installation of equipment.

C. Warranty Documentation: Warranty shall be for 10 years.

1. Complete documentation regarding the manufacturer's warranty shall be submitted as part of the submittal process. This shall include, but is not limited to a sample of the warranty that shall be provided to the owner when the installation is complete and documentation of the support procedure for warranty issues.

2. A systems application assurance manual documenting the vendor supported applications and application guidelines shall be provided as part of the submittals.

D. Persons / Entity Covered

1. This Limited Warranty shall be for the benefit of the person or entity to which the manufacturer's CCS Registration Certificate is issued and any successor (Transferable) in interest to the site in which such System was originally installed by the manufacturer or an Authorized manufacturer's Reseller.
2. If manufacturer repairs the product, it may use new or reconditioned replacement parts. If manufacturer chooses to replace the product, manufacturer may replace it with a new or reconditioned one of the same or similar design. Any such repair or replacement will be warranted for either (a) 90 days or (b) the remainder of the original 10 -year warranty period, whichever is longer.
3. Extended Product Warranty

a. The Extended Product Warranty covers product defects for all passive components of the CCS. Passive components are defined as those exhibiting no gain or contributing no energy. The manufacturer shall warrant, from the date a Registration Certificate is issued by the manufacturer to the end-user, the following:

(1) That the passive products that comprise the registered CCS will be free from manufacturing defects in material or workmanship under normal and proper use;

(2) That all CCS approved passive cabling products that comprise the registered CCS solution exceed the specification of TIA 568-B.1, B.2, B.3 and exceed ISO/IEC 11801 standards and will conform to the performance specifications of the manufacturer's associated product data sheet in effect at the time the Registration Certificate is issued;

(3) That the installation will exceed the insertion and return loss, attenuation and near end crosstalk (NEXT) requirements of TIA 568-B and the ISO/IEC 11801 standards for cabling links/channel configurations specified in these standards.

b. This extended Product Warranty shall be applicable to the CCS only on the original site of installation. Under the Extended Product Warranty, manufacturer shall either repair or replace the defective product itself at manufacturer's cost. And in the U.S.A., manufacturer shall pay an Authorized manufacturer's Reseller for the cost of labor to repair or replace any such defective product on behalf of the manufacturer.

1.9 MAINTENANCE

Not Applicable

1.10 COORDINATION

A. Coordinate Work of this Section with the existing telephone service, telephone/data locations and Owner's technical personnel.

1. Meet jointly with representatives of the local exchange carrier and Owner's representatives to exchange information and agree on details of equipment arrangements and installation interfaces.

2. Record agreements reached in meetings and distribute record to other participants.
3. Adjust arrangements and locations of distribution frames, patch panels, and cross connects in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amp Connect
2. Berk-Tek and Ortronics (Net Clear)
3. Belden IBDN
4. Hubbell and Mohawk (Sure bit)
5. Leviton and Superior Essex (Next lad)
6. Sumitomo Electric – Future Flex
7. The Siemon Company
8. Pre approved equal

B. Unspecified equipment and material

1. Any item of equipment or material not specifically addressed on the drawings or in this document and required to provide a complete and functional CCS installation shall be provided in a level of quality consistent with other specified items.

C. Cabling Part numbers: The following catalog numbers are based upon communications cable and termination components manufactured by Amp Netconnect. Subject to the available manufacturers list above, contractor shall provide equivalent equipment by the listed manufacturers.

1. Category 3 UTP cables
   a. (Plenum Rated): Colors White-Blue for data, White-Orange for phone.
      (1) Amp Netconnect #57241-X
2. Category 6 FTP (shielded) cables
   a. (Plenum Rated): Colors Blue for data, Orange for phone.
3. Single-Mode Fiber Optic Cables (24 strands)
   a. (Plenum Rated):
      (1) Amp Netconnect #1664-series
4. Multimode 62.5/125 μm Fiber Optic Cables (24 strands)
   a. (Plenum Rated):
      (1) Amp Netconnect #1664-series
   b. (Riser Rated):
      (1) Amp Netconnect #1664-series
5. Terminal Patch Panel (CAT-6 shielded cables):

a. Amp Netconnect #1644042-2

6. Terminal Fiber Patch Components:

a. 24 fibers, 2U rack mounted: Amp Netconnect #559542-2
b. 48 fibers, 3U rack mounted: Amp Netconnect #559614-2
c. 96 fibers, 4U rack mounted: Amp Netconnect #559552-2

7. Connectors, Jacks, Plates:

a. Fiber strand connectors shall be Type LC for all cabling.

(1) Single mode cables #refer to catalog
(2) Multimode cables #refer to catalog

b. Jacks B compatible with selected cable manufacturer throughout. Color: match cable color.

(1) CAT6 Modular Jack: Amp Connect #1375055-X (unshielded)
(2) CAT6 Modular Jack: Amp Connect #1375118-1 (shielded)
(3) CAT 5e Modular Jacks: Amp Netconnect #1375191-X unshielded)
(4) CAT 5e Modular Jacks: Amp Netconnect #1375189-1 (shielded)
(5) CAT 3 Modular Jacks: Amp Netconnect #1375195-X

c. Face Plates B Color: match cable color, 2 -position to mount on single gang outlet box and 4position to mount on a 2-gang outlet box. Provide blank fill modules as required (to match plate) to close up all unused positions.

(1) Amp Netconnect #557505-X (2-position)
(2) Amp Netconnect #558088-X (4-position)

8. 110 Blocks:

a. 50 pair blocks: Amp Netconnect #558841-1
b. 100 pair blocks: Amp Netconnect #558842-1

D. Distribution Racks:

a. Homaco #19-84-6T2SD-CMB/VO-84-6M6E Organizer (large "MDF" rack) with #GS-8 ground strap and #PS-48-20A-10P power strip. (Hoffman Company As equal).
b. Great Lakes #GL48WM with power strip and ground strap (48" lockable cabinets. See plans for locations).

E. Equivalent products

1. Equivalent product(s) may be considered for substitution for those products specified, however, the equivalent product(s) must be approved and show demonstrated and documented equivalence to the product(s) specified.
2. Documentation shall include, but is not limited to: product samples, data sheets, and actual test data.
3. The request for product substitution, and supporting documentation, must be submitted, in writing, prior to submitting the bid.

a. Written approval for product substitution must be submitted with the bid.

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. Expansion Capability: Unless otherwise indicated, provide spare fibers and conductor pairs in cables, positions in patch panels, cross connects, and terminal strips, and space in backbone cable trays and wireways to accommodate 20% future increase in active workstations.

C. Guaranteed Performance

1. Category 3 Guaranteed performance

a. The Category 3, 4 pair UTP channel shall consist of all cable and components that comprise the full length circuit from the punch down blocks located in the ER and TR rooms to the TO at the work station inclusive of all patch cables and work station cables.

b. A single manufacturer shall be responsible for all of the Category 3 cable and all Category 3 channel components.

c. The manufacturer shall warrant the Category 3 channel cable, components, and applications for a minimum period of 10 years.

d. The 10 -year warranty shall be a transferable warranty and include all labor to replace any defective components as well as the component replacement.

2. Category 6 Guaranteed Channel Performance

a. All copper cable and apparatus shall conform to the Category 6 Channel Performance Specification.

b. The copper cable and apparatus channel performance shall be measured over the full 100 meters (328 feet) length and include 4 connection points.

c. The specifications for the 4 pair UTP Category 6 channel are divided into two primary groups based upon high performance and premium performance cable. The Category 6 channel shall consist of all cable and components with four connections that comprise the full 100 meter (328 feet) length circuit from the Hub/Server/LAN Electronics port located in the ER and TR rooms to the TO at the Work Station inclusive of all patch cables and work station cables.

d. The Category 6, 4 pair UTP channel shall support emerging high-bandwidth applications, including 1 Gbps Ethernet, potentially 1.2 Gbps ATM and 2.4 Gbps ATM, Multi-Tasked Split Screen Computing, Virtual Holographic Video Conferencing, Instant Access Telemedicine, 3D CAD/CAM Engineering, Internet-Intranet Communications/Commerce, as well as all 77 channels (550 MHz) of analog broad band video.

e. The Category 6 cable and Category 6 channel components shall be manufactured by a single manufacturer. The manufacturer shall warrant the Category 6 channel cable, components, and applications for a minimum period of 10 years.

f. The 10 year warranty shall be a transferable warranty and include all labor to replace any defective components as well as the component replacement.

g. The Category 6 channel with four (4) connections shall have a minimum of 10dB Attenuation to Crosstalk Ratio (ACR), across the full frequency range of 1MHz - 149.1MHz. At no point across the frequency range of 1MHz - 149.1MHz shall the ACR drop below 10dB.

h. The Delay Skew on the 100 meter channel shall not exceed 30 ns.

i. The Category 6 cable and components shall be electrically backward compatible with existing Category 3, 5, 5E plus future networks.

j. The Category 6 components shall be engineered and manufactured to compensate for any CAT 3, 5 or 5E component crosstalk and shall provide at least CAT 3, 5 or 5E performance in all of the customer's existing installed base of voice/data/video.

k. The Category 6 cable and components shall be physically compatible with existing installed base of equipment.

l. The Category 6 cable and components shall not require special cords, specialty tools or special installation requirements.

m. The guaranteed channel performance requirements of the Category 6 Channel described above with cable, cords, outlets manufactured by the same manufacturer and four (4) connections for 100 meters shall be as shown in the following tables:

Guaranteed Channel Performance Specifications for Category 6 Systems												
Frequency (MHz)	1	4	8	10	16	20	25	31.25	62.5	100	200	250
Insertion Loss (dB)	2.1	3.9	5.4	6.1	7.7	8.7	9.7	10.9	15.8	20.4	30.3	34.5
NEXT (dB)	69.0	67.0	62.2	60.6	57.2	55.6	54.0	52.4	47.4	43.9	38.8	37.1
ACR (dB)	66.9	63.2	56.7	54.5	49.5	47.0	44.3	41.5	31.6	23.5	8.5	2.6
PSNEXT (dB)	67.5	66.0	61.1	59.5	56.1	54.5	52.8	51.2	46.1	42.6	37.4	35.7
PSACR (dB)	65.4	62.1	55.7	53.4	48.4	45.8	43.1	40.3	30.3	22.1	7.1	1.2
ELFEXT (dB)	67.3	55.2	49.2	47.3	43.2	41.2	39.3	37.4	31.3	27.3	21.2	19.3
PSELFEXT (dB)	66.3	54.2	48.2	46.3	42.2	40.2	38.3	36.4	30.3	26.3	20.2	18.3
Return Loss (dB)	21.0	21.0	21.0	21.0	20.0	19.5	19.0	18.5	16.0	14.0	11.0	10.0
Delay (ns)	580	562	557	555	553	552	551	550	549	548	547	546
Delay Skew (ns)	30	30	30	30	30	30	30	30	30	30	30	30

Note: The table provides reference values only. All parameters comply with the governing equations given below over the entire frequency range. All values and equations apply to worst-case channels utilizing four-pair High Performance E series cables with full cross-connects, consolidation points and work area outlets (4 connectors in a channel) for any channel lengths up to 100 meters.

Electrical Parameter (1 - 250MHz)	**Guaranteed Margins to draft Category 6 / Class E channel Specifications**
Insertion Loss	4 %
NEXT	4 dB
PSNEXT	5.5 dB
ELFEXT	4 dB
PSELFEXT	6 dB
Return Loss	2 dB

(1) Governing Equations for 6-Connection High Performance Category 6 Channels (1-250MHz):

$$Insertion\ Loss \le 1.8472 \times \sqrt{f} + 0.0166 \times f + \frac{0.1958}{\sqrt{f}} + 2.88 \times 10^{-4} \times f^{1.5}$$

$$NEXT \ge -\left[20 \times \log\left(1.2162 \times 10^{-4} \times f^{0.75} + 2.5179 \times 10^{-5} \times f\right)\right]$$

$$PSNEXT \geq -\left[20\times\log\left(1.2882\times10^{-4}\times f^{0.75}+3.3576\times10^{-5}\times f\right)\right]$$

$$ELFEXT \geq -\left[20\times\log\left(4.3367\times10^{-4}\times f\right)\right]$$

$$PSELFEXT \geq -\left[20\times\log\left(4.8658\times10^{-4}\times f\right)\right]$$

$$RL \geq 21,\ 1\leq f<10\ MHz;\quad RL\geq 26-5\times\log(f),\ 10\leq f<40\ MHz;\quad RL\geq 34-10\times\log(f),\ 40\leq f<250\ MHz$$

$$Delay \leq 544+\frac{36}{\sqrt{f}};\quad Skew\leq 30$$

3. Single-mode Fiber Optic Guaranteed Channel Performance
   a. The Single-mode fiber channel shall support single-channel serial transmission, in the OSP and both the building and campus backbones, to 10 gigabits per second (Gb/s) with 4 connections.
   b. The Single-mode fiber channel shall be backward compatible with legacy applications such as: Ethernet, Token Ring, FDDI, Fast Ethernet and ATM for in-building network distances) ensuring a smooth migration path from 10Mb/s to 10 Gb/s using achievable technology.
4. 10 Gb/s, 62.5/125 µm Multimode Guaranteed Channel Performance
   a. The 62.5/125 µm fiber channel shall support single-channel serial transmission, in the OSP and both the building riser and campus backbones, to 10 gigabits per second (Gb/s) for a distance of 300 meters with 4 connections.
   b. The 62.5/125 µm fiber channel shall be backward compatible with legacy applications such as: Ethernet, Token Ring, FDDI, Fast Ethernet and ATM for in-building network distances) ensuring a smooth migration path from 10Mb/s to 10 Gb/s using achievable technology.
   c. The channel shall support 10 Gb/s short wavelength (850 nm) emerging technology applications using vertical cavity surface emitting lasers (VCSELs)and low bit rate LED applications for legacy systems.
   d. The 62.5/125 µm fiber shall be optimized to control differential mode delay (DMD) so that "pulse splitting" at 10 Gb/s is eliminated.
   e. A single manufacturer shall manufacture the 62.5/125 µm fiber cable, fiber connectors, patch cords and apparatus, which comprise the channel.
   f. The 62.5/125 µm fiber shall meet or exceed the following standards, as applicable, for OSP or Plenum cables: ICEA S-83-596, ISO/IEC-794, GR-409, EIA/TIA 455, EIA/TIA 492, EIA/TIA 568-B, ANSI-FDDI, IEEE 802, UL 910, OFNP classification as described in the National Electric Code (NEC2), OFN-LS Low Smoke Cables, CSA Certified (OFN FT4/FT6) and approved component industry standards.
   g. The manufacturer shall warrant the 10 Gb/s channel's cable, components, and applications for a minimum period of 10 years.
   h. The 10 year warranty shall be a transferable warranty and include all labor to replace any defective components as well as the component replacement.

D. Outlets

1. Outlet Locations

a. Unless otherwise noted on the floor plans or within this document, all voice and data wall outlets for 24 AWG copper cable shall be:

(1) Insulation displacement
(2) Support Universal applications in a multivendor environment, accepting modular RJ-11 jacks (telephone) and RJ-45 Jacks (data).
(3) Provided with blank module inserts for all unused module locations. Jack module arrangements are shown on the drawings. Provide color coded inserts at each outlet, termination block and at patch panels as shown on the drawings.
(4) Mounted in one or two gang utility outlet boxes.
(5) Equipped with EIA/TIA-T568A and EIA/TIA-T568B universal wiring labels.

2. Category 3 Outlets

a. All Category 3 outlets shall conform to ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard, Horizontal Cable Section, and be part of the UL® LAN Certification and Follow-up Program.
b. Shall be UL® Verified Category 3 Electrical Performance
c. Shall comply with FCC Part 68
d. ISO 9001 Certified Manufacturer
e. All Category 3 shall meet or exceed the following electrical and mechanical specifications:

(1) Electrical Specifications: ANSI/TIA/EIA 568-B Category 3 minimum transmission requirements

Insulation resistance	500 MΩ minimum
Dielectric withstand voltage	1,000 VAC RMS, 60 Hz minimum, contact-to-contact and 1,500 VAC RMS, 60 Hz minimum from any contact to exposed conductive surface.
Contact resistance	20 mΩ maximum
Current rating	1.5 A at 68° F (20°C) per IEC Publication 512-3, Test 5b.

(2) Mechanical Performance:

Plug Insertion Life:	750 insertions
IDC Terminations:	200 terminations
Contact Force:	3.5 oz (99.2 g) minimum using FCC-Approved modular plug
Plug Retention Force:	30 lb (133 N) minimum between modular plug and jack
Temperature Range:	-40 to 150°F (-40 to 66°C)

3. Category 6 Gigabit outlets

a. All Category 6 outlets shall meet or exceed Category 6 transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA 568-B Commercial Building Telecommunications Cabling Standard and be part of the UL® LAN Certification and Follow-up Program.
b. The Category 6 outlets shall be backward compatible with Category 5E, 5 and 3 cords and cables.

c. The Category 6 outlets shall be capable of being in a modular patching situation or as a modular telecommunication outlet (TO) supporting current 10Base-T, Token Ring, 100 Mbps TP-PMD, 155 Mbps ATM, 622 Mbps ATM using parallel transmission schemes and evolving high-speed, high-bandwidth applications, including Ethernet, 1000BASE-T and 1.2 Gbps ATM.

d. The Category 6 outlets shall be capable of being installed at a 90° angle in any series modular faceplate, frame, or surface-mounted box avoiding the need for special faceplates.

e. The Category 6 outlets shall have improved pair splitters and wider channel for enhanced conductor placement. The outlet shall also have a low-profile wire cap, which protects against contamination and secures the connection. Multicolored identification labels shall be available to assure accurate installation.

f. The Category 6 outlets shall meet the following Guaranteed Margin Performance and Physical Specifications:

(1) Guaranteed Margin:

	Category 6 Outlet	High Performance Channel	Premium Performance Channel
	Typical Worst Pair Margin*	Guaranteed Margin**	Guaranteed Margin**
Insertion Loss	26.9%	5.0%	7.5%
NEXT	5.4 dB	6.0 dB	7.0 dB
PSNEXT	4.7 dB	7.5 dB	8.5 dB
ELFEXT	10.5 dB	6.0 dB	8.0 dB
PSELFEXT	10.8 dB	8.0 dB	10.0 dB
Return Loss	8.0 dB	4.0 dB	4.0 dB
Frequency Range	1-250 MHz	1-250 MHz	1-250 MHz

* Typical worst pair swept margin when measured with same manufacture's Cat 6 modular patch cord.

**Guaranteed margin is valid at any frequency from 1-250 MHz for the single manufacturer's certified channel comprising the single manufacturer's Cat 6 apparatus and the single manufacturer's High Performance series cable or Premium Performance series. Values represent margin over the draft Category 6/Class E channel specifications.

(2) Physical Specifications:

Dimensions	0.8 in (20 mm) W x 0.8 in (20 mm) H x 1.2 in (31 mm) D
Plastic	High-impact, flame-retardant, UL rated 94V-0 thermoplastic
Connector	Copper alloy, 100 micro-inch bright solder over 100 micro-inch nickel underplate
Outlet Wires	Copper alloy, 50 micro-inch lubricated gold plating over 100 micro-inch nickel underplate
Operating Temperature	14°F to 140°F (-10°C to 60°)
Storage Temperature Range	-40°F to 158°F (-40°C to 70°C)
Humidity	95% (noncondensing)
Nominal Solid Conductor Diameter:	0.025 to 0.020 in (22 to 24 AWG)
Nominal Stranded Conductor Diameter	0.64 to 0.51mm (22 to 24 AWG)
Plug Retention Force	30lb (133 N) minimum
Plug / Jack Contact Force	100 grams minimum per contact using FCC-8 position telecommunication plug

Insertion Life	750 cycles minimum using FCC-8 position telecommunication plug

2.3 MOUNTING ELEMENTS

A. Cable Trays, innerducts, conduits, ladder racks, and horizontal and vertical cable management systems: Comply with Section 260536.

B. Raceways and Boxes: Comply with Section 260533.

C. Telephone Terminal Backboards: ¾" (19-mm) interior grade, fire resistive treated plywood. Comply with Section 16700.

2.4 TWISTED-PAIR CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

A. Listed as complying with Category 3, and 6 of EIA/TIA-568-B.

B. Conductors: Solid copper

C. Station cable

1. Category 6 FTP, 4 Pair (High Performance Shielded Cable)

a. The high performance Category 6 UTP cable shall be of the traditional round design with mylar separator tape between pairs 2 & 3 and 1 & 4 and integral foil shield.

b. The cable shall support Voice, Analog Baseband Video/Audio, Fax, Modem, T-1, ISDN,RS-232, RS422, RS-485, 10BASE – T Ethernet, Token Ring, 100Mbps TP-PMD, 100BASE-T Ethernet, 155 Mbps ATM, AES/EBU Digital Audio, 270 Mbps Digital Video, 622 Mbps 64-CAP ATM and emerging high-bandwidth applications, including 1 Gbps Ethernet, gigabit ATM, as well as all 77 channels (550 MHz) of analog broadband video.

c. The cable jacket shall comply with Article 800 NEC for use as a riser, plenum or non-plenum cable. The 4 pair UTP cable shall be UL® Listed Type CMP (plenum) or CM (non-plenum).

d. Performance shall be characterized to 550 MHz to support high-bandwidth video applications

e. All Category 6 high performance cables shall the following specification:

	Non Plenum	**Plenum**
Weight	25.3 lb (1000 ft)	29 lb (1000 ft)
Outside Diameter	0.232 in	0.22 in
Conductor Diameter	.022 in	.022 in
Jacket Material	PVC	Low Smoke PVC
Maximum Pulling Tension	25 lbs	25 lbs
Nom. Velocity of Propagation	0.69	0.72
Max DC Resistance	9.83 Ohms/100m	9.83 Ohms/100m
Mutual Capacitance @ 1kHz	4.95 nF/100m	4.78 nF/100m
Operating Temperature	-20 to 60° C	-20 to 60° C
UL Type	CMR & CMG	CMP

f. The high performance Category 6 cable shall be specified to 550 MHz and shall meet the guaranteed swept margin as follows:

High Performance Cable	High Performance Channel	Premium Performance Channel
Typical Worst	Guaranteed	Guaranteed

	Pair Margin*	Margin**	Margin**
Insertion Loss	3.0 %	5.0%	7.5%
NEXT	6.0 dB	6.0 dB	7.0 dB
PSNEXT	6.0 dB	7.5 dB	8.5 dB
ELFEXT	5.0 dB	6.0 dB	8.0 dB
PSELFEXT	5.0 dB	8.0 dB	10.0 dB
Return Loss	4.0 dB	4.0 dB	4.0 dB
Frequency Range	1-550 MHz	1-250 MHz	1-250 MHz

* Typical worst pair swept margin.

**Guaranteed margin is valid at any frequency from 1-250 MHz for the single manufacturer's certified channel comprising the single manufacturer's Cat 6 apparatus and the single manufacturer's High Performance series cable or Premium Performance series. Values represent margin over the draft Category 6/Class E channel specifications.

D. Copper cable – Telephone Building Riser

1. Shielded 24 AWG multi-pair copper cables shall be used as the vertical riser cables. The cable shall support voice data applications.
2. Shielded
3. The shielded riser rated, plenum and nonplenum cable shall consist of solid-copper conductors insulated with expanded polyethylene covered by a PVC skin, be conformance tested to meet EIA/TIA 568-B for Category 5 cables, be UL® and c (UL®) Listed as CMR.
4. The PVC sheath shall have improved frictional properties, allowing it to be pulled through conduit without the use of lubricants.
5. The cable shall be available in 25, 50, 100, 150, 200, 300, 400, 600, 900, 1200, 1500, and 1800 pair counts.
6. UL® and c (UL®) Listed for Fire Safety
7. ISO 9001 Certified Manufacturer
8. The copper riser cable shall meet or exceed the following electrical specifications listed below:

Electrical Specifications:

Average DC Resistance	26.5Ω/1,000 ft (8.7Ω/100m), maximum
Average DC Resistance Unbalance	1.7%, maximum
Mutual Capacitance @ 1kHz	16 nF/1000 ft (5.25 nF/100 m), maximum
Capacitance Unbalance (pair to ground)	201pF/1,000 ft (65.94 pF/100m) maximum

Attenuation (dB/100 m, 328 ft.) :

Frequency	Attenuation (Max.)
1.00 MHz	2.3 dB
4.00 MHz	4.9 dB
10.00 MHz	8.5 dB
16.00 MHz	12 dB

Worst Pair Near-End Crosstalk (NEXT) dB/100 m,328 ft:

Frequency	Pair-To-Pair NEXT (Max.)
1.0 MHz	13.8 dB
4.0 MHz	11.2 dB

10.0 MHz	10.2 dB
16.0 MHz	9.2 dB

E. 110 wiring block

1. The wiring block shall support Category 3, Category 5E and Category 6 applications and facilitate cross connection and interconnection using either cross connect wire (voice only) or the appropriate category patch cords.
2. The wiring blocks shall be fire retardant, molded plastic consisting of horizontal index strips for terminating 25 pairs of conductors each. The index strips shall be marked with five colors on the high teeth, separating the tip and ring of each pair, to establish pair location.
3. A series of fanning strips shall be located on each side of the block for dressing the cable pairs terminated on the adjacent index strips.
4. The wiring block shall accommodate 22- through 26-AWG conductors and shall be able to mount directly on wall surfaces with plywood backboards or on a 19" free-standing frame.
5. Clear label holders with the appropriate colored inserts shall be provided with the wiring blocks. The insert labels shall contain vertical lines spaced on the basis of circuit size (3-, 4-, or 5-pair) and shall not interfere with running, tracing or removing jumper wire/patch cords.
6. The wiring blocks shall be available in 25, 50, 100, and 300 pair sizes. The 100 and 300 pair wiring blocks shall be available with or without legs.
7. The 25 and 50 pair sizes are not available with legs and shall be utilized for low pair count and/or depth restrictive situations.
8. The wiring block shall be able to accommodate over 500 repeated insertions without incurring permanent deformation and it shall pass the reliability test of no more than one contact failure in 10000 connections.
9. The 110 wiring blocks shall meet the following specifications:

Physical Specifications:

Height:	25-, 50-Pair – 1.75 in. (4.45 cm) 100-Pair – 3.59 in. (9.12 cm) 300-Pair, 10.79 in. (27.41 cm)

Electrical Specifications:

ANSI/EIA/TIA – T-568-B	Category 5, 5E, 6

F. Category 6 modular patch panels

1. The Category 6 modular jack panels shall meet or exceed the proposed Category 6 standards requirements in ISO/IEC 11801, CENLEC EN 50173 and ANSI/TIA/EIA and shall be UL Listed.
2. The modular jack panel shall utilize universal A/B wiring.
3. The jack panels shall be either wall or 19-inch rack mountable.

Physical specifications: 24and 48 port patch panels:

Insertion Life: 750 cycles minimum
Plug/Jack Contact Force: 100 g minimum
Plug retention Force: 133 N minimum
Operating Temperature Range: 0 to 60˚C

Storage Temperature Range: -40 to 66˚C
Humidity: 5 to 95% (noncondensing)
Height: 24-Ports:4.38cm (1u); 48-Ports:8.83cm (2u);64-Ports 17.7cm (4U0)
Width: 48.26cm (19 inch)
Depth: 4.06cm

Guaranteed Margin:

	Category 6 Patch Panel	High Performance Channel	Premium Performance Channel
	Typical Worst Pair Margin*	Guaranteed Margin**	Guaranteed Margin**
Insertion Loss	64.3%	5.0%	7.5%
NEXT	6.6 dB	6.0 dB	7.0 dB
PSNEXT	7.3 dB	7.5 dB	8.5 dB
ELFEXT	6.4 dB	6.0 dB	8.0 dB
PSELFEXT	6.1 dB	8.0 dB	10.0 dB
Return Loss	6.6 dB	4.0 dB	4.0 dB
Frequency Range	1-250 MHz	1-250 MHz	1-250 MHz

* Typical worst pair swept margin when measured with same manufacture's Category 6 patch cord.

**Guaranteed margin is valid at any frequency from 1-250 MHz for the single manufacturer's certified channel comprising the single manufacturer's Cat 6 apparatus and the single manufacturer's High Performance series cable or Premium Performance series. Values represent margin over the draft Category 6/Class E channel specifications.

G. Copper patch cords

1. Category 6 Patch Cords

a. All patch cords shall exceed ANSI/TIA/EIA and ISO/IEC Category 6/Class E specifications.

b. All patch cords shall be backward compatible with Category 5 and Category 5E systems.

c. The patch cords shall incorporate an anti-snag feature that provides maximum protection from snagging during moves and re-arrangements.

d. Patch cords shall be UL listed, UL-C certified and AUSTEL approved.

e. Patch cords shall support network line speeds in excess of 1 gigabit per second.

f. Patch cords shall be available in stranded and solid conductor in lengths to 100 feet.

g. The Category 6 modular patch cord shall have guaranteed margin as follows:

Guaranteed Margin:

	Category 6 Modular Patch Cord (4 Pair)	High Performance Channel	Premium Performance Channel
	Typical Worst Pair Margin*	Guaranteed Margin**	Guaranteed Margin**
Insertion Loss	NA	5.0%	7.5%

NEXT	4.4 dB	6.0 dB	7.0 dB
PSNEXT	NA	7.5 dB	8.5 dB
ELFEXT	NA	6.0 dB	8.0 dB
PSELFEXT	NA	8.0 dB	10.0 dB
Return Loss	5.9 dB	4.0 dB	4.0 dB
Frequency Range	1-250 MHz	1-250 MHz	1-250 MHz

* Typical worst pair swept margin to TIA Patch cord specification when measured with same manufacturer's Category 6 information outlet.
**Guaranteed margin is valid at any frequency from 1-250 MHz for the single manufacturer's certified channel comprising the single manufacturer's Cat 6 apparatus and the single manufacturer's High Performance series cable or Premium Performance series. Values represent margin over the draft Category 6/Class E channel specifications.

2.5 EQUIPMENT RACKS

A. The equipment racks shall be made of lightweight steel, black in color and include steel mounting hardware for mounting 110 wiring blocks, Category 3 and 6 modular patch panels, and fiber termination panels to the frame. In addition, the mounting hardware must provide vertical and horizontal wireways for cross connect wire.

B. Racks shall be mounted on an isolation pad and utilize non-conductive washers to secure the rack to the floor.

C. Floor mounted open racks shall be secured from the top rail to the backboard in the room with a length of cable runway to prevent movement.

D. All racks shall be grounded to the isolated ground bar within the ER using a standard ground lug and #6 jacketed green cable.

E. The standard frame must be available in two configurations, which are commonly referred to as single-sided or double-sided frames. Frames must meet the following specifications:

23" Single-sided Dimensions - 7 ft. x 24 inches x 3 inches with 23 inch center mounting

Footprint	24 inches (length) x 15 inches (depth)
Hole pattern	half-inch centered
Screw size	12-24 thread, half-inch length
Pair termination capacity	3600 UTP copper pairs

23" Double-sided Dimensions - 7 ft. x 24 inches x 6 inches with 23 inch center mounting

Footprint	24 inches (length) x 18 inches (depth)
Hole Pattern	half-inch centered
Screw size	12-24 thread, half-inch length.
Pair termination capacity	7200 UTP copper pairs

19" Single-sided Dimensions - 7 ft. x 20 inches x 3 inches with 19 inch center mounting

Footprint	20 inches (length) x 15 inches (depth)
Hole pattern	half-inch centered
Screw size	12-24 thread, half-inch length
Pair termination capacity	3600 UTP copper pairs

19" Double-sided Dimensions - 7 ft. x 20 inches x 6 inches with 19 inch center mounting

Footprint	20 inches (length) x 18 inches (depth)

Hole Pattern	half-inch centered
Screw size	12-24 thread, half-inch length.
Pair termination capacity	7200 UTP copper pairs

2.6 FIBER-OPTIC CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

A. Cables: Factory fabricated jacketed, low loss, glass type, fiber optic, single mode and multimode, graded index, operating at 1300 nm

1. Backbone, Strands per Cable: as noted on the contract drawings
2. Multi-Mode Fiber Dimensions: 50/62.5 μmeter core diameter, 100/125 μmeter cladding diameter
3. Multi-Mode Fiber Maximum Attenuation: Minus 1.5 dB/km at 1300 nm
4. Single Mode Fiber Maximum Attenuation: Minus 0.7dB/km at 1550nm
5. Multi-Mode Fiber Minimum Modal Bandwidth: 500 MHz/km at 1300 nm
6. Operating Temperature Range: -20C to +50C for all cables

B. Plenum Cable: Listed for use in plenums, installation as noted on contract drawings.

C. Patch Panel: Modular panels housing multiple numbered duplex cable connectors.

1. Permanent Connection: Permanently connect one end of each connector module to installed cable fiber
2. Number of Connectors per Field: One for each fiber of cable or cables assigned to field
3. Mounting: Rack or wall as indicated on the contract drawings

2.7 MODULAR PATCH PANELS AND 110 WIRING BLOCKS

A. The wiring block shall support Category 3 and Category 6 applications and facilitate cross connection and interconnection using either cross connect wire (voice only) or the appropriate category patch cords.

B. The wiring blocks shall be fire retardant, molded plastic consisting of horizontal index strips for terminating 25 pairs of conductors each. The index strips shall be marked with five colors on the high teeth, separating the tip and ring of each pair, to establish pair location.

C. A series of fanning strips shall be located on each side of the block for dressing the cable pairs terminated on the adjacent index strips.

D. The wiring block shall accommodate 22- through 26-AWG conductors and shall be able to mount directly on wall surfaces with plywood backboards or on a 19" free-standing frame.

E. Clear label holders with the appropriate colored inserts shall be provided with the wiring blocks. The insert labels shall contain vertical lines spaced on the basis of circuit size (3-, 4-, or 5-pair) and shall not interfere with running, tracing or removing jumper wire/patch cords.

F. The wiring blocks shall be available in 100 pair sizes. The wiring blocks shall be available with or without legs.

G. The 25 and 50 pair sizes are not available with legs and shall be utilized for low pair count and/or depth restrictive situations.

H. The wiring block shall be able to accommodate over 500 repeated insertions without incurring permanent deformation and it shall pass the reliability test of no more than one contact failure in 10000 connections.

I. The 110 wiring blocks shall meet the following specifications:

Physical Specifications:

Height:	25-, 50-Pair – 1.75 in. (4.45 cm) 100-Pair – 3.59 in. (9.12 cm) 300-Pair, 10.79 in. (27.41 cm)

Electrical Specifications:

ANSI/EIA/TIA – T-568-B	Category 3, 5E, 6

J. Category 6 modular patch panels

1. The Category 6 modular jack panels shall meet or exceed the proposed Category 6 standards requirements in ISO/IEC 11801, CENLEC EN 50173 and ANSI/TIA/EIA and shall be UL Listed.
2. The modular jack panel shall utilize universal A/B wiring.
3. The jack panels shall be either wall or 19-inch rack mountable.

Physical specifications: 24and 48 port patch panels:

Insertion Life: 750 cycles minimum
Plug/Jack Contact Force: 100 g minimum
Plug retention Force: 133 N minimum
Operating Temperature Range: 0 to 60˚C
Storage Temperature Range: -40 to 66˚C
Humidity: 5 to 95% (noncondensing)
Height: 24-Ports:4.38cm (1u); 48-Ports:8.83cm (2u);64-Ports 17.7cm (4U0)
Width: 48.26cm (19 inch)
Depth: 4.06cm

Guaranteed Margin:

	Category 6 Patch Panel	High Performance Channel	Premium Performance Channel
	Typical Worst Pair Margin*	Guaranteed Margin**	Guaranteed Margin**
Insertion Loss	64.3%	5.0%	7.5%
NEXT	6.6 dB	6.0 dB	7.0 dB
PSNEXT	7.3 dB	7.5 dB	8.5 dB
ELFEXT	6.4 dB	6.0 dB	8.0 dB
PSELFEXT	6.1 dB	8.0 dB	10.0 dB
Return Loss	6.6 dB	4.0 dB	4.0 dB
Frequency Range	1-250 MHz	1-250 MHz	1-250 MHz

* Typical worst pair swept margin when measured with same manufacture's Category 6 patch cord.

**Guaranteed margin is valid at any frequency from 1-250 MHz for the single manufacturer's certified channel comprising the single manufacturer's Cat 6 apparatus and the single manufacturer's High Performance series cable or Premium Performance series. Values represent margin over the draft Category 6/Class E channel specifications.

2.8 IDENTIFICATION PRODUCTS

A. Comply with Division 26 Section 26 0505, "Basic Electrical Materials and Methods," "Electrical Identification" and the following:

1. Cable Labels: Self adhesive vinyl or vinyl cloth wraparound tape markers, machine printed with alphanumeric cable designations.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cable. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CABLING SYSTEM BASIC REQUIREMENTS

A. Cable Pathway

1. Installation of all fiber, data, and voice cables shall be within raceway, conduit, cable tray jhooks, bridal rings or other designated cable delivery system provided and installed by the CCS installer as shown on the electrical drawings.

   a. All cables installed concealed in walls shall be installed in conduit only.
   b. All cables installed surface mounted on walls shall be installed in surface mounted raceway, as shown on the electrical or communication drawings.
   c. All exposed cabling above ceilings in plenum and non-plenum spaces may be run in conduit, cable tray, or other designated cable delivery system(s) as indicated on the electrical or communication drawings.

B. Hardware

1. Provide all required hardware including, but is not limited to, termination panels and blocks, fastening devices, data outlets, voice outlets, connectors and all required accessories to comply with this specification.

3.3 INSTALLATION

A. Install cable using techniques, practices, and methods that are consistent with category rating of components and that ensure category performance of completed and linked signal paths, end to end.

B. Install cable without damaging conductors, shield, or jacket.

C. Do not bend cable in handling or in installing to smaller radii than minimums recommended by manufacturer.

D. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

1. Pull cables simultaneously if more than one is being installed in the same raceway.
2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
3. Use pulling means; including fish tape, cable, rope, and basket weave wire/cable grips, which will not damage media or raceway.

E. Install exposed cable parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

F. Secure and support cable at intervals not exceeding 30" and not more than 6" from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

G. Wiring on Wiring Racks and Enclosures: Provide adequate length of conductors. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to

prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

H. Separation of Wires: Comply with EIA/TIA-569 rules for separating unshielded copper communication and data processing equipment cables from potential EMI sources, including electrical power lines and equipment.

I. Make terminations only at indicated outlets, terminals, and cross connect and patch panels.

J. The entire in installation shall be completed in conformance with ANSI/EIA/TIA 568-B standards, NECA/BICSI 586-2006 Installing Commercial Building Telecommunications Cabling standard, all federal and local standards and the manufacturer's design and installation guidelines.

1. The Contractor shall ensure that the maximum pulling tensions of the specified distribution cables are not exceeded and cable bends maintain the proper radius during the placement of the facilities. Failure to follow the appropriate guidelines will require the Contractor to provide in a timely fashion the additional material and labor necessary to properly rectify the situation. This shall also apply to any and all damages sustained to the cables by the Contractor during the implementation.

K. Power Separation

1. The Contractor shall not place any distribution cabling alongside power lines, or share the same conduit, channel or sleeve with electrical apparatus.

L. Miscellaneous Equipment

1. The Contractor shall provide any necessary screws, anchors, clamps, tie wraps, distribution rings, wire molding (ER location), miscellaneous grounding and support hardware, etc., necessary to facilitate the installation of the System.

M. Special Equipment and Tools

1. It shall be the responsibility of the Contractor to furnish any special installation equipment or tools necessary to properly complete the System.

a. Tools shall include, but are not limited to:

(1) Tools for terminating cables
(2) Testing and splicing equipment for copper/fiber cables
(3) Communication devices
(4) Jack stands for cable reels
(5) Cable winches

N. Cable Storage

1. The Contractor shall not roll or store cable reels without an appropriate underlayment and the prior approval of Engineer/Owner, or it's General Contractor.

O. Cable Records

1. The Contractor shall maintain conductor polarity (tip and ring) identification at the main equipment room (switch room), risers, and station connecting blocks in accordance with industry practices.

3.4 GROUNDING AND BONDING

1. All grounding and bonding shall meet the National Electrical Code (NEC®) as well as local codes, which specify additional grounding and/or bonding requirements.
2. Bonding and Grounding
    a. Communication bonding and grounding shall be in accordance with the NEC and NFPA. Horizontal cables shall be grounded in compliance with ANSI/NFPA 70 and local requirements and practices. Horizontal equipment includes cross connect frames, patch panels and racks, active telecommunication equipment and test apparatus and equipment.

B. Comply with Division 26 Section 26 0526, "Grounding and Bonding."

C. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.

D. Bond shield and drain conductors to ground at only one point in each circuit.

E. Bonding and Grounding Terminal: Locate in each equipment room and wiring closet.
1. Telecommunications Bonding Backbone
    a. Provide a Telecommunications Bonding Backbone utilizing a #6-AWG or larger bonding conductor that provides direct bonding to the building's electrical system and all conductive metallic parts of the communications system in accordance with Article 250 of the NEC. Supplementary grounding systems will not be allowed. This is part of the grounding and bonding infrastructure (part of the telecommunications pathways and spaces in the building structure), and is independent of equipment or cable.

3.5 WORKMANSHIP

A. Components of the CCS system shall be installed in a neat, workmanlike manner.

B. Wiring color codes shall be strictly observed and terminations shall be uniform throughout the system.

C. Identification markings and systems shall be uniform.

D. ANSI/TIA/EIA 568-B wiring codes shall standardize all CCS wiring.

3.6 WORK AREA

A. Work location information outlets
1. All outlets, including conduit stub-ups shall be provided by the electrical contractor as shown on the Electrical Drawings or as directed by the Engineer/Owner.

3.7 HORIZONTAL CABLING

A. Contractor shall supply horizontal cables to connect each information outlet to the backbone system as shown on the contract drawings.

B. Unless otherwise noted on the floor plans or within this document, the type of horizontal cables used for each work location shall be 4-pair unshielded twisted pair (UTP) as specified in this section.

C. The 4-pair shall be run using a star topology format from the ER to every individual Telecommunication Outlet.

D. All cable routes to be approved by Engineer/Owner prior to installation of the cabling.

E. The length of each individual run of horizontal cable from the ER to the Telecommunication Outlet shall not exceed 295 ft (90 m).

F. Contractor shall observe the bending radius and pulling strength requirements of the 4-pair cable during handling and installation.

G. Each run of cable between the termination block and the information outlet shall be continuous without any joints or splices.

H. In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Contractor shall bundle station wiring with Velcro cable ties at a distance not to exceed 5′-0″ on center.

I. The cable bundling shall be supported via "J" hooks and bridal rings attached to the existing building structure and framework.

J. Plenum cable will be used in all appropriate areas.

K. Every effort will be made to schedule the requirements under this Contract in such a manner so as to complete all above ceiling work prior to ceiling tile installation. In the event Contractor is required to remove ceiling tiles, such Work shall not break or disturb grid and must be coordinated with the General Contractor.

L. Contractor shall provide Engineer/Owner with detailed cable run diagrams for cable runs within raised floors detailing exact locations of cable for review and approval by Engineer/Owner after coordination with other contractors, architect and general contractor.

M. Conduit installation shall be as required in Division 26 Section 26 0533, “Raceways and Boxes” of these specifications.

N. Station cables and tie cables installed within ceiling spaces shall be routed through these spaces at right angles to electrical power circuits.

3.8 INSTALLATION IN EQUIPMENT ROOMS AND WIRING CLOSETS

A. Provide plywood backboards as shown on drawings.

B. Mount terminal strips, and other connecting hardware on backboards, unless otherwise indicated.

C. Group connecting hardware for cables into separate logical fields.

D. Terminations

1. Contractor shall connect the trunk cross connect and the distribution cross connect to the common equipment such as PBX or host computer in the equipment room.

E. Electrical Protection

1. Contractor shall supply lightning protectors and wires used to ground the equipment.
2. The electrical protection devices supplied by the contractor shall be in multi-pair form.
3. For small pair count applications, contractor shall supply electrical protection devices, which consist of a mounting panel for a series of solid-state, or gas tube protector units and a wiring block. The wiring block shall be used for input and output cable terminations. Insertion of the protector units into the mounting block will complete the circuit.
4. The protection devices shall be available in 4, 6, 25, 50 and 100 pair sizes.

5. If the electrical protection circuit is separated from the cross connect field, contractor shall supply protector units consisting of a metal housing containing mountings for a series of solid-state or gas tube protector units. The protector shall include a 25 foot, 26 AWG stub cable that serves as a fusible link, a 24 AWG terminating cable, and two connectors for external ground connections.

3.9 IDENTIFICATION

A. Identify system components complying with applicable requirements in Division 26 Section 26 0505, "Basic Electrical Materials and Methods," "Electrical Identification" and the following Specifications.

B. System: Use a unique, four syllable alphanumeric designation for each cable, and label cable and jacks, connectors, and terminals to which it connects with the same designation. Use logical and systematic designations for facility's architectural arrangement.

1. First syllable identifies whether it is a data or telephone outlet.
2. The second letters or numbers indicate MDF or IDF termination point.
3. The remaining numbers indicate cable designation.

C. Workstation: Label cables within outlet boxes.

D. Distribution Racks and Frames: Label each unit and field within that unit.

E. Within Connector Fields, in Wiring Closets and Equipment Rooms: Label each connector and each discrete unit of cable terminating and connecting hardware. Where similar jacks and plugs are used for both communication and data processing equipment, use a different color for jacks and plugs of each service. (Match cable color).

F. Cables, General: Label each cable within 4 inches of each termination, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

G. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet.

H. Cable Schedule: Post in prominent location in each wiring closet and equipment room. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Provide electronic copy of final comprehensive schedules for Project, in software and format selected by Owner.

I. All labels shall be machine printed. Labels shall not be written by hand.

3.10 SPECIAL REQUIREMENTS FOR CABLE ROUTING

A. Cabling

1. All communications cabling used throughout this project shall comply with the requirements as outlined in the National Electric Code (NEC) Articles 725, 760, 770, and 800 and the appropriate local codes.
2. All copper cabling shall bear CMP (Plenum Rated), CM/CMR (Riser Rated) and/or appropriate markings for the environment in which they are installed.
3. All fiber optic cabling shall bear OFNP (Plenum Rated), OFNR (Riser Rated) and/or appropriate markings for the environment in which they are installed.

B. Cable Pathway

1. In suspended ceiling and raised floor areas where duct, cable trays or conduit are not available, the Contractor shall install cable bundles of 50 or less, station wiring with VELCRO cable ties snug, but not deforming the cable geometry.

2. Cable bundles shall be supported via "J" hooks or bridal rings attached to the existing building structure and framework at a maximum of five (5) foot intervals.
3. Plenum rated cable ties shall be used in all appropriate areas.
4. The contractor shall adhere to the manufacturers' requirements for bending radius and pulling tension of all data and voice cables.
5. Cables shall not be attached to lift out ceiling grid supports or laid directly on the ceiling grid.
6. Cables shall not be attached to or supported by fire sprinkler heads or delivery systems or any environmental sensor located in the ceiling air space (NO EXCEPTIONS).
7. Cables shall not be supported from the suspended ceiling grid hangers (NO EXCEPTIONS).

C. Fire Stopping

1. Sealing of openings between floors, through rated fire and smoke walls, existing or created by the contractor for cable pass through shall be the responsibility of this contractor.
2. Sealing material and application of this material shall be accomplished in such a manner, which is acceptable to the local fire and building authorities having jurisdiction over this work. Refer to Division 26 Section 26 0505, "Basic Materials and Methods" for Fire stopping specifications.
3. Creation of such openings as are necessary for cable passage between locations as shown on the drawings shall be the responsibility of this contractor's work.
4. Any openings created by or for the contractor and left unused shall also be sealed as part of this work.

D. Contractor Responsibility

1. The contractor shall be responsible for damage to any surfaces or work disrupted as a result of his work. Repair of surfaces, including painting, shall be included as necessary.

3.11 PLANNING AND COORDINATION

A. Planning meetings and schedule

1. An initial planning meeting will be held with the successful bidder to:
   a. Clarify all requirements (systems, services, distribution methods, etc.),
   b. Identify responsibilities,
   c. Schedule the events that will transpire during the implementation of the project.
2. Within two (2) weeks of the initial meeting, the contractor shall provide a written report and project schedule to clearly document the events and responsibilities associated with the project.

B. Drawings and review

1. In order to start the initial planning phase, Engineer/Owner shall provide the Contractor with one (1) clearly readable, up-to-date scale copy of all architectural, electrical, and mechanical drawings, two (2) weeks prior to the commencement of any planning activities. This will allow for a one (1) week review of the diagrams by the Contractor, and allow one (1) week for Engineer/Owner, to answer any queries pertaining to the Contractor's review. In reviewing such drawings Contractor shall be obligated to make an on-site

inspection with Engineer/Owner and its General Contractor for on-site verification of access routes for cabling and other matters.

C. Proposed Wiring Solution

1. Upon completion of the initial planning stage, the Contractor shall provide five (5) draft copies of proposed cabling layout documentation for review by Engineer/Owner. Engineer/Owner will review the engineering documentation within a two (2) week period.
2. This documentation will include, but is not limited to the following:
   a. A detailed layout drawing of each proposed ER space
3. If no revisions are required, the documentation shall be stamped and noted with "Complies With Design Intent" and returned to the contractor for execution of the work.
4. If minor revisions are noted, the documentation shall be may be stamped with "Comments Noted" and returned to the contractor. Contractor may begin the installation based upon these comments.
5. If the documentation does not comply with the design intent, they may be stamped with "Rejected", with comments noted. Contractor shall revise the documentation to comply with the design intent and resubmit all copies to the Engineer/Owner for a second review. Any revisions shall be completed by the contractor within a two (2) week time period and resubmitted for review.
6. No work may begin until the documentation has been reviewed and stamped in accordance with comments in sentences #3 or 4 of this paragraph.

D. Drawings and diagrams

1. Upon completion of final planning stage and the incorporation of Engineer/Owner review comments, Contractor shall provide to Engineer/Owner for its records the following:
   a. ER Diagrams which shall include:
      (1) cable routing
      (2) position of all components and
      (3) detailed layout of the wallfield
      (4) labeling plan
   b. Work Area Floor Plans which shall Include:
      (1) detailed cable routes
      (2) approved labeling plan for all work areas
   c. Cross Connect Documentation which shall include:
      (1) cross connect records for all voice, and data devices
   d. Riser Distribution Plan
   e. Cable Tray, Conduit, and Raceway Plans
2. Documentation shall be in the following format:
   a. Four (4) copies and one reproducible sepia of all diagrams and drawings in "D" size (24" x 36") or "E" size (30" x 42") as appropriate,
   b. Two (2) copies of all cross connect documentation in printed form

E. As Built Documentation

1. Upon completion of the project, Contractor shall prepare "As Built" documentation showing actual site conditions and installation as constructed.

2. Provide copies of such documentation to Engineer/Owner as mentioned above.

F. Additional Records

1. In addition to the engineering diagrams, the following items shall be provided by the contractor:

a. Cable Records and Assignments

3.12 DAMAGES

A. The Contractor shall be liable for any and all damages to portions of the building caused by it, its employees or subcontractors; including but not limited to:

1. Damage to any portion of the building caused by the movement of tools, materials or equipment.
2. Damage to any component of the construction of spaces "turned over" to the Contractor.
3. Damage to the electrical distribution system and/or other space "turned over" to the Contractor.
4. Damage to the electrical, mechanical and/or life safety or other systems caused by inappropriate operation or connections made by the Contractor or other actions of Contractor.
5. Other damage to the materials, tools and/or equipment of the owner, its consultants, General Contractor, subcontractors, Architect, Engineer, other contractors, agents and lessees.

3.13 PENETRATIONS OF WALLS, FLOORS, AND CEILINGS

A. Prior consent

1. The Contractor shall make no penetration of floors, walls or ceiling without the prior consent of the Architect/Engineer/Owner and General Contractor.

B. Sealing penetrations

1. Where penetrations through acoustical walls or other walls for cableways have been provided for the Contractor or made by the Contractor, such penetrations shall be sealed by the Contractor in compliance with applicable code requirements and as directed by Engineer, Owner, Architect, or General Contractor.
2. Where penetrations through fire-rated walls for cableways have been provided for the Contractor or made by the Contractor, such penetrations shall be sealed by the Contractor as required by code and as directed by Engineer, Owner, Architect, or General Contractor.
3. Contractor shall, prior to the commencement of on-site activities, submit to Engineer/Owner for review by its Architect, details of any special systems to be used.

3.14 ON SITE MOVE-IN DAY SUPPORT

A. Technical Support

1. Contractor will provide technical support on a per/hour basis at such levels and at such times as Owner deems necessary during the physical move to the site.
2. The personnel providing technical support will:

a. Have intimate knowledge of the System and Materials that were used
b. Be skilled in all use of equipment and materials used under the Contract
c. Be competent to troubleshoot and fix problems associated with Contractor provided materials

3.15 PROJECT DIRECTION

A. Single Point of Contact

1. Contractor will provide a single point of contact, i.e., Project Manager, to speak for the Contractor and to provide the following functions:

   a. Initiate and coordinate tasks with Owner, its General Contractor, Architect, Engineer, and others as specified by the Owner
   b. Provide day-to-day direction and on-site supervision of Contractor personnel

B. Ensure conformance with all Contract provisions

3.16 INSPECTION

A. On-going inspections shall be performed during construction by the Project Manager and/or the CCS System Manager. All work shall be performed in a high quality manner and the overall appearance shall be clean, neat and orderly.

B. The following shall be examined and shall comply satisfactorily in all instances.

1. Is the design documentation complete?
2. Are all cables properly labeled, from end-to-end?
3. Have all terminated cables been properly tested in accordance with the specifications for the specific category as well as tested for opens, shorts, polarity reversals, transposition and presence of AC and/or DC voltage?
4. Is the cable type suitable for its pathway?
5. Are the cables bundled in parallel?
6. Have the pathway manufacturer's guidelines been followed?
7. Are all cable penetrations installed properly and fire stopped according to code?
8. Have the Contractors avoided excessive cable bending?
9. Have potential EMI and RFI sources been considered?
10. Is Conduit/Cable Fill Correct?
11. Are hanging supports within 1.5 meters (5 feet)?
12. Does hanging cable exhibit some sag?
13. Are telecommunications closet terminations compatible with applications equipment?
14. Have Patch Panel instructions been followed?

    a. jacket removal point
    b. termination positions
    c. all pair terminations tight with minimal pair distortions
    d. twists maintained up to Index Strip

15. Have Modular Panel instructions been followed?

    a. cable dressing first
    b. jackets remain up to the Connecting Block
    c. all pair terminations tight and undistorted
    d. twists maintained up to the Connecting Block

16. Are M1/ MPS100E / MGS400 connectors properly turned right side up in the Jack Panels without cables wrapped or twisted around the Mounting Collars?

    a. Have the correct outlet connectors been used (M1 / MPS100E / MGS400)
    b. Have outlets been wired correctly? (T568A or T568B)?
    c. Is the cable jacket maintained up to the M1/MPS100E/MGS400?
    d. Are identification markings uniform, permanent and readable?

3.17 FIELD QUALITY CONTROL

A. Copper Cable testing

1. Testing of all copper wiring shall be performed prior to system cutover.
2. 100 percent of the horizontal and riser wiring pairs shall be tested for opens, shorts, polarity reversals, transposition and presence of AC voltage.
3. Voice and data horizontal wiring pairs shall be tested from the information outlet to the ER or TR.
4. The Category 3 cable runs shall be tested for conformance to the specifications of EIA/TIA 568-B Category 3.
5. The Category 5E cable runs shall be tested for conformance to the specifications of EIA/TIA 568-B Category 5E.
6. The Category 6 cable runs shall be tested for conformance to the specifications of EIA/TIA 568-B Category 6.
7. Category 5E and Category 6 horizontal cables shall be tested according to test set manufacturer's instructions utilizing the latest firmware and software.
    a. Testing shall include all of the electrical parameters as specified in the Products Section of this document.
    b. Any pairs not meeting the requirements of the standard shall be brought into compliance by the contractor, at no charge to the Owner.
8. Complete, end to end, test results must be submitted to Engineer/Owner.

B. Optical Fiber Cable Testing

1. All fiber testing shall be performed on all fibers in the completed end to end system.
2. Testing shall consist of a bi-directional end to end OTDR trace performed per EIA/TIA 455-61 or a bi-directional end to end power meter test performed per EIA/TIA 455-53A.
3. The system loss measurements shall be provided at 850 and 1310 nanometers for multimode fibers and 1310 and 1550 for single mode fibers.
4. Pre-installation cable testing
    a. The Contractor shall test all lightguide cable prior to the installation of the cable.
    b. The Contractor shall assume all liability for the replacement of the cable should it be found defective at a later date.
5. Loss Budget
    a. Fiber links shall have a maximum loss of:
        (1) Allowable cable loss per km)(km of fiber in link) + (.4dB)(number of connectors) = maximum allowable loss
            (a) A mated connector to connector interface is defined as a single connector for the purpose of this RFP
    b. Loss numbers for the installed link shall be calculated by taking the sum of the bi-directional measurements and dividing that sum by two.
    c. Any link not meeting the requirements of the standard shall be brought into compliance by the contractor, at no charge to the Owner.
    d. Documentation shall be provided in both hard copy and 3 1/2 inch diskette to the point of contact.

3.18 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

3.19 COMPLETION OF WORK

A. At the completion of the System, the Contractor shall restore to its former condition, all aspects of the project site and on a daily basis, shall remove all waste and excess materials, rubbish debris, tools and equipment resulting from or used in the services provided under this Contract.

B. All clean up, restoration, and removal noted above shall be by the Contractor and at no cost to the Owner.

C. If the Contractor fails in its duties under this paragraph, the Owner may upon notice to the Contractor perform the necessary clean up and deduct the costs thereof from any amounts due or to become due to the Contractor.

D. The Owner, through the General Contractor will provide a dumpster for the use of the Contractor.

E. It shall be the Contractor's responsibility to remove trash from the areas it is working in and bring trash and debris to the dumpster.

F. The Contractor shall not use the General Contractor's dumpsters or trash disposal without prior approval of the General Contractor.

3.20 TRAINING

A. The CCS Contractor shall provide a minimum of (1) technician for one (1) week beginning with the first scheduled move-in date.

B. This technician will also assist the owner in cross connecting the voice and data services throughout the building during the move-in period. It is at this time that all Owner provided connectivity schedules for voice and data services will be provided to the Contractor.

C. Patching (cross connection) of the station assignments between the Owners service demarc shall also be considered part of this Contractors work.

END OF SECTION

SECTION 28 23 00
VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

Applicable provisions of Division 0 and 1 shall govern work of this Section.

CONTENTS

PART 1 - GENERAL
- SCOPE
- RELATED WORK
- REGULATORY REQUIREMENTS
- SUBMITTALS

PART 2 - PRODUCTS
- CAMERAS
- CABLING
- DISPLAY MONITOR
- VIDEO AND NETWORK ELECTRONICS
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PART 3 - EXECUTION
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- CABLE INSTALLATION
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- CAMERA INSTALLATION
- TESTING AND ACCEPTANCE
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- OPERATIONS AND MAINTENANCE MANUALS
- WARRANTY AND SUPPORT

SCOPE
This section covers the equipment, hardware and cabling requirements of a Video Surveillance System (VSS) for the project.

Major features of the Video Surveillance System include Cameras and Camera Mounting Hardware, Camera Signal and Power Wiring, and Display and Recording Hardware and Software. The system is also to be integrated with security alarms and other devices.

Detailed requirements of the system and responsibilities to provide, furnish and/or install are as follows:

<u>Contractor-furnished, Contractor installed</u>
IP (Network) Cameras.
Camera Housings
Camera Mounts
Camera Power Supply/Supplies (if other than Power-over-Ethernet)
Video Encoders
Display Monitors and related cabling
Patch Cords at Camera locations
Cabling (Signal, Power, Control) and Termination Hardware
Cable Support Hardware
Display Monitor Support Hardware
Network Electronics (Routers, switches, etc.)
PoE Injectors (as applicable; may be integrated into network electronics)
Recording Equipment, related hardware and software
Cabling - Signal and camera Power (if applicable)
Cable Pathways
Camera Rough-in

All equipment, cables and related termination, support and grounding hardware, bonding as required for a full and functioning system, shall be installed, wired, tested, labeled, and documented by the Contractor, as detailed in this and related section(s).

RELATED WORK

Division 28 Sections:
None.

Division 27 Sections:
Section 27 1300-Telephone & Data Cabling System

Division 26 Sections:
Section 26 05 05 Basic Electrical Materials and Methods
Section 26 05 26 – Grounding and Bonding for Electrical Systems
Section 26 05 33 – Raceway and Boxes for Electrical Systems

REGULATORY REQUIREMENTS
UL Listed
FCC Part 15 as applicable to the equipment type(s) included

SUBMITTALS
Submit the following for approval prior to ordering any equipment in accordance with requirements of Division 1, General Conditions:
- Product data for all equipment, hardware cabling and miscellaneous components proposed,
- Floor plan drawings showing equipment and device locations with proposed conduit wiring, pull box and junction box locations,
- Camera mounting details specific to location,
- Schematic drawings - specific to project - of all circuits from the field devices to the required connection points. The diagrams shall show schematic wiring of equipment and all connections to be made to devices. Terminal connections in the equipment shall be numbered to correspond to the diagrams for use in making connections. Wiring diagrams shall be coordinated so that terminal numbering, circuit designation and equipment or device designations are the same on all drawings. All drawings must be submitted and approved by the Engineer before installation starts, but such approval will not waive any specification requirements unless specifically stated.

Mark submittal package with specification section number. Do not mix sections in a single submittal.

Mark general catalog sheets and drawings to indicate specific items being submitted and proper identification of equipment by name and/or number, as indicated in the contract documents.
- Markings shall be reproducible (arrow, underlines, circled, checkmark, etc.).
- Where sheet or drawing includes options, mark proposed option(s).
- When manufacturer's reference numbers are different from those specified, provide explanation and cross-reference number for each item.

Work shall not proceed without Engineer approval of the submitted items.

No substituted materials shall be installed except by written approval from the Engineer.

The Owner reserves the right to make changes to descriptive information, component selection and nomenclature during shop drawing review without incurring any additional cost.

PART 2 - PRODUCTS

CAMERAS
General

Mount

As required for camera type and location. Refer to project drawings.

Power Supply
Except where otherwise noted, IP (network) cameras are powered via network connection (e.g. Power-over-Ethernet; PoE). Exceptions include:
- Outdoor locations where camera is equipped with an environmental package (e.g. heater, fan)
- PTZ models including: Refer to project drawings.

Power supplies shall be Contractor-Furnished, Contractor-Installed.

CABLING
Horizontal Cabling
4-pair UTP; Category 6.
- Refer to specification Section 27 10 00 for cable and termination component specifications.
- Cable Jacket Color –Same as other "Data" cabling on project.
- Modular Jack Color (Camera Location) – Same as other "Data" cabling on project.

DISPLAY MONITOR

Display and Mounting hardware as follows:
Refer to project drawings.

VIDEO AND NETWORK ELECTRONICS
Recording, Control and Storage Equipment

Network Electronics

Media Converters

Video Encoders and other Analog Video Equipment

MISCELLANEOUS ITEMS
Surge Protection
Outdoor cameras served by copper cabling shall incorporate Surge Protection in the path from camera to network electronics.

Surge Protection features:
- Supports Category 6 transmission.
- Protects 10/100/1000 Base-T Ethernet networks.
- Provides protection for both common- and differential-mode surges.
- Supports Modes A and B of 802.11af-2003 (PoE) and 802.11at-2009 (PoE+) standards.
- Complies with Telcordia GR-1089-CORE (Intra-Building).
- Network Interface: 8P8C Modular Jacks (e.g. RJ45).
- External Ground Lug
- Incorporates heavy-duty, weatherproof ABS or cast metal enclosure.
- Incorporates weatherproof cable glands at cable entry. Gland opening is large enough to pass un-booted 8P8C Modular jack so pre-terminated cables can be used.

Uninterruptable Power Supply (UPS)
UPS features:
- Capable of providing voltage and current as required to operate equipment for no less than (15) minutes duration.
- Protects connected loads from surges, spikes, lightning, and other power disturbances.
- Incorporates audible alarm to indicate change in site power and UPS status.
- Automatic self-test provides early indication when battery replacement is required.
- Incorporates hot-swappable batteries.
- Includes a protection indicator light and master power switch.
- Input: 120V/60 Hz. AC cord with NEMA5-15P straight-in plug connection. Re-settable circuit breaker.
- Minimum 3-year product warranty.

PART 3 - EXECUTION

GENERAL
The complete installation shall be done in a neat, workmanlike manner in accordance with Division 26 of these documents and manufacturer's recommendations.

The installation shall conform to site requirements for security and inmate care. Temporary or permanent installations, which conflict with site operations, security or inmate care, shall be immediately corrected by the contractor with no additional compensation.

Security guidelines for working within the secure areas of the facility shall be followed by the contractor.

CABLE INSTALLATION

General

All cable shall be installed in accordance with Section 27 1300-Telephone & Data Cabling System, (Part 3 - Execution).

All wiring shall be run "free-air" above accessible ceilings, or in a secured metal raceway for outdoor or as designated on the plan drawings. All cable shall be free of tension at both ends.

Size conduit per manufacturers recommendations or per project plans, whichever is larger.

All video, network, power and control wire and cable (as applicable) shall be secured with multi-use cable straps Cable straps shall be Hook-and-Loop type to provide easy access for servicing of cable.

Horizontal Cabling

Provide 4-pair cable to each camera location for video signal (and PoE if applicable).

Terminate horizontal cabling at Telecommunications Room (Equipment Room, Telecom Enclosure, etc.) in a Modular Patch Panel.

- Cables designated for cameras shall be terminated on patch panel separate from other 4-pair horizontal cabling.

Camera (Work Area) Cords and Patch Cords

- Camera Location – Not applicable. Horizontal Cable terminated in Modular Plug.
- Equipment Location – Provide 4-pair Cords between Modular Patch Panel and Network Electronics.
- Fiber Optic – Provide as required to establish needed network connectivity between project buildings.

CAMERA INSTALLATION

General

Camera mounts shall be rigidly attached to structural members. Cameras located on lay-in ceiling shall not be supported by the ceiling tile or grid. Support shall be added from structural building members utilizing threaded rod and strut metal framing, tile bridge, or other approved means.

Install cameras, mounts, power supplies, control equipment, monitors, recording equipment and related hardware as applicable per manufacturer recommendations.

Connect Alarms Input(s) / Alarm Output(s) and/or connections to other systems as specified.

Power Supply

Not applicable to this project. All cameras are PoE-powered.

Network Settings

Where IP (Network) type cameras are installed, coordinate network addresses and camera settings with Owner. Contractor is responsible for configuring camera.

Provide documentation horizontal cabling identifying on which Patch Panel port each camera cable is terminated (e.g. Camera X = port Y).

Positioning and Lens Adjustment - Preliminary

Prior to rough-in at camera locations, the contractor shall demonstrate all camera locations for the purposes of making final camera position and lens adjustments. Contractor shall provide 14 day notice (minimum) to allow for participation by Owner and Engineer.

Demonstration of the camera view at each location shall be as follows:

- Place representative camera at the given location and display the video on a temporary monitor or workstation. Provide laptop computer or other suitable display as required to perform this work.

- Camera placement may be by temporary support or by holding the camera in place by hand. (The Technician should not be visible in the image.)
- Owner Construction Representative will direct the contractor to the desired field of view at that location.
- Document the approved field of view by saving the image electronically (preferred), taking a still photo of the viewing monitor or other approved means.
- At locations where Pan-Tilt-Zoom capabilities are called for, the movement of the camera shall be simulated and the views at the extents of this movement documented.

For purposes of bidding, contractor shall assume the responsibility to provide temporary power supply, PoE injector or other means to power camera for this demonstration.

The Contractor shall include in his estimate, minor adjustments in camera location/placement relative to plan to account for unanticipated obstructions to the field of field, mechanical interferences with new raceway and lighting fixture obstructions. There shall be no additional cost for this adjustment. Minor adjustments are considered those that do not change the housing type or mounting conditions and either a) decreases the distance from the camera to the wiring hub or b) increased the distance from the camera to the wiring hub by no more than ten (10) feet when compared to the location shown on the drawings.

SYSTEM POWER
Surge Suppression
Install per manufacturer's recommendations.

Position Surge Suppression as close to building entrance as practicable or as noted on drawings. Document location on record documents.

Bond to communications ground. Size grounding conductor per manufacturer's recommendations.

Uninterruptable Power Supply (UPS)
Provide Uninterruptable Power Supply (UPS) as follows:

Install per manufacturer's recommendations.

TESTING AND ACCEPTANCE
General
Conduct tests upon completion of all work or during course of construction when identifiable portion(s) of overall work are complete.

Sequence of Acceptance Testing shall be as follows:
- Submit Acceptance Test Plan
- Plan Accepted
- Perform Pre-Test Inspection
- Perform Acceptance Tests

Owner Construction Representative, site representatives, and Engineer may be in attendance to witness testing. Provide minimum one (1) week advance notice as to allow for such participation. Failure to provide notification shall be grounds for the Owner/Engineer to reject any and all documentation of results on related testing and to require a repeat of the affected test.

Test plan shall be established as to not delay project schedule. Obtain approval of schedule with the above parties before commencing with Acceptance Tests. Schedule shall allow time for correction of defects and remedial work.

Supply all equipment and personnel necessary to conduct acceptance tests.

Perform tests related to connected equipment of others only with permission and presence of Contractor(s) responsible for that equipment.

Should it be found by the Engineer that the materials or any portion thereof furnished and installed under this contract fail to comply with the specifications and drawings, with the respect or regard to the quality, amount of value of materials, appliances or labor used in the work, it shall be rejected and replaced by the Contractor and all work distributed by changes necessitated in consequence of said defects or imperfections shall be made good at the Contractor's expense.

Document all tests.

At the request of the Engineer, provide copies of the original test results.

Use of equipment for actual testing that is different than that submitted shall be cause for rejection of all tests performed with that equipment.

Acceptance Test Plan
Prior to Acceptance Testing, submit a summary of the proposed test plan to Owner Construction Representative, site representatives, and Engineer.

Test plan shall include – at minimum – proposed schedule, list of tests to be performed, equipment to be used, set-up, expected results and documentation format.

Testing shall not proceed without approval by the Engineer.

Pre-Test Inspection
Prior to commencement of the Acceptance Tests, inspect equipment, hardware and cabling.

At minimum, verify the following:
- Cameras of the specified type are installed at the specified locations.
- Cameras are secured as required to protect against operational damage.
- Signal, power and control cabling (as applicable) are installed and terminated as specified..
- External cameras are provided with adequate protection against moisture and other environmental conditions;
- Cameras, operator workstation equipment and cabling are properly labeled.
- Associated equipment such as power supplies are connected correctly and secured appropriately.

Prior to the commencement of the Acceptance Tests, verify the installation and configuration of software related to the operation and control of the VSS.

At minimum, verify the following:
- Software specified in the design documentation and/or modules required to perform all specified operation functions are installed and configured.
- The latest release version of all software modules including patches and upgrades have been provided;
- The control equipment hardware has sufficient capacity to support the software routines and functions under worst-case demand conditions;
- Cameras, system reports, screens and menus have been correctly configured;
- Software has been registered to the Owner.

Acceptance Tests
The contractor shall obtain written approval of the documentation from Owner representatives before commencing the Acceptance Tests.

Perform tests to assess overall functionality of the VSS as per the project documents.

Equipment and Sub-system specific testing requirements are as follows:
<u>Cameras</u>
Verify the following for each Camera:
- Camera produces a clear picture and is aimed per site requirements.
- Camera maintains a clear picture and automatically compensates for changing light conditions including day/night change.
- Camera has wide dynamic range installed where specified and operate to prevent camera blinding;
- Camera provides complete and correct coverage of the area specified.
- Pan, Tilt and Zoom (PTZ) function (as applicable) is fully controllable and functions correctly.
- PTZ Cameras (if applicable) are able to perform call to preset positions by simulating an event alarm.
- Cameras are fitted with anti-tamper devices where specified.
- Simulated tamper alarm is transmitted to the operator workstation.
- Functioning of Alarms Input(s)/Output(s) and/or connections to other systems as specified.
- Areas of the camera view can be masked to prevent unwanted alarm activation.
- Simulated video feed fault transmits correct signal to the operator workstation.

Operator Workstation / Control
Verify the following:
- Display orientation/position, camera/view identification.
- Display and/or notification of alarm condition (if applicable).
- Manual control of cameras (if applicable).
- Real time video data analysis functions (such as movement detection) are performed in real time and the corresponding view displayed on the monitor.
- VSS interfaces with the electronic monitoring and access control system and/or the intercom system to display the correct camera view on the monitor when the corresponding signal is received.

Recording and Playback Functions
Verify the following:
- Data storage capacity has been installed on the workstation as specified;
- System hardware supplied is per specification.
- Correct video data is recorded by the system in response to simulated alarms.
- Manual Record function operates correctly.
- Playback functions operate correctly including Play, Stop, Pause, Rewind, Fast forward, Frame by frame view.
- Retrieval of stored video.
- Export of stored video.

Retain copies of test results for inclusion in documentation at project completion.

TRAINING
Provide training to Owner and site staff, and/or contract maintenance personnel on an overview of the system and on operation and maintenance of equipment installed by the contractor.

Coordinate with Owner Construction Representative, site staff, and Engineer to schedule session(s). Provide adequate notification to allow Owner to schedule staff.

Training to include:
- Overview of System Topology and General Concepts
- Overview of Product Used
- Overview of Monitoring/Control Layout
- Overview of Labeling Formats
- Camera control functionality (if applicable)
- Overview of Test Results and their meaning
- Overview of Documentation

Training shall be held at Project Site and shall be conducted during normal working hours.

For purposes of bidding, assume (1) Training Session(s). Coordinate training with Owner to accommodate staff schedules.

Training session duration shall be not less than two (2) hours.

Provide training materials for each student plus (2) additional copies.

Owner reserves the right to videotape session(s) for use as future refresher materials for Owner technical staff.

OPERATIONS AND MAINTENANCE MANUALS
General
Submit quantities required by Division 1.

Provide documents in hard copy and in electronic form.

Submit product and test data as Adobe Acrobat (.pdf) files.

Submit drawings and schematics as Adobe Acrobat (.pdf) files and AutoCAD (.dwg) files.

Submit images of individual camera views as JPEG (.jpg; preferred) or Adobe Acrobat (.pdf) files.

As a minimum, O&M Manuals shall include:
- Drawings annotated to show as-installed camera locations, cable routes and major equipment locations
- Cabling Schematics
- Approved Submittals

- Test plan and test report sheets
- Programming documents (pre-sets, tours, etc.)
- Hardware and software technical manuals;
- Operator and maintenance manuals
- Troubleshooting Guidelines
- Equipment Rack Elevations

All documentation, including hard copy and electronic forms shall become the property of the State.

WARRANTY AND SUPPORT
Warranty
This Contractor shall guarantee the following for a period of two (2) years from date of substantial completion of this work:
- All provided materials and equipment
- Installation of all equipment, hardware, cabling and related components.

Warranties shall include labor, materials and travel time.

See Division 1, GENERAL CONDITIONS, and GENERAL REQUIREMENTS - Guarantee Documents and the individual technical sections for further requirements.

Contractor shall repair, replace or alter systems or parts of systems having failed, or found defective or not meeting specified performance requirements. This shall be at no cost to the State.

If while fulfilling requirements of this warranty, the Contractor disturbs other work, the Contractor shall arrange for such disturbed work to be restored to its original condition by the responsible Contractor. This shall be at no cost to the State.

END OF SECTION

SECTION 28 3111
NEW FIRE ALARM SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This Section includes, but is not limited to, providing a new addressable multiplexed fire alarm system, including manual stations, smoke and heat detectors, visible and audible notification devices, voice notification, networked signal communication, HVAC and fire protection controls, and other devices.

1.2 DEFINITIONS

A. FACP: Fire Alarm Control Panel

B. BMS: Building Management (DDC) System

C. ADA: Americans with Disabilities Act

1.3 CODES AND STANDARDS

A. NFPA 72 – National Fire Alarm Code, 2002 Edition

B. UL – Underwriters Laboratories, Inc, latest edition

C. ISO 9001

D. NFPA 70 – National Electrical code (NEC)

E. NFPA 92A – Smoke Control Systems

F. NFPA 101 – Life Safety Code

G. International Fire Code, 2002 Edition

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced factory-authorized Installer to perform work of this Section.

B. Fire alarm designer: Shop drawings shall be produced by, or under the direct supervision of, a NICET Certified Level IV fire alarm engineering technician or licensed fire protection engineer (P.E.).

C. Single-Source Responsibility: Obtain fire alarm components from a single source who assumes responsibility for compatibility of system components.

D. Compliance with Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements of the authorities having jurisdiction.

E. Comply with NFPA 70.

F. Comply with NFPA 72.

G. Listing and Labeling: Provide fire alarm systems and components specified in this Section that are listed and labeled by Factory Mutual.

H. Listing and Labeling: Provide systems and equipment specified in this Section that are listed and labeled.

1. The Terms “Listed” and “Labeled”: As defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A “Nationally Recognized Testing Laboratory” (NRTL) as defined in OSHA Regulation 1910.7.

1.5 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data for each type of system component specified including dimensioned plans and elevations showing minimum clearances and installed features and devices. Include list of materials and Nationally Recognized Testing Laboratory (NRTL) listing data.

C. Letter from and NCIET Level IV designer or licensed fire protection engineer indicating that the fire alarm system design has been reviewed and is in compliance with codes and manufacture instructions.

D. Wiring diagrams from manufacturer differentiating clearly between factory- and field-installed wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Make all diagrams specific to this Project and distinguish between field and factory wiring.

E. Floor Plans: Indicate final outlet locations and routings of raceway connections.

F. Device Address List: Coordinate with final system programming.

G. System operation description covering this specific Project, 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. Manufacturer's standard descriptions for generic systems are unacceptable.

H. Operating instructions for mounting at the FACP, and all accessories.

I. Product certificates signed by manufacturers of fire alarm system components certifying that their products comply with specified requirements.

J. Maintenance data for fire alarm systems to include in the operation and maintenance manual specified in Division 01. Include data for each type of product, including all features and operating sequences, both automatic and manual. Include recommendations for spare parts to be stocked at the site. Provide the names, addresses, and telephone numbers of service organizations that carry stock of repair parts for the system to be furnished.

K. Submission to Authorities Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authorities having jurisdiction. Include copies of annotated Contract Drawings as needed to depict component locations to facilitate review. Upon receipt of comments from the authorities having jurisdiction, submit them for review. Resubmit if required to make clarifications or revisions to obtain approval.

L. Record of field tests of system.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

B. Where recommended by the equipment supplier, deliver equipment in fully enclosed vans after specified environmental conditions have been permanently established in spaces where equipment is to be placed. The products accepted on the site shall be wrapped in factory packing, and shall be inspected for damage prior to acceptance.

C. Store equipment in clean, dry with non-condensing environments that are controlled within manufacturer=s ambient tolerances for non-operating equipment. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

D. Handle equipment carefully to prevent damage, breaking, and scoring. The contractor shall not install damaged units or components; replace with new.

E. Equipment furnished by others. The contractor shall be responsible for receiving, uncrating, inspecting, storing, and installing of Division 26 equipment listed as furnished by others.

1.7 SPARE PARTS

A. Provide within the FACP spare capacity (cards & controllers) the ability to expand the quantity of initiating and notification devices by 25% over those indicated and required by the contract documents and specified herein.

B. Furnish extra materials described below, before installation begins, that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

1. Tamper Covers and Wire Guards: Quantity equal to 15% of the number of units installed; minimum of six
2. Lamps for Remote Indicating Lamp Units: Quantity equal to 10% of the number of units installed, but not less than one
3. Lamps for Strobe Units: Quantity equal to 10% of the number of units installed, but not less than one
4. Smoke Detectors, Heat Detectors, and Duct Detectors: Quantity equal to 10% of the number of units of each type installed, but not less than one of each type
5. Detector Bases: Quantity equal to 10% of the number of units of each type installed, but not less than one of each type
6. Printer Consumables: Four cartridges or ribbons

1.8 WARRANTY

A. Equipment and systems shall be warranted by the manufacturer and the Contractor for a period of one year following final acceptance. The warranty shall include, but not be limited to, parts, labor, 24 hour service, pick-up, and delivery.

1.9 MAINTENANCE

A. Maintenance Service: The equipment manufacturer shall include a maintenance contract for the entire campus-wide system to provide a minimum of two inspections and tests per year for two years in compliance with NFPA 72 guidelines.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. General: Provide a new zoned, multiplexed, networked, addressable, microprocessor-based fire-detection and alarm system, including manual and automatic alarm initiation, analog intelligent addressable detectors, smoke and heat detectors, duct detectors, tamper and waterflow switches, HVAC shutdown, elevator recall, automatic alarm verification, and sprinkler system interlocks as indicated.

B. Signal Transmission: Hard wired, using separate individual circuits for each zone of alarm initiation and alarm device operation.

C. Audible Alarm Indication: By sounding of speakers capable of reproducing various tones and voices.

D. Visual Alarm Indication: By xenon strobe-type units.

E. Supervision of circuits based on Class A wiring as follows:

1. Style D for initiating devices circuits
2. Style Z for notification appliance circuits

3. Style 7 for signaling line circuits

F. Releasing Control: The new FACP shall be listed and labeled for releasing control of fire suppression systems.

G. Smoke Control: The new FACP shall be listed and labeled for control of HVAC units to control smoke spread.

H. At the completion of the project, each newly installed control panel, annunciator panel, addressable wiring loop, equipment addresses and emergency battery supply shall have a minimum of 25% spare capacity for future additions.

2.2 MANUFACTURERS

A. Manufacturers and Products: Subject to compliance with requirements, manufacturers offering fire alarm systems based on the following fire alarm control panels (FACPs):

1. Notifier AM2020 system
2. Simplex 4120 system
3. Siemens Cerberus Pyrotonics MXL system
4. Edward Systems Technologies EST-3 System

2.3 FIRE ALARM CONTROL PANELS (FACPS)

A. General: The fire alarm control panel (FACP) shall provide power, annunciation, supervision, detection, alarm, and control for fire protection and smoke management.

B. Fire alarm panels shall be addressable, multiplexed, and capable of being networked in a pier-to-pier connection.

C. Cabinet: Lockable steel enclosure. Arrange panel so all operations required for testing or for normal care and maintenance of the system are performed from the front of the enclosure. If more than a single unit is required to form a complete control panel, provide exactly matching modular unit enclosures. Accommodate all components and allow ample gutter space for interconnection of panels and field wiring. Identify each enclosure by an engraved, red, laminated, phenolic-resin nameplate. Lettering on the enclosure's nameplate shall not be less than 1" high. Identify individual components and modules within the cabinets with permanent labels.

D. Systems: Alarm and supervisory systems are separate and independent in the FACP. The alarm-initiating zone boards in the FACP consist of plug-in cards. Construction requiring removal of field wiring for module replacement is unacceptable.

E. Control Modules: Provide new modules of types and capacities required to perform all functions of the fire alarm systems. Local, visible, and audible signals announce alarm, supervisory, and trouble conditions. Each type of audible alarm shall have a unique tone/sound.

F. Zones: Provide new circuitry for all alarm and supervisory zones indicated.

G. Resetting: Provide the necessary controls to prevent the resetting of any alarm, supervisory, or trouble signal while the alarm or trouble condition still exists.

H. Alphanumeric Display and System Controls: Arrange to provide the basic interface between human operator at the FACP and addressable system components, including annunciation, supervision, and control. A display with a minimum of 32 characters shows alarm, supervisory, and component status messages and indicates control commands to be entered into the system for control of smoke detector sensitivity and other parameters. Arrange keypad for use in entering and executing control commands.

I. Instructions: Printed or typewritten instruction card mounted behind a lexan plastic or glass cover in a stainless-steel or aluminum frame. Install the frame in a location

observable from the FACP. Include interpretation and appropriate response for displays and signals, and briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 FUNCTIONAL DESCRIPTION AND SEQUENCE OF OPERATION

A. Include the following system functions and operating features plus those additional functions and features required by the authorities having jurisdiction and by Owner:

1. Priority of Signals: Accomplish automatic response functions by the first zone initiated. Alarm functions resulting from initiation by the first zone are not altered by subsequent alarms. The highest priority is an alarm signal. Supervisory and trouble signals have second- and third-level priority. Higher-priority signals take precedence over signals of lower priority, even though the lower-priority condition occurred first. Annunciate all alarm signals regardless of priority or order received.
2. Non-interfering: Zone, power, wire, and supervise the system so a signal on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACP after the initiating device or devices are restored to normal. Systems that require batteries or battery back-up for the programming function are unacceptable.
3. Fire Alarm Control Panel (FACP) Response: The manual or automatic operation of an alarm-initiating or supervisory-operating device causes the FACP to transmit an appropriate signal including the following:
   a. General alarm
   b. Water flow alarm
   c. "Alarm Verification" sequence
   d. Fire-suppression system operation alarm
   e. Smoke or heat detector alarm
   f. Valve tamper supervisory signal
   g. Sprinkler piping supervisory signal
   h. Door release
   i. System trouble
   j. Fan shutdown
   k. Elevator recall
4. Transmission to Remote Central Station: Automatically route alarm, supervisory, and trouble signals to a remote central station service.
5. Silencing at the FACP: Switches provide capability for acknowledgment of alarm, supervisory, trouble, and other specified signals at the FACP; and capability to silence the local audible signal and light a light-emitting diode (LED). Subsequent zone alarms cause the audible signal to sound again until silenced by switch operation. Restoring alarm, supervisory, and trouble conditions to normal extinguishes the associated LED and causes the audible signal to sound again until restoration is acknowledged by switch operation.
6. Loss of primary power sounds a trouble signal at the FACP. The FACP indicates when the fire alarm system is operating on an alternate power supply.
7. Loss of primary power at the FACP sounds a trouble signal at the FACP and the annunciator. An emergency power light is illuminated at both locations when the system is operating on an alternate power supply.
8. Annunciation: Manual and automatic operation of alarm- and supervisory-initiating devices is annunciated both on the FACP and on the annunciator, indicating location and type of device.

9. FACP Alphanumeric Display: Displays plain-English language descriptions and addresses of initiating devices, alarms, trouble signals, supervisory signals, monitoring actions, system and component status, and system commands.
10. General Alarm: A system general alarm includes the following:
    a. Indicating the general alarm condition at the FACP.
    b. Identifying the device that is the source of the alarm (or its zone) at the FACP.
    c. Initiating audible and visible alarm signals throughout the building.
    d. Stopping supply and return fans serving zone where alarm is initiated.
    e. Closing smoke dampers on system serving zone where alarm is initiated.
    f. Recall of elevators in the zone where the alarm is initiated.
    g. Unlocking designated doors.
    h. Recording the event on the system printer.
    i. Initiating transmission of alarm signal to remote central station and municipal fire alarm system
    j. Initiating transmission to "Fire Detected" alarm signal to the facility BMS.
    k. Activating the deluge valve solenoid (opening deluge valve) in pre-action control cabinet.
11. Manual Station Alarm Operation:
    a. Indicating the general alarm condition at the FACP
12. Water-flow alarm switch operation:
    a. Initiates a general alarm
    b. Causes flashing of the device location-indicating lamp for the device that has operated.
13. Fire Detection from Smoke or Heat Devices Causes:
    a. General alarm initiation
14. Smoke Detection from Duct Detector Causes:
    a. Initiates a general alarm
    b. Stops only supply and return fans upstream or downstream from duct detector
15. Sprinkler valve tamper switch operation causes or initiates the following:
    a. A supervisory, audible, and visible "valve tamper" signal indication at the FACP
    b. The location-indicating light to flash for the device that has operated
16. Low-air-pressure switch operation on a dry pipe or pre-action sprinkler system causes or initiates the following:
    a. A supervisory, audible, and visible "low air pressure" signal indication at the FACP
    b. The location-indicating light to flash for the device that has operated
17. System Trouble including circuit break in the fire alarm system wiring, ground in the fire alarm system wiring, or maintenance switch operation causes or initiates the following:
    a. A supervisory, audible, and visible signal indication at the FACP
18. Maintenance Switch causes or initiates the following:
    a. A supervisory, audible, and visible signal indication at the FACP

b. Prohibits automatic activation of the deluge valve solenoid (opening of the deluge valve) by an alarm from a fire detector

19. Remote Detector Sensitivity Adjustment: Manipulation of controls at the FACP causes the selection of specific addressable smoke detectors for adjustment, display of their current status and sensitivity settings, and control of changes in those settings. The same controls can be used to program repetitive, scheduled, automated changes in sensitivity of specific detectors. Sensitivity adjustments and sensitivity adjustment schedule changes are recorded by the system printer.

B. Recording of Events: Record on PC computer and print a record all alarm, supervisory, and trouble events. Printouts are by zone, device, and function. When the FACP receives a signal, the alarm, supervisory, and trouble conditions are printed. The printout includes the type of signal (alarm, supervisory, or trouble) the zone identification, date, and the time of the occurrence. The printout differentiates alarm signals from all other printed indications. When the system is reset, this event is also printed, including the same information for device, location, date, and time. A command initiates the printout of a list of existing alarm, supervisory, and trouble conditions in the system.

1. Permissible Signal Time Elapse: The maximum permissible elapsed time between the actuation of any fire alarm or fire-detection system alarm-initiating device and its indication at the FACP is 2 seconds.
2. Independent System Monitoring: Supervise each independent smoke- or heat-detection system, duct detector, and elevator smoke-detection system for both normal operation and trouble.
3. Circuit Supervision: Indicate circuit faults by both a zone and a trouble signal at the FACP. Provide a distinctive indicating audible tone and LED-indicating light. The maximum permissible elapsed time between the occurrence of the trouble condition and its indication at the FACP is 10 seconds.

2.5 ADDRESSABLE DEVICES

A. Alarm-Initiating Devices: Classified as addressable devices according to NFPA 72.

1. Communication Transmitter and Receiver: Integral to device. Provides each device with a unique identification and capability for status reporting to the FACP.
2. External Addressable Interface Unit: May be used where specified devices are not manufactured and labeled with integral multiplex transmitter and receiver. Arrange to monitor status of each device individually.

2.6 MANUAL PULL STATIONS

A. Description: Addressable, double-action type, fabricated of metal or plastic, and finished in red with molded, raised-letter operating instructions of contrasting color.

1. Tamper Feature: All manual pull stations shall be provided with tamper covers which provide a local audible alarm when the cover is lifted prior activating the pull station.
2. Station Reset: Key or wrench operated, double pole, double throw, switch rated for the voltage and current at which it operates. Stations have screw terminals for connections.

2.7 FIRE DETECTORS

A. Fire Detectors shall be intelligent analog addressable units combining heat detection (fixed and rate of rise), photoelectric and ionization smoke sensing technology in one unit. Units shall comply with UL 268 and include the following features:

1. Sensitivity Adjustment from FACP.
2. Automatic Environmental correction.
3. Programmable to be in "single mode detection" such as fixed heat, rate of rise heat, photoelectric smoke, or ionization smoke as required on drawings.
4. Operating Voltage: 24VDC, nominal.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Plug-in Arrangement: Detector and associated encapsulated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. The plug connection requires no springs for secure mounting and contact maintenance. Terminals in the fixed base accept building wiring.
7. Integral Visual Indicating Light: Connect to indicate detector has operated.
8. Remote Controllability: Individually monitor detectors at the FACP for calibration, sensitivity, and alarm condition, and individually adjust for sensitivity from the FACP.

B. Smoke Detectors: Unless noted otherwise, where smoke detectors are shown on drawings they shall be provided as photoelectric type detection.

C. Heat Detectors: Shall be rate of rise or fixed temperature as shown on drawings.

D. Duct Smoke Detectors: Ionization type.

1. Sampling Tube: Design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Comply with NFPA 90 and 72.
2. Remote Test Station (RTS). Each duct smoke detector shall be furnished with a remote keyed test switch with indicator light. RTS shall be located inside the building in an accessible location.
3. Detectors shall be installed by the Mechanical Contractor. Units are furnished and wired by the Electrical Contractor.

E. Fan Shutdowns: HVAC units shutdowns shall come from directly from the FACP to individual addressable interface units (FSRs) placed at each HVAC control point. Contractor shall wire FSRs (furnished by fire alarm manufacturer) to HVAC unit controls, starter, or VFD.

2.8 ALARM-INDICATING (NOTIFICATION) DEVICES

A. General: Equip alarm-indicating devices for mounting.

B. Wire Guards: Provide wire guards (WG) for alarm devices where indicated on plans.

C. Weather Proof: Where indicated on plans to be weather proof (WP) alarm devices shall be suitable for outdoor and wet locations and include wire guards.

D. Visual Only Alarm Devices: Xenon strobe lights with clear or nominal white polycarbonate lens. Mount lenses on an aluminum faceplate. The word "FIRE" is engraved in minimum 1" high letters on the lens.

1. Devices have a minimum light output as required by the latest edition of the ADA.
2. UL 1971 compliant with minimum
3. Strobe Leads: Factory connected to screw terminals
4. Wiring separate from audible devices

5. Provide with synchronizing flash rate module

E. Audible/Visual Alarm Devices: Combination speaker/strobe units Xenon strobe lights with clear or nominal white polycarbonate lens. Mount lenses on an aluminum faceplate. The word "FIRE" is engraved in minimum 1" high letters on the lens.

1. Visual device shall comply with specifications for Visual Only units.
2. Speakers shall be capable of producing a range of programmable tones and voice up to a maximum of 90dBA at 10 feet. Speakers shall include adjustable taps to increase or decrease sound levels (generally tapped at ½ watt).
3. Combination unit shall be four-wire, with separate wires for speaker and strobe unit.
4. Combination devices consist of factory-combined, audible and visual alarm units in a single mounting assembly.

F. Remote Alarm Indicator: LED type, mounted flush in a single gang wall plate.

1. Connected to indicate the alarm operation of a single detector or other device.
2. Legend: "Alarm."

2.9 REMOTE DEVICE LOCATION - INDICATING LIGHTS AND IDENTIFICATION PLATES

A. Description: An LED indicating light in the vicinity of each sprinkler water-flow switch, valve tamper switch, or concealed/remote fire detector and denotes the associated device is in an abnormal or trouble mode. Lamp is flush mounted in a single gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, the room where the valve or smoke detector is located or the protected spaces downstream from the water-flow switch.

2.10 REMOTE COMPUTER AND PRINTER

A. Provide software, PC Computer, and Printer for supervision and management of fire alarm system. PC computer shall include a 19" color monitor.

2.11 EMERGENCY POWER SUPPLY

A. General: All FACPs and RAPs shall be provided with batteries.

B. General: Components include nickel-cadmium-type battery, charger, and an automatic transfer switch. Battery nominal life expectancy is 10 years minimum.

C. Battery capacity is adequate to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 24 hours. At the end of this period, the battery has sufficient capacity to operate the system, including alarm-indicating devices in either alarm or supervisory mode, for a period of 15 minutes.

D. Battery Charger: Solid-state, fully automatic, variable charging rate type. Provide capacity for 150% of the connected system load while maintaining the batteries at full charge. In the event batteries are fully discharged, the charger recharges them completely within 4 hours. Charger output is supervised as part of system power supply supervision.

E. Integral Automatic Transfer Switch: Transfers the load to the battery without loss of signals or status indications when normal power fails.

2.12 WIRE

A. Wire: Solid-copper conductors with 300V rated, 75C, color-coded insulation per NEC 760 FPLP or FPLR type cable minimum 18 AWG.

B. All fire alarm wiring shall be installed in conduit. See Section 26 0533 Raceways and Boxes for conduit types and applications.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install system according to NFPA standards referenced in Parts 1 and 2 of this Section.

B. Fire Alarm Power Supply Disconnect: Paint red and label "FIRE ALARM." Provide with lockable handle or cover.

3.2 DRAWINGS SUPPLIED

A. The drawings supplied by the engineer are diagrammatic in nature and show the general scope of work to be performed in conjunction with these specifications. The drawings are to be used as a guideline by the contractor for the equipment required, and for the approximate location and coverage of the fire detection and alarm systems specified.

B. The contractor shall retain the services of a qualified NICET Level IV fire alarm designer or licensed fire protection engineer who is authorized by the manufacture to provide exact quantities and locations for devices, performance requirements, and installation details to coincide with all physical restraints of the area due to the building layout and mechanical equipment, while maintaining conformity with all applicable codes.

3.3 EQUIPMENT INSTALLATION

A. Manual Pull Stations: Mount semi-flush in recessed back boxes with operating handles 48″ above the finished floor or lower as indicated.

B. Water-Flow Detectors and Valve Supervisory Switches: Connect for each sprinkler valve station required to be supervised.

C. Smoke Detectors: Install ceiling-mounted detectors not less than 4″ from a side wall to the near edge. Install detectors located on the wall at least 4″, but not more than 12″, below the ceiling. For exposed solid-joist construction, mount detectors on the bottom of the joists. On smooth ceilings, install detectors not over 30 feet apart in any direction. Install detectors no closer than 60″ from air registers.

D. Audible Only Alarm-Indicating Devices: Install not less than 90″ above the finished floor and not less than 6″ below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille or as indicated. Combine audible and visual alarms at the same location into a single unit.

E. Visual Alarm-Indicating Devices and Combination Audible/Visual Devices: Install adjacent to or in combination with each alarm bell or alarm horn and not more than 80″ above the finished floor and at least 6″ below the ceiling, per ADA requirements.

F. Device Location-Indicating Lights: Locate in public space near the device they monitor. Wall mount lights at 80″ above finished floor.

G. FACP: Surface-mounted with tops of cabinets not more than 72″ above the finished floor.

3.4 WIRING INSTALLATION

A. Wiring Method: Install wiring in metal raceway according to Division 26 Section 26 0505, "Basic Electrical Materials and Methods." Conceal raceway except in unfinished spaces and as indicated.

B. Wiring within Enclosures: Install conductors parallel with or at right angles to the sides and back of the enclosure. Bundle, lace, and train the conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

C. Cable Taps: Use numbered terminal strips in junction, pull or outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

D. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and a different color code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visual alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

E. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour rated wall, so the loss of one riser does not prevent the receipt or transmission of signal from other floors or zones.

F. Wiring to Central-Station Transmitter: 1" GRC between the FACP and the central-station transmitter connection as indicated. Install number of conductors and electrical supervision for connecting wiring as needed to suit central-station monitoring function. Final connections to terminals in central-station transmitter are made under another contract.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 26 Section 26 0505 "Basic Electrical Materials and Methods".

3.6 GROUNDING

A. Ground cable shields and equipment according to system manufacturer's instructions to eliminate shock hazard and to minimize, to the greatest extent possible, ground loops, common mode returns, noise pickup, cross talk, and other impairments.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.

B. Pre-testing: After installation, align, adjust, and balance the system and perform complete pre-testing. Determine, through pre-testing, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pre-testing. Replace malfunctioning or damaged items with new ones and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.

C. Report of Pre-Testing: After pre-testing is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of the witnesses to the preliminary tests.

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. Minimum required tests are as follows:

1. Verify the absence of unwanted voltages between circuit conductors and ground.
2. Test all conductors for short circuits using an insulation-testing device.
3. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on the record drawings.
4. Verify that the control unit is in the normal condition as detailed in the manufacturer's operation and maintenance manual.

5. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10% of the initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
6. Test each initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
7. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications. Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level.
8. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the period and in the manner specified.

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. Submit log upon the satisfactory completion of tests.

H. Tag all equipment, stations, and other components at which tests have been satisfactorily completed.

3.8 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Touch up scratches and marred finish to match original finish. Clean unit internally using methods and materials recommended by manufacturer.

3.9 DEMONSTRATION

A. Startup Services: Engage a factory-authorized service representative to provide startup service and to demonstrate and train Owner's maintenance personnel as specified below.

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, adjusting, and preventive maintenance. Provide a minimum of 8 hours of training.
2. Training Aid: Use the approved final version of the operation and maintenance manual as a training aid.
3. Schedule training with Owner with at least 7 days' advance notice.

3.10 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, controls, and sensitivities to suit actual occupied conditions. Provide up to three requested adjustment visits to the site for this purpose.

3.11 TRAINING

A. System vendor shall provide up to two (2) eight-hour sessions of on-site orientation of Owner personnel in the operation, programming and maintenance of the FACP and all system devices.

B. Training shall be conducted at the convenience of Owner after the system is accepted by Owner as complete.

C. Provide instruction as required for operating the system. "Hands-on" demonstrations for the operation of all system components and the entire system including program changes and functions shall be provided.

D. The contractor and/or the Systems Manufacturer's representative shall provide a typewritten "Sequence of Operation" to Owner.

3.12 OFF SITE MONITORING (REMOTE CENTRAL STATION)

A. Monitoring Service: The contractor shall coordinate with local authorities to provide 24 hour off site monitoring and response of fire alarm and trouble signals. Contractor shall include costs for the first year (paid in full and in advance) of an offsite monitoring contract. Contract shall be in Owner's name and signed by Owner.

PART 4 - MANUFACTURER'S REPRESENTATIVE

4.1 MANUFACTURERS

A. Contractor shall include in their bid, the cost for equipment and services provided by the following manufacturer's representative.

1. Simplex
2. Siemens
3. Honeywell

END OF SECTION

SECTION 31 23 00 – EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Earthwork.

B. Related Specification Sections include but are not necessarily limited to:
   1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
   2. Division 01 - General Requirements.
   3. Section 07 26 00 - Under Slab Vapor Retarder.

1.2 QUALITY ASSURANCE

A. Referenced Standards:
   1. ASTM International (ASTM):
      a. C33, Standard Specification for Concrete Aggregates.
      b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
      c. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3(2,700 kN-m/m)).
      d. D3786, Standard Test Method for Bursting Strength of Textile Fabrics--Diaphragm Bursting Strength Tester Method.
      e. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
      f. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
      g. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

1.3 SUBMITTALS

A. Shop Drawings:
   1. See Division 1 for requirements for the mechanics and administration of the submittal process.
   2. Product technical data including:
      a. Acknowledgement that products submitted meet requirements of standards referenced.
      b. Manufacturer's installation instructions.
   3. Certifications.
   4. Test reports:

B. Samples:
   1. Submit samples and source of fill and backfill materials proposed for use.
   2. Submit samples and source of borrow materials proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fill and Backfill: Selected material approved by Soils Engineer from site excavation or from off site borrow. Reference Soils Engineer Report for specific details on the fill and backfill.

B. Engineered Fill Under Building Floor Slabs-On-Grade: Reference Soils Engineer Reoprt for specific details on the fill and backfill.

C. Geotextile Filter Fabric:
   1. Nonwoven type.
   2. Equivalent opening size: 50-100 (U.S. Standard Sieve).
   3. Permeability coefficient (cm/second): 0.07 minimum, 0.30 maximum.
   4. Grab strength: 90 LBS minimum in either direction in accordance with ASTM D4632 requirements.
   5. Mullen burst strength: 125 psi minimum in accordance with ASTM D3786 requirements.

D. Vapor Barrier: Refer to Specification Section 07 26 00.

PART 3 - EXECUTION

3.1 PROTECTION

A. Protect existing surface and subsurface features on-site and adjacent to site as follows:
   1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
   2. Protect and maintain bench marks, monuments or other established reference points and property corners.
      a. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
   3. Verify location of utilities.
      a. Omission or inclusion of utility items does not constitute nonexistence or definite location.
      b. Secure and examine local utility records for location data.
      c. Take necessary precautions to protect existing utilities from damage due to any construction activity.
      d. Repair damages to utility items at own expense.
      e. In case of damage, notify Engineer at once so required protective measures may be taken.
   4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed.
      a. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition.
      b. All repairs to be made and paid for by Contractor.
   5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
   6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
   7. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.

B. Salvageable Items: Carefully remove items to be salvaged, and store on Owner's premises unless otherwise directed.

C. Dispose of waste materials, legally, off site.
   1. Burning, as a means of waste disposal, is not permitted.

3.2 SITE EXCAVATION AND GRADING

A. The work includes all operations in connection with excavation, borrow, construction of fills and embankments, rough grading, and disposal of excess materials in connection with the preparation of the site(s) for construction of the proposed facilities.

B. Excavation and Grading:
   1. Perform as required by the Contract Drawings.
   2. Contract Drawings may indicate both existing grade and finished grade required for construction of Project.
      a. Stake all units, structures, piping, roads, parking areas and walks and establish their elevations.
      b. Perform other layout work required.
      c. Replace property corner markers to original location if disturbed or destroyed.
   3. Preparation of ground surface for embankments or fills:
      a. Before fill is started, scarify to a minimum depth of 10 IN in all proposed embankment and fill areas.
      b. Where ground surface is steeper than one vertical to four horizontal, plow surface in a manner to bench and break up surface so that fill material will bind with existing surface.
   4. Protection of finish grade:
      a. During construction, shape and drain embankment and excavations.
      b. Maintain ditches and drains to provide drainage at all times.
      c. Protect graded areas against action of elements prior to acceptance of work.
      d. Reestablish grade where settlement or erosion occurs.

C. Borrow:
   1. Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification.
   2. Include cost of all borrow material in original proposal.
   3. Fill material to be approved by Soils Engineer prior to placement.

D. Construct embankments and fills as required by the Contract Drawings:
   1. Construct embankments and fills at locations and to lines of grade indicated.
      a. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.
   2. Provide approved fill material which is free from roots, organic matter, trash, frozen material, and stones having maximum dimension greater than 6 IN.
      a. Ensure that stones larger than 4 IN are not placed in upper 6 IN of fill or embankment.
      b. Do not place material in layers greater than 8 IN loose thickness.
      c. Place layers horizontally and compact each layer prior to placing additional fill.
   3. Compact by sheepsfoot, pneumatic rollers, vibrators, or by other equipment as required to obtain specified density.
      a. Control moisture for each layer necessary to meet requirements of compaction.

3.3 USE OF EXPLOSIVES

A. Blasting with any type of explosive is prohibited.

3.4 FIELD QUALITY CONTROL

A. Do not include in bid price the cost of inspection services indicated herein as being performed by the Soils Engineer.

B. Moisture density relations, to be established by the Soils Engineer required for all materials to be compacted.

C. Extent of compaction testing will be as necessary to assure compliance with specifications.

D. Give minimum of 24 HR advance notice to Soils Engineer when ready for compaction or subgrade testing and inspection.

E. Should any compaction density test or subgrade inspection fail to meet specification requirements, perform corrective work as necessary.

F. Pay for all costs associated with corrective work and retesting resulting from failing compaction density tests.

3.5 COMPACTION DENSITY REQUIREMENTS

A. Obtain approval from Soils Engineer with regard to suitability of soils and acceptable subgrade prior to subsequent operations.

B. Provide dewatering system necessary to successfully complete compaction and construction requirements.

C. Remove frozen, loose, wet, or soft material and replace with approved material as directed by Soils Engineer.

D. Stabilize subgrade with well graded granular materials as directed by Soils Engineer.

E. Assure by results of testing that compaction densities comply with the following requirements:

1. Sitework:

LOCATION	COMPACTION DENSITY
Under Paved Areas, Sidewalks and Piping:	
Cohesive soils	100 percent per ASTM D698
Cohesionless soils	75 percent relative density per ASTM D4253 and ASTM D4254
Unpaved Areas:	
Cohesive soils	85 percent of ASTM D698
Cohesionless soils	60 percent relative density per ASTM D4253 and ASTM D4254

2. Structures:

LOCATION	COMPACTION DENSITY
Inside of structures under foundations, under equipment support pads, under slabs-on-grade	95 percent per ASTM D1557
Scarified existing subgrade under fill material	92 percent per ASTM D1557
Outside structures next to walls, piers, columns and any other structure exterior member	95 percent per ASTM D1557

3.6 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

A. General:
   1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.
   2. Obtain fill and backfill material necessary to produce grades required.
      a. Materials and source to be approved by Soils Engineer.
      b. Excavated material approved by Soils Engineer may also be used for fill and backfill.
   3. In this Specification Section, the word "foundations" includes footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil.
   4. In the paragraphs of this Specification Section, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

B. Excavation Requirements for Structures:
   1. General:
      a. Do not commence excavation for foundations for structures until Soils Engineer approves:
         1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
         2) Density and moisture content of site area compacted fill material meets requirements of specifications.
         3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.
         4) Surcharge or mass fill material has been removed from construction area or portions thereof.
      b. Engineer grants approval to begin excavations.
   2. Dimensions:
      a. Excavate to elevations and dimensions indicated or specified in Soils Engineer Report.
      b. Allow additional space as required for construction operations and inspection of foundations.
   3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings.

a. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by Soils Engineer.

4. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads, or compacted fill.
   a. Remove loose materials and bring excavations into approved condition to receive concrete or fill material.
   b. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 10 IN and then compact to density stated in this Specification Section before fill material can be placed thereon.
   c. Do not carry excavations lower than shown for foundations except as directed by Soils Engineer or Engineer.
   d. If any part of excavations is carried below required depth without authorization, maintain excavation and start foundation from excavated level with concrete of same strength as required for superimposed foundation, and no extra compensation will be made to Contractor therefore.
5. Make excavations large enough for working space, forms, dampproofing, waterproofing, and inspection.
6. Notify Soils Engineer and Engineer as soon as excavation is completed in order that subgrades may be inspected.
   a. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-grade, under equipment support pads, and under retaining wall footings has been inspected and approved by the Soils Engineer as being free of undesirable material, being of compaction density required by this specification, and being capable of supporting the allowable foundation design bearing pressures and superimposed foundation, fill, and building loads to be placed thereon.
   b. Soils Engineer shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.
   c. Place fill material, foundations, retaining wall footings, floor slabs-on-grade, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved.
   d. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.
7. Dewatering:
   a. Where groundwater is or is expected to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope.
   b. Groundwater shall be maintained at least 3 FT below the bottom of any excavation.
   c. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
   d. Employ dewatering specialist for selecting and operating dewatering system.
   e. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure.
   f. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
      1) Install groundwater monitoring wells as necessary.

g. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.

8. Subgrade stabilization:
   a. If subgrade under foundations, fill material, floor slabs-on-grade, or equipment support pads is in a frozen, loose, wet, or soft condition before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by Soils Engineer.
   b. Provide compaction density of replacement material as stated in this Specification Section.
   c. Loose, wet, or soft materials, when approved by Soils Engineer, may be stabilized by a compacted working mat of well graded crushed stone.
   d. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids.
   e. Remove and replace frozen materials as directed by Soils Engineer.
   f. Method of stabilization shall be performed as directed by Soils Engineer.
   g. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Soils Engineer.
9. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction.
   a. Do not place building floor slabs-on-grade including equipment support pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DegF before structure is completed and heated to a temperature of at least 50 DegF.
10. Protection of structures:
    a. Prevent new and existing structures from becoming damaged due to construction operations or other reasons.
    b. Prevent subgrade under new and existing foundations from becoming wet and undermined during construction due to presence of surface or subsurface water or due to construction operations.
11. Shoring:
    a. Shore, sheet pile, slope, or brace excavations as required to prevent them from collapsing.
    b. Remove shoring as backfilling progresses but only when banks are stable and safe from caving or collapse.
12. Drainage:
    a. Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures.
    b. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water.
    c. Provide pumping required to keep excavated spaces clear of water during construction.
    d. Should any water be encountered in the excavation, notify Engineer and Soils Engineer.
    e. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.
13. Frost protection:
    a. Do not place foundations, slabs-on-grade, equipment support pads, or fill material on frozen ground.

b. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, floor slabs, equipment support pads, or fill material can be placed immediately after excavation has been completed and approved.
c. Protect excavation from frost if placing of concrete or fill is delayed.
d. Where a concrete slab is a base slab-on-grade located under and within a structure that will not be heated, protect subgrade under the slab from becoming frozen until final acceptance of the Project by the Owner.
e. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 DegF.

C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, Equipment Support Pads and Piping:
1. General:
a. Subgrade to receive fill or backfill shall be free of undesirable material as determined by Soils Engineer and scarified to a depth of 10 IN and compacted to density specified herein.
b. Surface may be stepped by at not more than 12 IN per step or may be sloped at not more than 2 percent.
c. Do not place any fill or backfill material until subgrade under fill or backfill has been inspected and approved by Soils Engineer as being free of undesirable material and compacted to specified density.
2. The existing soils for the Operations and Maintenance Facility are not adequate to properly support the slabs-on-grade or the foundations without some form of on site improvement. The soils shall be excavated to a specific depth and an engineered fill shall be placed and compacted. The depth of over excavation will depend on field testing once a minimum amount of soil is removed. Reference the Project Soils Engineer Report for specific details of fill type, thickness, and final bearing capacity.
3. Obtain approval of fill and backfill material and source from Soils Engineer prior to placing the material.
4. Vapor barrier: Install a continuous vapor barrier under floor slabs-on-grade as required by Specification Section 07 26 00 and shown on Contract Drawings.
5. Fill and backfill placement:
a. Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from Soils Engineer.
b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.
c. Compact material by means of equipment of sufficient size and proper type to obtain specified density.
d. Use hand operated equipment for filling and backfilling next to walls.
e. Do not place fill and backfill when the temperature is less than 40 DegF and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft.
f. Use vibratory equipment to compact granular material; do not use water.
6. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content, outside the exterior limits of foundations located around perimeter of structure the following horizontal distance whichever is greater:
a. As required to provide fill material to indicated finished grade.
b. 5 FT.
c. Distance equal to depth of compacted fill below bottom of foundations.

d. As directed by Soils Engineer.

D. Filling and Backfilling Outside of Structures.
1. This paragraph of this Specification applies to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving.
2. Provide material as approved by Soils Engineer for filling and backfilling outside of structures.
3. Fill and backfill placement:
   a. Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from Soils Engineer.
   b. Place fill and backfill material in thin lifts as necessary to obtain required compaction density.
   c. Compact material with equipment of proper type and size to obtain density specified.
   d. Use only hand operated equipment for filling and backfilling next to walls and retaining walls.
   e. Do not place fill or backfill material when temperature is less than 40 DegF and when subgrade to receive material is frozen, wet, loose, or soft.
   f. Use vibratory equipment for compacting granular material; do not use water.
4. Backfilling against walls:
   a. Do not backfill around any part of structures until each part has reached specified 28-day compressive strength and backfill material has been approved.
   b. Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work, concrete finishing, dampproofing and waterproofing have been completed.
   c. Do not place fills against walls until floor slabs at top, bottom, and at intermediate levels of walls are in place and have reached 28-day required compressive strength to prevent wall movement.
   d. Bring backfill and fill up uniformly around the structures and individual walls, piers, or columns.

E. Backfilling Outside of Structures Under Piping or Paving:
1. When backfilling outside of structures requires placing backfill material under piping or paving, the material shall be placed from bottom of excavation to underside of piping or paving at the density required for fill under piping or paving as indicated in this Specification Section.
2. This compacted material shall extend transversely to the centerline of piping or paving a horizontal distance each side of the exterior edges of piping or paving equal to the depth of backfill measured from bottom of excavation to underside of piping or paving.
3. Provide special compacted bedding or compacted subgrade material under piping or paving as required by other Specification Sections for the Project.

F. Backfilling Over Old Bridge Foundations
1. Reference the Soils Engineer Report for minimum depth of engineered backfill that shall be installed over the tops of the old bridge foundation pile caps before any foundations or slabs-on-grade are installed.

3.7 SPECIAL REQUIREMENTS

A. Erosion Control:
1. Conduct work to minimize erosion of site.
2. Construct stilling areas to settle and detain eroded material.
3. Remove eroded material washed off site.

4. Clean streets daily of any spillage of dirt, rocks or debris from equipment entering or leaving site.

END OF SECTION

SECTION 32 31 19 - PRE-FABRICATED ORNAMENTAL STEEL FENCE

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.

1.3 SUMMARY

A. Furnish labor, materials, tools, equipment, and services for Pre-fabricated Ornamental Steel Fence, as indicated, in accordance with provisions of Contract Documents.

A. System Description:
1. Supply a total ornamental metal fencing system of the style indicated.
a. The system shall include components (i.e., pickets, rails, posts, gates and hardware) and their installation.
2. Completely coordinate with work of other trades.

1.4 QUALITY ASSURANCE

A. Installation Supervision: Employ a qualified person, thoroughly familiar with the type of construction involved and materials and techniques specified.

1.5 SUBMITTALS

A. Shop Drawings: Large scale Plans, Elevations, Sections, and Details showing extent of fencing required.

B. Product Data.

C. Samples: Specimens of members for approval of shapes, sizes and colors.

D. Contract Closeout Information: Maintenance Data.

1.6 SITE CONDITIONS

Field verify dimensions prior to fabrication of fence units.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Base: Ameristar Fence Products.

B. Optional:
1. Anchor Fence & Supply Company.

2. Boundary Fence and Railing Systems, Inc.
3. Builders Fence Company.

2.2 MATERIALS

A. Material for Framework (i.e., pickets, rails, and posts) shall conform to the following standards:
   1. Items galvanized after forming:
      a. ASTM-A1011 with a minimum yield strength of 50,000 PSI.
      b. Outside surface shall be hot dip galvanized with a minimum zinc coating weight of 0.45 OZ/SF^2.
      c. Inside surface shall be coated with a minimum of 81% zinc pigmented coating.
   2. Items galvanized before forming:
      a. ASTM-A924 with a minimum yield strength of 50,000 PSI.
      b. Hot dip galvanized coating complying with ASTM-A653 with a minimum zinc coating weight of 0.90 OZ/SF^2 (coating Designation G-90).

B. Finish: Six stage pretreatment/wash with zinc phosphate followed by an electrostatic spray application of a two coat powder system.
   1. Base coat (gray, zinc-rich, thermosetting epoxy powder coating) with a minimum thickness of 2 mils.
   2. Top coat: No-mar polyester powder coat finish with a minimum thickness of 2 mils.
   3. Color: Black.
   4. Coated galvanized framework shall have a salt spray resistance of 3,500 hours using ASTM B117 without loss of adhesion.

2.3 COMPONENTS

A. Base Product: Aegis II by Ameristar Fence Products:
   1. Style: Classic.
   2. Design: 2-rail.
   3. Nominal Height: 8 FT.

B. Pickets:
   1. Cross Section: 1 inch square.
   2. Minimum wall thickness: 14 GA tubing.
   3. Picket Style: Square tip with cap
      .

C. Rails:
   1. The cross-sectional shape of the rails shall conform to the manufacturer's double wall design:
      a. Outside cross-section dimension: 1-3/4 IN square.
      b. Minimum wall thickness: 14 GA.
   2. Picket holes in the rail shall be nominally spaced 5 IN O.C.
   3. PVC grommets seal all picket-to-rail intersections.
   4. Picket retaining rods shall be 1/8 IN diameter galvanized steel.

D. Posts:
   1. Minimum O.D.: 3inches square.
   2. Minimum wall thickness: 12 GA.
   3. Cap Design: Plain top.
   4. Nominal Post Spacing (typical): 8 feet on center, +/- 1/2 inch.
      a. Exceptions:
         1) Other spacing as indicated.

2) Gate posts shall be spaced according to the gate openings indicated.

5. Exact spacing: As recommended by the manufacturer for nominal spacing indicated.

2.4 MISCELLANEOUS MATERIALS

A. Swinging Gate Hardware: Utilize items that suit the shape and size of gate / post framing members.

1. Hinges:
   a. Pressed of forged steel or malleable iron.
   b. Non-removable heavy duty type.
   c. Offset to permit 180-degree gate opening.
   d. Quantity:

Minimum Number of Hinges	
Nominal Gate Height	Minimum Number of Hinges Required
2440 mm 8 FT	4
Note: Oversize gates may require a higher quantity and heavy weight hinges.	

2. Latches: Heavy duty automatic engaging and lockable.
   a. Single-leaf Gates: Deadbolt latch: Lever handles, Lock/unlock from inside and outside.
   b. Double-leaf Gates:
      1) Active Leaf: Deadbolt latch: Lever handles, Lock/unlock from inside and outside.
      2) Inactive Leaf:
         a) Strike.
         b) Padlock-able drop rod (cane bolt).
      3) Furnish suitable casting set in concrete to hold gate leaf in place when drop rod is engaged.
3. Keepers: Automatically engage gate and hold it open until manually released.

B. Sliding Gate hardware: To be provided by Manufacturer as indicated location on drawings.

1. Provide shop drawings for review.
2. Gates to be remote activated.

C. Concrete:

1. Portland cement: ASTM-C150, Type I.
2. Aggregate: ASTM-C33, 1 IN maximum.
3. Minimum 28 day compressive strength: 2500 PSI.
4. Slump: 3 IN slump.
5. Entrained Air: 2 to 4%.

2.5 FABRICATION

A. Pickets, rails, and posts shall be precut to specified lengths.

B. Forerunner rails shall be pre-punched to accept pickets.

C. Grommets shall be inserted into the pre-punched holes in the rails and pickets shall be inserted through the grommets so that pre-drilled picket holes align with the internal upper raceway of the Forerunner rails

D. Retaining rods shall be inserted into each Forerunner rail so that they pass through the predrilled holes in each picket.

E. Completed sub-assemblies (i.e., panel sections) shall be capable of supporting a 600 lbs load applied at midspan without permanent deformation.

F. Panels shall be bias able to a 25% change in grade.

G. Gates shall be fabricated using same materials and gate ends having the same outside cross-section dimensions as the fence rail.

H. Each upright and rail intersection shall be joined by welding.

I. Each picket and rail intersection shall also be joined by welding.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that site has been prepared according to the design intent indicated, and that it is ready for fence installation to commence.

3.2 PREPARATION

A. Installation shall be laid out in accordance with the construction plans, modified as necessary to accommodate actual field dimensions and established grades.

3.3 ERECTION

A. Do not start fence installation before final grading is complete and finish elevations established.

B. Install fence true to line and in correct alignment with posts plumb and vertical.

C. Coordinate the installation with the work of other trades.

D. Concrete Footings:
1. Drill holes in firm, undisturbed or compacted soil, not less than 3 IN deeper than bottom of posts.
2. Set posts in concrete footings with crowned, steel troweled tops.
3. Minimum Footing Sizes: Utilize applicable criteria from the following Tables.

Footing Diameter				
Post Size (O.D.)	Line Posts	Corner and Terminal Posts	Dimension Between Gate Posts	
			Less than 4 FT	4 FT to 8 FT Wide
63.5 mm 2-1/2 IN	254 mm 10 IN	305 mm 12 IN	305 mm 12 IN	380 mm 15 IN
75 mm 3 IN	305 mm 12 IN	380 mm 15 IN	380 mm 15 IN	460 mm 18 IN
100 mm 4 IN	406 mm 16 IN	510 mm 20 IN	510 mm 20 IN	610 mm 24 IN
> 100 mm > 4 IN	4x Post O.D.	5x Post O.D.	5x Post O.D.	6x Post O.D.

Footing Depth

Nominal Fence Height	Minimum Depth	
	Line, Corner and Terminal Posts	Gate Posts
1220 mm 4 FT	610 mm 24 IN	990 mm 39 IN
1525 mm 5 FT		
1830 mm 6 FT	762 mm 30 IN	610 mm 42 IN
2135 mm 7 FT		
2440 mm 8 FT	915 mm 36 IN	1220 mm 48 IN
2745 mm 9 FT		
3050 mm 10 FT	610 mm 42 IN	1220 mm 48 IN

E. Attach rails to posts using panel brackets and bolt-on hardware supplied by manufacturer.
   1. Align rails in a consistent manner.
   2. Place fence such that bottom of pickets are 2 IN above finished grade.

3.4 FIELD QUALITY CONTROL

A. Field Tolerances:
   1. Post to post spacing: +/- 1/2 inch.
   2. Plumb-ness of Posts: +/- 1/8 inch.

B. Visual Alignment of Posts and rails: Fencing which is visibly misaligned will not be accepted, and shall be corrected.

3.5 ADJUSTING

A. Adjust hardware on gates to operate smoothly an ensure positive latching.

B. Correct minor grade irregularities to maintain maximum 2 IN clearance.

3.6 CLEANING

A. Clean the jobsite of excess materials; post hole excavations shall be scattered uniformly away from posts.

3.7 PROTECTION

A. Protect completed work from damage.

B. Repair or replace damaged items as necessary.

END OF SECTION 32 31 19

SECTION 41 22 00 - HOISTS AND CRANES

PART 1 - GENERAL

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

1.1 WORK INCLUDED

A. Equipment items as listed below by Equipment Identifier:

1. 5075 Crane, bridge, top running, 7-1/2 ton (Ref. Part 2.1)
2. 5392 Hoist, chain, electric, motorized trolley, 2 ton (Ref. Part 2.2)

B. Roughing-in, installation of equipment, and final connection of utilities, with labor, services, and incidentals necessary for complete and operational equipment installation.

C. Wiring, and switching between equipment and utilities.

1.2 QUALITY ASSURANCE

A. Equipment shall be produced by a manufacturer of established reputation with a minimum of five years experience supplying specified equipment.

B. Manufacturer's Representative:

1. Installation: Provide a qualified manufacturer's representative at site to supervise work related to equipment installation, check out, and start up.
2. Training: Provide technical representative to provide training to Owner's maintenance personnel in operation and maintenance of specified equipment.
3. Quality standards shall meet or exceed ISO-9001.

1.3 Buy America Compliance

A. The Contractor shall comply with the applicable Buy America requirements set forth in 49 U.S.C. 5323(j) and the applicable regulations in 49 C.F.R. Part 661, as amended. If the Contractor procures any capital items with Federal funds, it is the Contractor's responsibility to obtain the Buy America certification required under such regulations.

B. Reference Division 1 for Buy America compliance.

1.4 SUBMITTALS

A. Product Data: Submit Product Data in accordance with Division 1 of these specifications.

B. Operations and Maintenance Manual:

1. Submit Operations and Maintenance Manuals in accordance with Division 1- General Requirements of these specifications.
2. Provide complete parts, operating, and maintenance manual covering equipment at time of installation.
3. Description of system and components.
4. Schematic diagrams of electrical, plumbing, and compressed air system.
5. Manufacturer's printed operating instructions.
6. Printed listing of periodic preventive maintenance items and recommended frequency to validate warranties. Failure to provide maintenance information will indicate that preventive maintenance is not a condition for validation of warranties.

C. Shop Drawings: Submit Shop Drawings in accordance with Division 1.

1.5 PRODUCT SUBSTITUTIONS

A. Follow requirements specified in Division 1 - General Requirements.

B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.

C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements. Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

1.6 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situations resulting from non-performance of a manufacturer's recommended preventive maintenance schedule.

D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.

E. All parts shall be readily available locally in the United States.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.

C. Provide equipment and material specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

PART 2 - PRODUCTS

2.1 CRANE, BRIDGE, TOP RUNNING, 7-1/2 TON
Equipment Identifier: 5075

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a.	Konecranes
b.	Tempe, AZ (602) 267-8191
c.	Model No.: 7.5 ton single girder top running

2. Alternate manufacturers: Contingent upon compliance with these specifications and documentation requirements set forth in *Submittals*, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a.	Demag Cranes and Components, Cleveland, OH (440) 248-2400
b.	R&M Materials, Springfield, OH (937) 525-5100

B. General Requirements:

1. Top running double girder electric overhead traveling cranes shall be designed, manufactured, and tested as per Crane Manufacturers Association of America (CMAA) Specification #70, Revised 2000.
2. Top running and under running single girder electric overhead traveling cranes shall be designed and manufactured as per CMAA Specification #74, Revised 2000.
3. In addition the crane design and installation shall meet all the applicable local, state, and federal laws and OSHA regulations having jurisdiction.
4. Cranes shall operate in the given spaces and shall match the runway dimensions and rails indicated. Crane design shall maximize hook coverage, hook vertical travel, and clear hook height.
5. The crane shall be designed and manufactured to meet the appropriate service conditions based on the particular application. The crane service class shall be clearly indicated by the manufacturer at the time the crane proposal is submitted.

C. Capacities/Dimensions:

1. Crane dimensions:

a. Span: 30 feet, 3-3/4 inch (verify exact span in field prior to fabrication)
b. Runway length: 105 feet, 2 inches
c. Clear hook height: 18 feet

2. Lift: Hoist design shall maximize hook coverage, hook vertical travel (i.e. end approach), and clear hook height (i.e. headroom). The use of a low headroom hoist is mandatory.
3. Lifting capacity: 15,000 pounds
4. Lower load block or assembly of hook, swivel bearing sheaves, pins and frames suspended by the hoisting ropes shall not be considered part of the rated capacity.
5. CMAA service class: Crane shall be designed and constructed to CMAA Specification #70 (revised 1994) for Class "C" service requirements and operation in a non-hazardous environment.
6. Rated speeds (FPM) ±10%:

   a. Hoist: Maximum high 19; Minimum low 3.3 FPM
   b. Trolley: Maximum high 65; Minimum low 65 FPM
   c. Bridge: Maximum high 100; Minimum low 100 FPM

7. Motors:

   a. Hoist: 12.1 maximum; 1.9 HP minimum
   b. Trolley: 2 at 0.6 HP minimum
   c. Bridge: 2 at 0.4 HP minimum

D. Features/Performance/Construction:

1. Hoists and trolleys

   a. Hoist design shall maximize hook coverage, hook vertical travel (i.e. end approach), and clear hook height (i.e. headroom).
   b. All top running and under-running single girder cranes shall utilize low headroom electric wire rope hoists.
   c. All hoists/trolleys shall be supplied with two-speed hoisting contractor controls and inverter trolley speed controls (steeples or programmed two-speed) to minimize load swing and ensure accurate load positioning.
   d. Any proposed equivalent must meet or exceed the dimensional and performance specification of the above-mentioned products.
   e. Unless otherwise specified, hoists shall be single reeved. Lateral hook drift shall not exceed 1/8 inch per foot of vertical travel, or true vertical lift.
   f. The drum to rope diameter ratio shall be a minimum of 30:1 to minimize rope flex and significantly extend rope life. Drum shall be made from steel and supported on heavy-duty anti-friction bearings; groove depth shall be at least 35 percent of rope diameter. The rope drum shall be equipped with a rope guide and spring loaded roller to help keep the rope aligned in the grooves of the drum at all times.
   g. Gear reducers shall be integral components of standard hoists or hoist/trolley units of manufacturers regularly engaged in the design and manufacturing of hoists or hoist/trolley units for Class C cranes. The hoist gearbox must be mounted on angle to the drum to achieve zero gear lash and insure long gear bearing life. The gear reduction units shall be fully enclosed in oil-tight housing. Operation shall be smooth and quiet.

h. Hoisting gears shall be hardened and ground. Gears and pinions shall be spur, helical, or herringbone type only, and shall be forged, steel; open-type gearing is not acceptable. Gears and pinions shall be manufactured to AGMA 2001-B Quality Class 11 or better precision per AGMA 2000-A. Gear reducer shall not incorporate a mechanical load brake; the gear reducer shall not require regular internal maintenance (such as mechanical load brake adjustment) and frequent lubricant changes due to friction material contamination and high running temperatures.

i. If a secondary brake is required the brake shall be installed in such a way as to provide redundant braking at each brake application. Secondary brakes, which are not regularly activated and may become inoperative due to lack of use, are not acceptable.

j. The secondary brake shall be a self-adjusting DC disc type rated at a minimum of 150 percent of rated motor torque not including regeneration type braking.

k. Each hoist shall be equipped with an electro-mechanical load-limiting device that shall prevent lifting more than 110 percent of the rated load.

l. Hooks shall be made of forged alloy steel (34rMo4 Class T). Hooks shall be fitted with spring loaded safety latches designed to preclude inadvertent displacement of slings from the hook saddle and have 360 degree rotation on anti-friction bearings. Painting or welding shall not be performed on the hook. Hook nut shall be secured with a removable type set screw or other similar fastener; nut shall not be welded. Hooks shall be designed and commercially rated with safety factors in accordance with CMAA.

m. Bottom block shall be totally enclosed in a steel housing. Rope sheaves shall be supported on heavy-duty anti-friction bearings. Load blocks shall be of steel construction. Load blocks shall be provided with hot-rolled or forged steel fixed crosshead separate from the sheave pin with swivel mounting for forged steel hook. Each lubrication fittings for sheave pins shall be independent type recessed within the sheave pin or adequately guarded to prevent damage.

n. Sheaves shall be of steel or ductile iron (240 to 302 BHN hardness). Sheaves grooves shall be accurately machined, smoothly finished and free of surface defects. The sheave to rope diameter ratio shall be a minimum of 20:1 to minimize rope flex and extended rope life.

o. Wire rope shall be constructed from galvanized steel having a steel core and a minimum safety factor of 5. (Hoisting ropes shall be the rated capacity load plus the load block weight divided be the number of rope parts, and shall not exceed 20 percent of the certified breaking strength of rope.) Ropes shall be suited to meet the service requirements. Rope socketing or U-bolt clip connections shall be equal to or greater than the rope lengths. Hoisting ropes shall be secured to hoist drum so that no less than two wraps of rope remain at each anchorage of hoist drum at the extreme low position (limit switch stop).

p. Trolley shall be complete with a drive arrangement with a minimum of two-wheel driven by an integral electric motor. Drive mechanism shall run in totally enclosed oil bath. Drive gears shall conform to AGMA 2001-B Quality Class 11 or better. Stop limit switches must be provided for drive mechanism. Acceleration and deceleration controls shall meet requirements specified in this section. Trolley motor shall be inverter duty motor with minimum class “F” insulation. Motors shall have quick disconnect plugs for easy maintenance. Speed shall be infinitely variable from 0 to 50 FPM.

q. Trolley breaking system shall be automatically set when controls are released or power is interrupted. Brakes shall be sealed, dust proof and shall require no adjustment over a million cycles and last the life of the hoist under normal use.

2. Bridge components:

a. High-strength bolted connections shall utilize SAE Grade 5 bolts with corresponding lockwashers, nuts, etc., conforming to requirements of AISC S329 bolts. Bolts, nuts, and washers shall conform to ASTM 325 bolts. Galvanized bolts are not acceptable.

b. Bridge girders shall be constructed from A36 welded box girders, or A36 Structural beams. Girder shall be notched at ends and bolted to top of end trucks with horizontal connection plate utilizing shear rings to absorb horizontal shear forces and to maintain squareness. No “in shear” connections between girders and trucks will be allowed.

c. Bridge end trucks to be constructed of welded box shapes, formed into a rigid tubular housing. Trucks to be equipped with removable rail sweep on each end as well as energy-absorbing bumper. Wheel assemblies shall consist of flat tread, double-flanged, high- quality nodular iron or forged steel wheels, having anti-friction bearing assemblies with whole wheel assembly readily removed for easy repair. Drive wheels shall have rotating axles; idler wheels may be of fixed axle type. End connections shall be made with high-strength bolts.

d. Bridge drives shall be A-4 drive arrangement as specified in MHI CMAA 70. Bridge drive shall consist of a single electric motor mechanically connected through gear reduction and drive shafts to each drive wheel. Gears shall conform to applicable AGMA standards. Gear reducers shall be oil tight and fully enclosed with pressure or splash type lubrication to reduce maintenance and improve reliability.

e. Bridge braking system shall be provided with a spring-applied and electrically released disc brake for each bridge drive motor. Brakes shall have a torque rating of at least 50 percent of bridge drive motor rated torque. Brakes shall be self-adjusting for wear.

f. Wheels shall be manufactured of steel or nodular iron. Wheel treads and flanges shall be rim toughened to between 220 and 300 Brinell hardness number. Bridge and trolley wheels shall be double-flanged. Trolley wheels shall have straight treads. Bridge wheels shall have straight treads. Wheel shall be equipped with heavy-duty anti-friction bearings- no bushings shall be allowed.

g. Where applicable, cranes shall be designed to preclude leakage of lubricants onto the lifted loads or the floor. Equipment and components, which cannot be made leak-proof, shall be fitted with suitable drip pans. Drip pans shall be manufacture of stainless steel and designed to permit removal of collected lubricant.

h. Electrically controlled brakes shall be fail-safe spring set when power is interrupted. Brakes shall be released with a mainline contractor POWER-OFF push button or a master switch for the associated drive. Brakes shall automatically stop when there is a power failure.

i. Runway (track-type) limit switches shall be provided for crane bridge motion to stop the bridge motion. Trip mechanisms for bridge motion shall be located on crane runway to trip switch before bumper contacts stop. When the switch is tripped, the switch shall permit opposite travel in the direction of stop and then automatically reset.

3. Welding: Welders, welding operations and welding procedures shall be qualified or pre-qualified in accordance with AWS D14.1. The surface of parts to be welded shall be free from rust, scale, paint, grease or other foreign matter. Minimum preheat and interpass temperatures shall conform to the requirements of AWS D14.1. Welding shall be performed in accordance with written procedures, which specify the Contractor's standard dimensional tolerances for deviation from camber and sweep. Such tolerances shall not exceed those specified in accordance with AWS D14.1. Allowable stress ranges shall be in accordance with MHI CMAA 70. Welding of girders and beams shall conform to AWS D14.1.
4. Markings, labels, and warnings:

    a. Two capacity plates including the crane capacity in tons are required, one secured to each side of bridge crane. Each capacity plate shall be fabricated of steel or a quality/fade-resistant stick-on label with letters large enough to be easily read from the floor. Capacity plates shall be placed in a location visible to pendant operator's position after the crane has been installed.
    b. Readable warning labels shall be affixed to each lift block or control pendant in a readable position in accordance with ASME B30.16, ASME B30.2, and ASME B30.17. The word "warning" or other legend shall be designed to bring the label to the attention of the following information concerning safe-operating procedures: operating the hoist when the hook is not centered under the hoist; operating hoist with twisted, kinked or damaged rope; with a rope that is not properly seated in its hoist drum groove; lifting people; lifting loads over people; and removing or obscuring the warning label.

5. Crane runway rail: Manufacturer to provide crane runway rail to match end truck wheel assembly with crane stop.

E. Electrical and Control Requirements:

1. Cranes shall be designed to be operated from a 460 VAC, 3 phase, 60 Hz, alternating current system power source.
2. The hoist/trolley shall be CAS (US/ Canada) approved and/ or UL approved to NEMA 3R protection. Hoist control enclosure shall be rated NEMA 4.
3. Hoisting motors shall be two-speed/two winding squirrel cage type with a speed ratio of 6:1. Hoisting motors effective duty shall be 60 percent ED (30 minute rated) or higher with minimum class "F" insulation. One thermal sensitive device embedded in hoist motor windings shall be provided. Thermal-sensitive device and associated circuits shall be self-restoring (automatic reset). Motors shall be designed specifically for crane and hoist duty.
4. The hoist motor shall be positioned inside the drum to minimize heat buildup by directing airflow over the motor in close proximity to the motor housing. The cooling effect of the hoist drum surrounding the motor shall be an acceptable means of directing this airflow, and keeping damaging motor heat to a minimum.
5. Hoist controls shall be full magnetic type, specifically selected for hoisting service. The trolley shall be supplied with variable frequency drive (VFD) controls for two-step or infinitely variable speed control for smooth acceleration and deceleration; minimal load swing and accurate load placement.
6. Hoist shall be equipped with a geared adjustable upper and lower limit switch to limit extreme upper and lower travel of the bottom block assembly. Geared limit switch shall have four positions with the following functions- lower limit, upper slowdown, upper

limit, and phase reversal supervision. The upper most limit shall be wired to the down circuit in such manner to prevent hoisting in the event of a phase reversal.

7. Bridge motors shall be inverter duty motors with minimum class “F” insulation. Motors shall have quick-disconnect plugs for easy maintenance. Travel motors shall have a duty of 40 percent or higher. Motor enclosure shall be TENV (totally enclosed non-ventilated). Provide slow down and stop limit switches at each end of the bridge to insure safe operation. Speed shall be infinitely variable from 0 to 100 FPM.
8. A mainline disconnect consisting of a combination circuit breaker (50,000 AIC) and non-reversing starter, starter without overloads (mainline contractor) in NEMA Type 4X enclosure shall be provided. Mainline disconnect shall be controlled by a control circuit so that all crane motions will be stopped upon mainline under voltage, overload, control circuit fuse failure, or operation of POWER-OFF push button. Mainline disconnect shall be equipped with energy isolating devices designed to accept lockout devices.
9. Pendant control station enclosure shall be NEMA 4X Type. Physical size of pendant shall be held to a minimum. A separate cable of corrosion-resistant chain consisting of a minimum 1/4 inch wire shall be provided. Cable shall be integral with pendant control wire.
10. Push button control enclosure shall be NEMA 4X. Thermal overloads to be provided for all motors. Hoist to be equipped with overload cut-off device. Hoist and trolley control functions to be combined with pushbutton control functions for crane motions.
11. Reduced voltage at pendant push button.
12. Operation push buttons shall be heavy-duty; type with distinctively felt operation positions, which meet requirements of NEMA 4X. Pendant control buttons shall be momentary push buttons. Push buttons (except the POWER- OFF button) shall be recessed type to avoid accidental operation. Diameter of buttons shall be a size, which will make operation possible with a thumb while holding the pendant with the same hand. Nameplates shall be provided adjacent to each push button. In a multi-speed application, dual-position push buttons shall have a definite click-detent position for each speed. Push buttons shall be designed and manufactured not to hand up in control case. Pendant shall include a separate set of pushbuttons for each motion and for POWER-OFF. Push buttons shall be as follows:

    a. POWER-OFF
    b. POWER-ON
    c. Hoist-Up
    d. Hoist-Down
    e. Bridge- East
    f. Bridge- West
    g. Trolley- North
    h. Trolley-South

13. Bridge span conductor system shall be the festoon type consisting of a support rail, electrical cables, junction boxes, cable cars and accessories. Cable loops shall not drop below the hook high position. Outdoor crane bridge festoon system hardware shall be corrosion resistant.
14. Pendant festoon system shall consist of a support rail, cables, junction boxes, cable cars, and accessories. Cable loops shall not drop below the hook high position. Pendant control car shall be provided with NEMA Type 12 junction box. Outdoor crane pendant festoon system hardware shall be corrosion resistant.
15. Main power electrification system shall provide power to crane starter/ disconnect circuit breakers.

F. Accessories:

1. Crane runway rail to match end truck wheel assembly with crane stop.
2. Crane runway conductor system shall be covered conductor bar system type designed and manufactured to meet UL requirements. Protective covers shall be the rigid or flexible self-closing type designed to cover all live conductors and shall be shaped to prevent accidental contact with conductors. Collectors shall be heavy-duty sliding shoe type compatible with the electrification system. Two tandem designed collector heads shall be provided for each conductor rail to provide redundancy.
3. A solid-state electronic warning horn shall be provided on the crane. Any bridge or trolley motion shall be accompanied by a continuous series of alternating tones.

G. Utility Requirements:

1. Electrical:

a. Connection Requirements

	Unit	Control Panel
Voltage	460	115
Phase	3	1
HP	1.9	---
Amps	21.7	15

H. Finish: Bridge crane including bridge, trolley, hoist, and all attached items shall be painted in accordance with the manufacturer's standard practices. Items such as surfaces in contact with the electrical collector bars in contact with the collector shoes and nameplates shall not be painted.

2.2 HOIST, CHAIN, ELECTRIC, MOTORIZED TROLLEY, 2 TON
Equipment Identifier: 5392

A. Manufacturer's Reference:

1. Prime manufacturer: Specifications are based on equipment identified herein by manufacturer's name and model to establish minimal acceptable standards of quality, features, performance, and construction.

a. Columbus McKinnon Corporation
b. Amherst, NY (800) 477-5003
c. Model No.: ECMT4016-3-25 with accessories

2. Alternate manufacturers: *Contingent upon compliance with these specifications* and documentation requirements set forth in SUBMITTALS, equipment produced by other manufacturers, including the following, *may* be considered as equal.

a. Jet Tools, LaVergne, TN (800) 274-6848 b. Harrington Hoists, Inc., Conona, CA (951) 279-7500

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	31-13/32	19-25/32	22

2. Hoist:

   a. Lifting capacity: 4,000 pounds
   b. Motor: 2 HP
   c. Lifting speed: 16 FPM
   d. Lifting range: 26 feet (Verify prior to fabrication)
   e. Headroom, with trolley: 22.25 inches (maximum)

3. Trolley:

   a. Capacity: 4,000 pounds
   b. Motor: 3.4 HP
   c. Travel speed: 35 FPM
   d. I-beam size range: 6 to 18 inches, American Standard Section (3.33 to 7 inches, 9 inches upon request).

4. Weight: 375 pounds

C. Features/Performance/Construction:

1. Hoist shall have needle and ball type bearings with gears running in oil bath.
2. Frame shall be cast aluminum alloy.
3. Load hook and chain: Hook shall be forged steel with safety clip and shall be attached to chain by bearing type swivel.
4. Safety: Safety features shall include mechanical load brake, overheating, and positive limit switches.
5. Hoist mounting: Hoist shall be lug mounted to trolley for minimum headroom.
6. Pendant height: Pendant shall hang 36 inches above finished floor.
7. Hoist shall be controlled by a three-motion, two-speed remote control with one receiver and two transmitters. Remote control shall be capable of switching the hoist and trolley on and off.

D. Controls: Four push button pendant for hoist UP/DOWN and trolley FORWARD/REVERSE

E. Accessories:

1. Reel, 45 foot travel: Coffing No. 08004W (one each per unit) 2. Chain container, mounted to hoist: Coffing No. 08731W (one each per unit) 3. Battery-powered remote control: Enrange Flex EX No. 0-FLEX-6EX (one each per unit) 4. Combo kit (rubber bumper and retractable belt clip): Enrange No. 0-UCC-01 (one each per unit)

F. Utility Requirements:

1. Electrical:

a. Connection Requirements

	Unit
Voltage	460
Phase	3
HP	2

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.

3.2 INSTALLATION

A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect or designated representative.

B. Install equipment in accordance with plans, shop drawings, and manufacturer's instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.
2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.

3. Anchorage: Attach equipment as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. After final installation is complete and prior to authorizing payment, specified equipment shall be checked with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

3.4 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing and installation debris from job site.

D. Notify Architect or designated representative for final observation (punch list).

3.5 TRAINING

A. Direct the technical representative to provide specified hours of training to designated Owner's maintenance personnel in operation and maintenance of the following equipment. Coordinate, with Owner, training schedule and list of personnel to be trained.

1. 5075 Crane, bridge, top running, 7-1/2 ton; 4 hours (minimum)
2. 5392 Hoist, chain, electric, motorized trolley, 2 ton; 1 hour (minimum)

B. Obtain, from technical representative, a list of Owner's personnel trained in equipment operations and maintenance.

END OF SECTION - 41 22 00

SECTION 45 39 00 - FABRICATED EQUIPMENT

PART 1 - GENERAL

The General Provisions of the Contract, including General and Special Conditions and the requirements of Division 1, apply to the Work in this Section.

1.1 WORK INCLUDED

A. Equipment items as listed below by Equipment Identifier:

1. 1860 Workbench, severe use, 6 feet (Ref. Part 2.1)

B. Installation of equipment with labor, services, and incidentals necessary for complete and operational equipment installation.

1.2 QUALITY ASSURANCE

A. Equipment shall be manufactured by a manufacturer of established reputation with a minimum of five years experience performing similar fabrication techniques.

1.3 Buy America Compliance

A. The Contractor shall comply with the applicable Buy America requirements set forth in 49 U.S.C. 5323(j) and the applicable regulations in 49 C.F.R. Part 661, as amended. If the Contractor procures any capital items with Federal funds, it is the Contractor's responsibility to obtain the Buy America certification required under such regulations.

B. Reference Division 1 for Buy America compliance.

1.4 SUBMITTALS

A. Shop Drawings shall be submitted in accordance with Division 1 - General Requirements of these specifications.

1.5 PRODUCT SUBSTITUTIONS

A. Follow requirements specified in Division 1 - General Requirements.

B. Additional costs resulting from substitution of products other than those specified, by model number, including drawing changes and construction, will be at the expense of the Contractor.

C. Substitution Approval: Prior to delivery or installation, submittals for each equipment item by Equipment Identifier shall be provided in accordance with Division 1 - General Requirements.

Acceptance will be based on the technical requirements herein as determined by Owner and Architect.

1.6 WARRANTY

A. Warrant work specified herein for one year from substantial completion against defects in materials, functions, and workmanship.

B. Warranty shall include materials and labor necessary to correct defects.

C. Defects shall include, but not be limited to noisy, rough or substandard operation; loose, damaged, and missing parts; and abnormal deterioration of finish. Defects shall not include damage due to neglect, misuse, or situations resulting from non-performance of a manufacturer's recommended preventive maintenance schedule.

D. Submit warranties in accordance with Division 1 - General Requirements of these specifications.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in manufacturer's containers, appropriately packaged and/or crated for protection during domestic shipment and storage in humid and/or dusty conditions.

B. Indelibly label all containers, including those contained in others, on outside with item description(s) per title and Equipment Identifier of this specification.

C. Provide equipment and material specified complete in one shipment for each equipment item. Split or partial shipments are not permissible.

PART 2 - PRODUCTS

2.1 WORKBENCH, SEVERE USE, 6 FEET
Equipment Identifier: 1860

A. Manufacturer's Reference:

1. Fabricated item as shown on (Equipment Layout Drawing Sheet Q500).

B. Capacities/Dimensions:

1. Overall dimensions:

Dimensions (inches)			
	Length	Width	Height
a. Equipment	72	32	34

2. Load capacity: 2,500 pounds
3. Work surface thickness: 3/8 inch

C. Features/Performance/Construction:

1. Legs: Workbench legs shall be fabricated of 3 by 3 by 3/16 inch steel tube.
2. Leg braces: Leg braces shall be 3 by 1/4 inch steel plate continuously welded to tubing.
3. Top braces: Top braces shall be 3 by 3 by 1/4 inch steel angle with continuous electrical welds to tubing.
4. Top: Top shall be 3/8 inch steel plate with 50 percent minimum electrical welds to top braces. Corners of top shall have a 2 inch radius for protection of personnel. All edges shall be ground smooth.
5. Skid plate: Skid plate shall be 4 by 4 by 1/4 inches steel plate with continuous welds to tubing.
6. Welds: All welds shall conform to American Welding Society standards.

D. Finish: Cover all exposed steel surfaces including both sides of top, braces, and legs with one coat of zinc chromate primer and two coats of epoxy per manufacturer's recommendations in Owner's choice of color.

PART 3 - EXECUTION

3.1 INSPECTION

A. Coordinate location of rough-in work and utility stub-outs to assure match with equipment to be installed.

B. Inspect delivered equipment for damage from shipping and exposure to weather. Compare delivered equipment with packing lists and specifications to assure receipt of all equipment items and specified accessories.

3.2 INSTALLATION

A. Perform work under direct supervision of Foreman of Construction Superintendent with authority to coordinate installation of scheduled equipment with Architect.

B. Install equipment in accordance with plans, shop drawings, and manufacturer's instructions:

1. Positioning: Place equipment in accordance with any noted special positioning requirements generally level (or slight slope as required by instructions), plumb, and at right angles to adjacent work.
2. Fitting: Where field cutting or trimming is necessary, perform in a neat, accurate, professional manner without damaging equipment or adjacent work.
3. Anchorage: Attach equipment as directed by Architect or designated representative. Installation fasteners shall be installed to avoid scratching or damaging adjacent surfaces.

C. Upon completion of work, finish surfaces shall be free of tool marks, scratches, blemishes, and stains.

3.3 TESTING

A. After final connections are made and prior to authorizing payment, specified equipment shall be tested for compliance with specifications in the presence of the Architect or designated representative using acceptance procedures provided by the manufacturer. Testing report shall be submitted to the Architect or designated representative.

3.4 CLEANUP

A. Touch-up damage to painted finishes.

B. Wipe and clean equipment of any oil, grease, and solvents, and make ready for use.

C. Clean area around equipment installation and remove packing and installation debris from job site.

D. Notify Architect or designated representative for acceptance inspection.

END OF SECTION 45 39 00

MKE STREETCAR
APPENDIX A

Management of Solid Waste, Item SPV.0195.01.

A General

A.1 Description

This work will conform with the requirements of Section 205 of the Standard Specifications; to pertinent parts of the Wisconsin Administrative Code, Chapters NR 700-754 Environmental Investigation and Remediation of Environmental Contamination; Wisconsin Administration Code, Chapters NR 500-555, Solid Waste; and as shown on the plans and as supplemented herein.

Solid waste will be encountered within the construction limits. The solid waste contains NR 500 non-exempt industrial wastes including soil mixed with foundry sand and slag. Impacted waste material excavated during construction which cannot in the opinion of the environmental consultant be managed as common excavation or as petroleum contaminated soil will be managed as solid waste (historic fill).

This work consists of excavating, segregating, temporary stockpiling, loading, hauling, and disposing of solid waste material at a WDNR-approved disposal facility owned by the City of Milwaukee. The nearest owner's WDNR-approved disposal facility is:

City of Milwaukee
1600 E. College Ave.
Milwaukee, WI 53207

The owner's WDNR-approved disposal facility will be managed by owner's workers and heavy equipment to facilitate spreading of the solid waste (historic fill) and common excavation materials. An owner's representative will be at the owner's WDNR-approved disposal facility to verify the quantity listed on the load ticket.

A.2 Notice to the Contractor – Solid Waste Locations

The department and others completed hazardous materials assessment for locations within this project area where excavation is required. Investigation for soil contamination was conducted at elect locations. Results indicate that solid waste (historic fill) is present at the project site and all material excavated (common excavation and solid waste) will be taken to the owner's WDNR-approved disposal facility mentioned in A.1. The solid waste is contaminated with low level volatile organic compounds ((VOCs) benzene and tetrachloroethene), polynuclear aromatic hydrocarbons (PAHs) and metals (barium, chromium, lead and mercury). The solid waste (historic fill) varies in depth from 1 to 17.5 feet deep form the grounds surface based on environmental and geotechnical soil boring conducted at the site.

Directly load common excavation and solid waste excavated by the project at the above locations into trucks that will transport the material to the owner's WDNR-approved disposal facility mentioned in A.1.

If obviously contaminated soils or other signs of NR 500 non-exempt solid waste and hazardous materials are unexpectedly encountered elsewhere on the project, terminate excavation activities in the area and notify the Engineer. Examples of these unexpected conditions may include, but are not limited to, buried containers or tanks, noxious odors and fumes, stained soils, sheens on groundwater, other industrial wastes, significant volumes of municipal or domestic garbage, and building materials that may contain asbestos containing materials.

If dewatering is required at the above locations, conduct the dewatering in accordance with Section C below.

A.3 Excavation Management Plan Approval
The excavation management plan, including these special provisions, has been developed in cooperation with the Wisconsin Department of Natural Resources (WDNR). The WDNR concurrence letter is on file at the City of Milwaukee, Milwaukee County and Wisconsin Department of Transportation. For further information regarding previous environmental due diligence activities in the project area contact:

Engineer: HNTB Corporation
Name: Daniel K. Pelczar, CPG, P.G.
Address: 11414 W. Parke Place, Suite 300, Milwaukee, WI 53224
Phone: 414-359-2300
Fax: 414-359-2310
e-mail: dpelzcar@hntb.com

A.4 Coordination
Coordinate work under this contract with the (Engineer):

Consultant: HNTB Corporation
Address: 11414 W. Parke Place, Suite 300, Milwaukee, WI 53224
Contact: Daniel K. Pelczar, CPG, P.G.
Phone: 414-359-2300
Fax: 414-359-2310
E-mail: dpelzcar@hntb.com

At the preconstruction conference, provide a schedule for all excavation activities in the area of solid waste (historic fill) described in A.2 to the Engineer along with an example of the load ticket described in Section D.

Notify the Engineer at least three (3) calendar days prior to commencement of excavation. Perform excavation work on a continuous basis until excavation work is completed. Do not transport soil containing solid waste offsite without prior approval from the environmental consultant.

A.5 Health and Safety Requirements
Supplement standard spec 107.1 with the following:
During excavation activities, expect to encounter historic fill contaminated with industrial wastes (foundry sand and slag) and associated regulated metals and organic compounds. Site workers taking part in activities that will result in the reasonable probability of exposure to safety and health hazards associated with hazardous materials shall have completed health and safety training that meets the Occupational Safety and Health Administration (OSHA) requirements for Hazardous Waste Operations and Emergency Response (HAZWOPER), as provided in 29 CFR 1910.120.

Prepare a Site-Specific Health and Safety Plan, and develop, delineate and enforce the health and safety exclusion zones for the project site area as required by 29 CFR 1910.120. Submit the site-specific health and safety plan and written documentation of up-to-date OSHA training to the engineer prior to the start of work.

B (Vacant)

C Construction
Subsection 205.3 of the Standard Specification is supplemented with the following:

Directly load and haul solid waste and common excavation for offsite disposal to the owner's WDNR-approved disposal facility. Use loading and hauling practices that are appropriate to prevent any spills or releases of the material. Prior to transport, sufficiently dewater soils designated for off-site disposal so as not to contain free liquids. Verify that the vehicles used to transport material are licensed for such activity in accordance with applicable state and federal regulations. Do not transport regulated solid waste off-site without obtaining the approval of the Engineer.

If dewatering is required such water may, with approval of the Milwaukee Metropolitan Sewerage District (MMSD), be discharged to the sanitary sewer as follows:

1. Meet all applicable requirements of the MMSD including the control of suspended solids. Perform all necessary monitoring to document compliance with MMSD's requirements. Furnish, install, operate, maintain, disassemble, and remove treatment equipment necessary to comply with MMSD's requirements.

2. Ensure continuous dewatering and excavation safety at all times. Provide, operate, and maintain adequate pumping equipment and drainage and disposal facilities. Notify the Engineer of any dewatering activities, and obtain any permits necessary to discharge water. Provide copies of such permits to the Engineer. Meet any requirements and pay any costs for obtaining and complying with such permit use. Follow all applicable legislative statutes, judiciary decisions, and regulations of the State of Wisconsin.

Costs associated with excavation dewatering, if necessary, are considered incidental to this pay item. The owner will be the generator of regulated solid waste from this construction project.

D Measurement
The owner will measure solid waste by the cubic yard of waste accepted by the Owner's WDNR-approved disposal facility and as documented by a load tickets. The load tickets shall include the date; driver name and signature; trucking firm and drivers name; contents (i.e., solid waste or common excavation) and estimated quantity via. visual means in cubic yards.

E Payment
The owner will pay for measured quantities at the contract unit price under the following item:

ITEM NUMBER	DESCRIPTION	UNIT
SPV.0195.01	Management of Solid Waste	Cubic Yard

Payment is full compensation for excavating, segregating, loading, and hauling; obtaining solid waste collection and transportation service operating licenses; dewatering of soils prior to transport, if necessary; and for furnishing all labor, tools, equipment, and incidentals necessary to complete the work.