Digital Realty - Building L 230, L 236 and L 242
Ashburn, VA

Owner:

DIGITAL REALTY
Data Center Solutions

Architect/Engineer:

Integrated
Design Group

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Design Development
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END OF SECTION

SECTION 01 10 00
SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Project description.

B. Project's environmental goals.

C. Definitions – Owner, Construction Manager, and Architect.

D. Work by Owner.

E. Work restrictions.

1. Use of site.
2. Access to Site.

F. Project Manual formats and conventions.

1.2 PROJECT DESCRIPTION

A. These specifications will be utilized for L230, 236, and 242. Each suite has their own set of contract documents. Work covered by Contract Documents: The Project (one suite) consists of Interior fit-out of a one story ~ 50,000 square foot data hall including associated PBB scope. L230 and L236 data hall is a DR6000 with scope similar to L 118; L242 data hall is a DR4000 with scope similar to L 118.

1. Project Address:

   IAD39 Building L Suite 230, 236, and 242
   44274 Round Table Drive Ashburn, VA
   20147

2. Completeness: The Work shall be as shown on the Drawings and be complete in every respect and in conformance with all applicable requirements of the governing laws and codes.

B. Work beyond Contract Limits: The Project additionally includes work in areas beyond the Contract Limits, where indicated in the Contract Drawings.

C. Contract time: The Construction Manager may begin on-site work on, or after receipt of a written Notice to Proceed, or suitable Letter of Intent. After commencement of work, the Construction Manager shall pursue the Work continuously and with diligence, and bring the Project to Substantial Completion prior to date stipulated in Owner-Construction Manager Agreement.

1. Substantial completion is the stage in the progress of the Work when the work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the Work for its intended use. This includes any and all permits required by governmental agencies necessary for occupancy and use.
   a. Substantial Completion includes completion of required "Level 5" Integrated Testing

1.3 PROJECT ENVIRONMENTAL GOALS

A. Overview of the environmental requirements for the Project: The Owner has established the environmental goal to construct a "green" building integrating the Owner's environmental operational mission into the Project.
   1. Individual Specification Sections have additional detailed requirements.

B. Cooperative effort: The specifications are not intended to limit alternative means of achieving the Owner's environmental project objectives. Recommendations, and input from the Construction Manager and subcontractors for improving implementation of the Owner's

environmental project objectives are strongly encouraged.

C. Construction Manager's participation: The Construction Manager shall provide all administrative and procedural requirements necessary for the Owner to achieve its environmental goals in the construction of this Project.

1. The Construction Manager shall incorporate into the construction specific "green" products which comply with the Owner's environmental goals and objectives. Additionally, the Construction Manager is required to utilize "green" products which are part of the building process but not included in the final construction, (for example, cleaners, shipping containers and similar supplementary items).
2. The Construction Manager is advised that special consideration and modification of the Construction Manager's means and methods may be additionally required to achieve the Owner's environmental goals which are beyond the requirements of the Contract Documents.
3. The Construction Manager shall designate a trained and qualified representative responsible for instructing workers and overseeing the Owner's environmental goals for this Project.
4. The Construction Manager shall maximize environmentally-benign construction techniques, including:
   a. Provide a waste and recycling program for handling and disposal of solid waste.
   b. Maximize use and recycling of reusable delivery packaging.
   c. Reduce the use of municipally supplied potable water.
   d. Minimize noise generation during construction.

D. Objectives: Major components of the Owner's environmental goals include construction utilizing "green products", pollution prevention during the construction process, and maintenance of healthy Indoor Air Quality (IAQ).

1. Green products and sustainable materials are required for incorporation into the Project: utilization of recycled materials and materials with high recycled content, use of designated sustainable managed products, and energy efficient equipment and fixtures. Green products and sustainable materials include:
   a. Products with low embodied energy (production, manufacturing, and transportation).
   b. Products that maximize recycled content in materials products, and systems.
   c. Products easy to maintain, repair, and that can be cleaned using non-toxic substances.
   d. Products will not negatively affect healthy indoor air quality.
   e. Wood and agrifiber products that are certified to be sustainably harvested by the Forest Stewardship Council (FSC).
   f. Reusable and recyclable packaging.
2. Pollution prevention as achieved through recycle and reuse of materials, waste handling procedures, and limiting harmful pollutants emitted into the air, soil, and waterways. Pollution prevention efforts include, but are not limited to:
   a. Providing additional temporary facilities and controls.
   b. Minimizing the release of carbon dioxide (CO_2) from fuels burned on site or fuels burned off site to supply electricity to the building.
   c. Avoiding the release of ozone-depleting compounds, such as HCFCs from refrigerants or foam insulation materials.
3. Enhancement, restoration, and protection of the natural environment of the site.
4. Water resource protection: Conserve and use water efficiently, limit on-site fresh water usage to the greatest extent possible, control water distribution systems and waste, minimize use of imported or mined water. Capture and utilize rainwater to the greatest

extent permitted by Law. Utilize water-conserving appliances and equipment.

5. Air Quality is achieved by compliance with the limitation of indoor air concentrations of certain pollutants, at or below the established maximum allowable concentrations. Healthy air quality goals shall be maintained during construction, and through building commissioning.
6. Use construction practices that achieve the most efficient use of resources and materials.
7. Energy Efficiency (Operations Throughout Project Life): Materials and systems are intended to maximize energy efficiency for operation of Project throughout service life (substantial completion to ultimate disposition.

1.4 DEFINITIONS - OWNER, CONSTRUCTION MANAGER, AND ARCHITECT

A. Wherever the term "Owner" is used in this specification, it refers

to: Digital Realty
44274 Round Table Drive
Ashburn, VA 20147

1. All papers required to be delivered to the Owner shall, unless otherwise specified in writing to the contrary, be delivered to the office of the Architect:

B. Wherever the term "Architect", or “Architect/Engineer”, is used in the Contract Documents, it refers to:

Integrated Design Group Inc.
133 Federal Street
Boston, MA 02110

C. The terms “Construction Manager” and “Contractor” as used in the Project Manual have the same meaning and are interchangeable in Contract Documents both terms refer to:

DPR Construction
11109 Sunset Hills Road, Suite 200
Reston, VA 20190

1.5 WORK BY OWNER

A. Related work under separate agreements: The Owner will award a separate contract which will commence prior to or during the work of this Contract; which in general includes:

1. Testing Laboratory Services.

B. Owner Furnished Construction Manager Installed (OFCI) Products: The Construction Manager shall install the following Owner furnished items. Refer to individual specifications and drawings for detailed descriptions.

1. Uninterrupted Power Supply (UPS).
2. Power Distribution Units (PDU) with stands.
3. Electric Room RTUs.
4. Ventilation RTUs.
5. DR6000 2MW skid design.
6. Engine Generator, Enclosure, platforms.
7. Battery cabinet with stands.
8. DSE condenser skids.
9. DSE CRAC units.

10. GCB/SWR outside switchboards.

C. Owner Furnished and Installed (OFI) Products: The Construction Manager has coordinating responsibility for the following work, provided by others under separate agreement(s) with the Owner:

1. Interior signage.

1.6 USE OF SITE

A. Use of, and access to, site may be subject to special requirements of the Owner, as directed.

1. Prior to beginning the Work of this Contract, the Construction Manager shall meet with the Owner and the Architect to determine procedures regarding access and use of the site, locations and access to staging and storage areas, tree protection, temporary barriers and fencing, and any special site conditions or restrictions regarding the use of the site areas surrounding the construction.
2. Hours of construction, **7:30 AM to 4:30 PM** local time, Monday to Friday. Provisions for working hours other than those specified, must be pre- arranged with the Owner.
3. Use of existing elevators is prohibited.
4. Use of Owner's receiving/shipping areas and loading dock: Construction Manager is responsible to deliver and receive all materials and equipment. Construction Manager is not permitted to have supplies or equipment shipped directly to them in care of the Owner. Construction Manager's shipments of heavy or bulky equipment will be received at the Building loading dock only by prior arrangement. All other shipments will be refused.
5. Security: Owner's staff access must be permitted at all times in all construction areas, for purposes of security.

B. Confine operations to areas within Contract limits indicated on the Drawings. Portions of the site and building beyond areas in which construction operations are indicated are not to be disturbed.

1. Use of on-site areas outside of the contract limits for workers parking or storage of materials must be pre-arranged with Owner. Schedule deliveries to minimize requirements for storage of materials.

C. Construction Manager shall coordinate and permit uninhibited Owner's access to site prior to Substantial Completion as required for installation of equipment and furnishings performed under separate contracts outside of this Work.

1.7 ACCESS TO SITE

A. The Owner intends to occupy parking areas and access roads during construction. Notify the Owner of work which will affect the use of these areas; coordinate work schedule with Owner. The Construction Manager shall consult with the Owner on the best ways to provide access and on changes to access areas as the work progresses.

B. Keep all public roads and walks, and access drive to facility clear of debris caused by this Work during building operations.

C. Interruption of services: Any major work entailing disruption to heating, lighting, life safety system utility connections or other similar major disruption to building functioning must be coordinated with the Owner, and temporary services, safety precautions, or connections provided. Do not shut down any service without approval of the Owner.

1. Provide both Owner and Architect with **1 week** notification for any disruption of service; provide notification for connecting, disconnecting, turning on or turning off any service which may affect Owner's operations.

2. Provide **1 week** notice to local fire department of disruptions in electrical services, fire alarm services and emergency power services.
3. Any action either planned or unplanned, by the Construction Manager, or subcontractors which impairs the operation of anyone or the activation of the fire alarm detection and or suppression system shall cause notification of the appropriate party. In case of unplanned, accidental, impairment, the Construction Manager will immediately notify the Owner. The Construction Manager should be prepared to provide assistance as required to correct the problem.

1.8 PROJECT MANUAL FORMATS AND CONVENTIONS

A. Project Manual Format: The Project Manual is organized into Divisions and subdivided into Sections and Documents using Construction Specification Institute (CSI) publication "MasterFormat, 2004 Edition" numbering system.

1. Section Identification: Six digit Section numbers are utilized and cross- referenced throughout the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because only those Section numbers which are applicable to this Project are used.
2. Division One of the Project Manual governs procedural and administrative requirements of the Work. Division One requirements are applicable to all Sections and Documents in the Project Manual.

B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural, and plural words shall be interpreted as singular as applicable to the context of the Contract Documents.
2. Imperative mood and streamlined language is generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Construction Manager. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Construction Manager or by others when so noted.
   a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 14 00
WORK RESTRICTIONS

PART 1 - GENERAL

1.1 HOURS OF OPERATION AND WORK FORCE REQUIREMENTS

A. Hours of operation and work force requirements

1. Typical hours of construction: 7:30 am to 4:30 pm local time, Monday to Friday. Provisions for working hours other than those specified must be prearranged with the Building Owner.
2. None of the requirements herein shall be construed as relieving the Contractor of his responsibility to conduct his operations in conformance with local ordinances or requirements established by the Commonwealth.

B. Suspension of Work: The Owner retains the right to temporarily suspend work at any time when the noise or disturbance created by construction proves disruptive to the building's occupants. The Owner may request of the Contractor to utilize other means and methods, if practical, and acceptable to the Architect, which are less disruptive.

1.2 USE OF SITE

A. Use of, and access to, site will be subject to special requirements of the Owner and Building Owner, as directed.

1. Prior to beginning the Work of this Contract, the Contractor shall meet with the Building Owner and the Architect to determine procedures regarding access and use of the site, locations and access to staging and storage areas, tree protection, temporary barriers and fencing, and any special site condition s or restrictions regarding the use of the site areas surrounding the construction.
2. Security: Owner access must be permitted at all times in all construction areas, for purposes of security.

B. Confine operations to areas within Contract limits indicated on the Drawings. Portions of the site and building beyond areas in which construction operations are indicated are not to be disturbed.

1. 1. Use of on -site areas outside of the contract limits for workers parking or storage of materials must be pre -arranged with Building Owner. Schedule deliveries to minimize requirements for storage of materials.

C. Keep all public roads and walks, and access drive to facility clear of debris caused by this Work during building operations.

1.3 COORDINATIONG WITH OCCUPANTS

A. General: Perform all work in such a manner as to prevent interference with the Owner's operation of the facility, nor endanger the health, safety and well-being of the facility's staff and building's occupants

1. Take all measures to insure the safety, of staff and the general public. The Contractor must take every reasonable precaution and employ all necessary measures including extra cleaning, special supervisory personnel, and additional temporary barriers and signage to facilitate the clean, quiet, safe, and continual operation of the facility.

B. Interruption of services: Any major work entailing disruption to heating, lighting, life safety system utility connections or other similar major disruption to building functioning must be coordinated with the Owner, and temporary services, safety precautions, or connections provided. Do not shut down any service without approval of the Owner.

1. Provide both Owner and Architect with 1-week advance notification for any disruption of service; provide notification for connecting, disconnecting, turning on or turning off any service which may affect Owner's operations.
2. Provide 72-hour notice to local fire department of disruptions in electrical services, fire alarm services and emergency power services.
3. Any action either planned or unplanned, by the Contractor which impairs the operation of anyone or the activation of the fire alarm detection and or suppression system shall cause notification of the appropriate party. In case of unplanned, accidental, impairment, the Contractor will immediately notify the Owner. The Contractor should be prepared to provide assistance as required to correct the problem.

1.4 WORKER CONDUCT, APPEARANCE AND WORK RULES

A. The conduct and appearance of each worker at the job site is of paramount importance. The Owner reserves the right to require any worker to be banished from the Site.

B. Privacy: Conduct all work of the Contract with the maximum effort to maintain the privacy of the Owner's operations, staff, and guests. Do not permit the workers to peer into other areas of the building visible from the work area. Invasion of privacy is a major infraction of the work rules.

C. General Conduct and Demeanor: All construction workers shall treat all other workers, Owner staff, student and the public with respect and courtesy.

D. Physical Appearance: Require each worker to dress appropriately in a clean, neat, and professional manner.

E. Entertainment Devices (including, but not limited to radios, CD players, MP3 players and televisions): The use of all entertainment devices, including personal devices (walk man type) with headphones or earphones, is strictly prohibited at all times.

1. Control the volume of communication radios and loudspeakers to avoid creating a nuisance.

F. Smoking: Smoking is strictly prohibited on -site.

G. Language: Foul and rude language is strictly prohibited.

H. Physical Actions: Running, horseplay, fighting, and other unprofessional conduct are prohibited. Fighting is a major infraction of the work rules.

I. Stealing: Stealing of any materials, objects, furnishings, equipment, fixtures, supplies, clothing, or other items will not be tolerated and is a major infraction of the work rules.

J. Sexual Harassment: All forms of physical and verbal sexual harassment will not be tolerated and is a major infraction of the work rules Sexual harassment includes, without limitation: touching, whistling, sexually explicit stories, jokes, drawings, photos and similar representations, exhibitionism and all other sexually oriented offensive behavior.

K. Warnings and Dismissal:

1. For minor infractions of the rules, the Owner may issue a warning. Only one warning will be allowed per worker. A second infraction will result in immediate dismissal of the worker from the Site.
2. For major infractions of the rules, the worker shall be dismissed immediately without warning and is subject to possible criminal prosecution.

L. Notification of Workers: Clearly notify and educate each worker about these Work Rules and the requirements for worker conduct and appearance.

1. Recommendation: The Owner recommends that the Contractor notify each worker of the work rules in writing and obtain a signed acknowledgment of the worker's understanding of the work rules as a condition of employment on this project.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 25 13
PRODUCT SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Product options.
   1. Product selections.
   2. Visual matching.

B. Product substitutions.

1.2 PRODUCT OPTIONS

A. Product selections: Comply with the following for selection of products:
   1. Products specified by reference standards or by description only: Provide any acceptable product meeting those standards or description.
   2. Products specified by performance requirements only: Provide any acceptable product which has been tested to show compliance with specified requirements, including indicated performances.
   3. Products specified by naming one or more manufacturers: Provide products of manufacturers named and meeting specifications, no options or substitutions are allowed.
   4. Products specified by naming one or more manufacturers with a provision for substitutions: Provide products of manufacturers named, or submit a request for substitution for any manufacturer or product not named.

B. Additional product selection requirements:
   1. Provide products which comply with VOC emission limits required by the Owner's Environmental Policy.
   2. Provide products which comply with requirements for recycled content.
   3. Provide complete written documentation with all product substitutions that the proposed products are fully compliant to specific requirements applicable to the substitution.

C. Visual matching: Where Specifications require matching a sample, the Architect's decision on whether a proposed product matches is final. Where no product matches and complies with other requirements, comply with provisions for "substitutions" for selection of a matching product in another category.

1.3 PRODUCT SUBSTITUTIONS

A. General: Substitutions will only be considered when a product becomes unavailable through no fault of the Construction Manager. Construction Manager is required to provide documented proof the specified product is not available.
   1. Substitutions will not be considered without separate written request, or when acceptance will require revision to the Contract Documents.
   2. Substitution requests for available products which Construction Manager failed to obtain in sufficient time to maintain construction sequence or schedule will not be considered.

3. Substitutions will not be considered when they are indicated or implied on a shop drawing or in product data submittals.

B. Document each request for substitution with complete data substantiating compliance of proposed substitution with Contract Documents.

C. A request constitutes a representation that the Bidder or Construction Manager:

1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the substitution as for the specified product.
3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner for review or redesign services associated with re-approval by authorities.

D. Substitution submittal procedure:

1. Submit 3 copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.
3. The Architect will notify the Construction Manager by written Addendum, of his decision to accept or reject request.
4. The submitted “equal” item fully conforms to specified sustainability and environmental requirements.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 31 00
PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 GENERAL PROJECT COORDINATION

A. Coordination: The Construction Manager is fully responsible for coordinating the Work of this Contract including scheduling, submittals, Work and other activities included in various Sections to assure efficient and orderly sequence of installation of interdependent construction elements. The Contractor is responsible for coordinating actual installed location and interface of work, and to make provisions to accommodate items scheduled for later installation.

B. Where installation of one component depends on installation of other components before or after its own installation, schedule activities in the sequence required to obtain efficient installation with the least amount of alterations, or cutting and patching, to completed Work.

1. The Contractor shall be responsible to uncover work completed in order to install ill -timed work, at no additional cost to the Owner.

C. Where space is limited, coordinate installation of different components to assure maximum accessibility for maintenance, service and repair.

D. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Contract Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

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

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

G. Coordinate completion and clean up of Work of separate Sections in preparation for Substantial Completion and Owner's occupancy.

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

1.2 UTILITIES, MECHANICAL AND ELECTRICAL COORDINATION

A. Coordinate all Work of this Project. Provide full and complete coordination for utilities, mechanical and electrical work in Divisions 21 through 33 with Work of other Divisions.

B. Give all advance notice to public utility companies as required by law, and provide proper disposition, subject to Architect's approval of all existing pipe lines, conduits, sewers, drains, poles, wiring, and other utilities that in any way interfere with the Work, whether or not they are specifically shown on the Drawings.

C. Coordination regarding existing utilities:

1. Notify Owner and appropriate authorities when coming across an unknown utility line(s), and await decision as to how to dispose of same.

2. When an existing utility line must be cut and plugged or capped, moved, or relocated, or has become damaged, notify the Owner and Utility company involved, and assure the protection, support, or moving of utilities to adjust them to the new work.
3. The Contractor shall be responsible for all damage caused to existing, active utilities located within the limits of this Contract, whether or not such utilities are shown on the Drawings, including resultant damages or injuries to persons or properties.

D. General coordination of piping, ductwork, conduits and equipment:

1. The Contract Drawings are diagrammatic only intending to show general runs and general locations of piping, ductwork, equipment and sprinkler heads. Determine exact routing and location of individual systems prior to fabrication of components or installation.
   a. Piping runs requiring pitch have "right -of-way" over those systems what do not pitch.
   b. System components whose elevations cannot be changed have "right-of-way" over those components whose elevations can be changed.
2. Adjust locations of piping, ductwork, conduits and equipment as required to accommodate new work with interferences anticipated and as encountered during installation.
   a. Locate piping, conduits and ductwork to be clear of swinging doors, access doors, and clear for unimpeded equipment access.
3. Provide all offsets, transitions and changes of direction for all systems, as may be required to maintain proper clearances for headroom, and as may be required for coordination with other "fixed-in-place" building components (such as structural systems).
   a. Furnish all vents, drains and similar accessories as may be required for offsets, transitions and changes of direction.
4. Provide openings in the work for penetration of mechanical and electrical work.
5. Coordinate final locations of ceiling mounted devices (including air distribution devices, thermostats, heaters, control devices, sprinkler heads and similar work) with reflected ceiling plans. Review locations with Architect and obtain approval of all devices prior to installation.

E. Uility penetrations through rated construction: Notify Owner of all locations of every penetration in fire resistant rated partitions and walls, in smoke barriers, and in fire barriers, including but not limited to penetrations for elevators, plumbing, fire suppression, heating, ventilating and air conditioning, electrical systems, telephone systems, communications systems, building controls systems, and specialized wiring and piping for medical equipment.

1. Comply with requirements of Section 07 84 00 – FIRESTOPPING for installation of fireproof firestopping, firesafing materials, smoke seals and related accessories.
   a. Provide removable (temporary) firestopping to maintain fire integrity until permanent firestopping assemblies can be installed.
2. Allow for inspection prior to installation of suspended ceilings or concealed by other materials that may conceal firestopping work.

1.3 COORDINATION OF CUTTING AND PATCHING

A. Cutting and patching coordination: The Construction Manager is responsible for coordination of all cutting and patching necessary for the completion of this Contract and for the quality and appearance of all patch Work in exposed-to-view finished materials.

B. General cutting and patching: Comply with requirements of Section 01 73 29 - CUTTING AND PATCHING.

1. Do not drill through structural beams, slabs or columns. Core drilling through concrete unit masonry and stair platforms must be approved by the Architect.

1.4 COORDINATION DOCUMENTS

A. General: Prepare coordination drawings for areas where close coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space necessitates maximum utilization of space for efficient installation of different components.

1. Coordination Drawings include, but are not necessarily limited to:
   a. Structure.
   b. Partition/room layout.
   c. Ceiling layout and heights.
   d. Light fixtures.
   e. Access panels.
   f. Sheet metal, heating coils, boxes, grilles, diffusers, and similar items.
   g. All heating piping and valves.
   h. Smoke and fire dampers.
   i. Soil, waste and vent piping.
   j. Major water.
   k. Major electrical conduit runs, panelboards, feeder conduit and racks of branch conduit.
   l. Above ceiling miscellaneous metal.
   m. Sprinkler piping and heads.
   n. All equipment, including items in the Contract as well as OFCI and OFI items.
   o. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur, indicate areas in which the required access area may be greater than the suspended grid system.
   p. Existing conditions, including but not limited to mechanical, plumbing, fire protection and electrical items.
   q. Seismic Restraints.

B. Timing: Prior to fabricating materials or beginning work, supervise and direct the creation of one complete set of coordination drawings showing complete coordination and integration of work, including, but not limited to, structural, architectural, mechanical, plumbing, fire protection, elevators, and electrical disciplines.

C. Intent: Coordination drawings are for the Construction Manager's use during construction and are not to be construed as replacing shop drawings or record drawings. Architect's review of submitted coordination drawings shall not relieve the Construction Manager from his overall responsibility for the coordination of the Work of the Contract.

D. Base sheets: Contractor shall prepare and provide one accurately scaled set of building coordination drawing "base sheets" on reproducible transparencies showing all architectural and structural work. Base sheets shall be at appropriate scale; congested areas and sections through vertical shafts shall be at larger scale.

   1. Base sheets shall be at appropriate scale of not less than 1/4 inch scale (1/4" = 1'-0") ; congested areas and sections through vertical shafts shall be at larger scale.
      a. Highlight all fire rated and smoke partitions.
      b. Indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions, and other services.
      c. Indicate elevations relative to finish floor for bottom of ductwork and piping and conduit (6 inches and greater in diameter).
      d. Indicate the main paths for the installation, or removal of, equipment from mechanical and electrical rooms.
   2. CAD Files: Where available General Contractor may obtain CAD files of original Bidding Documents from the Architect, at the cost of $50 per drawing sheet for production and handling. Payment in full, plus signing of the following disclaimer shall be considered prerequisites for the release of CAD format drawings.

E. Construction Manager shall circulate coordination drawings to the following subcontractors and any other installers whose work might conflict with other work. Each of these subcontractors shall accurately and neatly show actual size and location of respective equipment and work. Each subcontractor shall note apparent conflicts, suggest alternate solutions, and return drawings to Construction Manager.

1. Plumbing subcontractor.
2. Fire protection subcontractor.
3. Heating ventilating and air conditioning subcontractor(s).
4. Electrical discipline subcontractors.
5. Control system subcontractors.

F. Review and modify and approve coordination drawings in cooperation with individual installers and subcontractors to assure conflicts are resolved before work in field is begun and to ensure location of work exposed to view is as indicated or as approved by Architect.

1. The Contractor shall stamp, sign and submit coordination drawing originals to Architect for review.
2. Do not commence work in areas described in the coordination drawings until receipt of Architect's comments.

1.5 GENERAL PROJECT ADMINISTRATION

A. Prepare memoranda for distribution to each party involved outlining required coordination procedures. Include required notices, reports, and attendance at meetings.

B. Prepare similar memoranda for the Owner and separate contractors where coordination of their Work is required.

C. Conduct conferences among subcontractors and others concerned with the Work, to establish and maintain coordination and schedules, and to resolve coordination matters in dispute.

D. Administrative Procedures: Coordinate scheduling and timing of administrative procedures with other activities to avoid conflicts and ensure orderly progress. Such activities include:

1. Preparation of schedules.
2. Installation and removal of temporary facilities.
3. Delivery and processing of submittals.
4. Progress meetings.
5. Project Closeout activities.

1.6 SITE MOBILIZATION CONFERENCE

A. Prior to commencement of the Work, schedule a meeting at a meeting room provided by the Construction Manager.

1. Attendance is required by Owner, Architect, engineering consultants, Construction Managers' Project Manager and Superintendent, and major subcontractors, applicators, installers and suppliers. Other persons are required to attend as the Architect may direct or the Construction Manager may wish to have present.
2. Items of Agenda:
   a. Use of premises by Owner, Contractor, and subcontractor(s).
   b. Owner's requirements and partial occupancy considerations,
   c. Demolition procedures, identity tagging of existing furnishings and equipment for salvage or disposal.
   d. Temporary utilities.
   e. Barricading and protection of the public, dust barriers.
   f. Survey and building layout.
   g. Potentially difficult areas of work.
   h. Project coordination.
   i. Construction-waste management and recycling procedures.

j. Sustainability product requirements and procedures.
k. Indoor air quality standards and testing requirements.
l. Security and housekeeping procedures.
m. Construction schedules.
n. Work beyond Contract Limit.
o. Procedures for testing and inspection.
p. Procedures for maintaining record documents.
q. Requirements for equipment start-up.
r. Inspection and acceptance of equipment put into service during construction period.

1.7 PRE-INSTALLATION/PRE-FABRICATION CONFERENCES

A. When required in individual specification sections, prior to commencing the work of that trade, convene a pre-installation conference at work site, if possible, on same day as weekly progress meeting.

B. Notify Architect and Owner's Project Representative **a minimum of 72 hours (3 work days) in advance of meeting date**.

C. Attendance is required by Construction Managers' Project Manager and Superintendent, and parties directly affecting, or affected by, work of the Section.

1. Contractor shall include discussions on waste management goals and requirements in all prefabrication meetings conducted with subcontractors, fabricators, and vendors.
2. Contractor shall include discussions on Owner's procedures and requirements in all pre-fabrication meetings conducted with subcontractors, fabricators, and vendors.

1.8 PROGRESS MEETINGS

A. The Construction Manager shall schedule and administer meetings throughout the progress of the Work at regular intervals; make arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record minutes and distribute copies within one week to Architect, Owner and participants, and to those affected by decisions made.

1. Scheduled Frequency of Meetings: Weekly.

B. Attendance is required by Construction Managers' Project Manager and Contractor's Project Superintendent, and each applicator, installer, and supplier whose work is on-going or scheduled. Owner, Architect, engineering consultants, and other persons are required to attend as the Architect may direct. Architect, engineering consultants, subcontractors, vendors, suppliers shall be present at meetings upon request of Construction Manager.

1. Attendee Authority: Subcontractors and supplier representatives present at meetings shall have authority to act for and make commitments for, the entity which they represent.

C. Items of Agenda:

1. Review minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems, and decisions.
4. Identifications of problems which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Coordination of projected progress.
10. Maintenance of quality and work standards.
11. Progress of Work to be adjusted under coordination requirements, and effect of proposed changes on progress schedule and coordination.
12. Review of construction waste management and recycling performance, material quantities disposed and diverted for recycling.

13. Other business relating to Work.

D. Special project meetings: Conduct special meetings as required throughout the course of the Work. Special meeting issues may include, but are not limited to:

1. Safety issues.
2. Labor issues.
3. Construction waste management and recycling issues.
4. Special scheduling issues.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SURVEY AND LAYOUT DATA

A. Prior to starting any construction work, stake out all limits of cut and fill, the limits of proposed walkways and site improvements. Promptly upon completion of layout work and before any construction work is begun on the site, notify the Architect and Designated Owner's Representative, who shall conduct a field inspection of the stake -out. The Architect reserves the right to adjust the location of such layouts as it deems necessary to comply with the intent of the Contract Documents.

1.2 SCHEDULING OF THE WORK

A. **Submit Gantt/Bar progress schedule in triplicate within 15 days after date of Owner - Contractor Agreement to Architect for Architect's review**. Revise and resubmit as required.

B. Schedule shall be of format approved by Architect showing complete sequence of construction activity, identifying Work of separate stages and other logically grouped activities. For each separate phase, stage of Work and individual activities, indicate the early and late start dates, early and late finish dates, float dates, and duration.

1. The Schedule shall show the sequence and phasing of activities required and reflect the manner in which actual work will be performed. The number of activities shown in the Schedule must be at least equal and related to the number of items listed in the Schedule of Values including back -up detail.
2. Indicate implementation and termination of each temporary utility.
3. Define portions of work which are dependent on the schedule of other related activities and phasing.
4. Define activities on which the work is dependent, including:
   a. Submittal of shop drawings, equipment schedules, samples, color submission, coordination drawings, templates, fabrication and material delivery times.
   b. Architect/Engineer's review of shop drawings, equipment schedules, samples and templates.
   c. Delivery times of equipment furnished under separate Contracts with Owner, where the Contractor has responsibility for installation or coordination.
5. Conclude all activities on one common end date, show contract completion date as a milestone activity on the Schedule.

1.3 CONTRACT PROGRESS REPORTING

A. Construction schedule updates:

1. During progress of Work, revise and resubmit with Applications for Payment in accordance with the provisions of the General Conditions and Supplementary Conditions.
2. Maintain progress schedule with project progress and utilize the plan in planning, coordinating and performing the work under this Contract.
3. Furnish copies of the Progress schedule, and revisions, to all subcontractors, installers, equipment vendors and suppliers.
4. Update schedule showing actual progress of Work in progress, identify Work started and completed during the previous update period. Show the estimated time required to complete each activity started but not yet completed, and reflect any changes in the schedule.

5. Prepare a Schedule Analysis for submission with revised project schedules. The Schedule Analysis shall include a description of problem areas, current and anticipated delaying factors and their estimated impact on performance of other activities and completion dates, and an explanation of corrective action to be taken. All activities that are behind schedule by more than two weeks shall be addressed individually in the Schedule Analysis.
6. Submit revised schedules with attached Schedule Analysis, with each Application for Payment; clearly identify changes since previous version. Indicate estimated percentage of completion for each item of Work at each submission.

B. Daily construction reports: Prepare a daily construction report, submit duplicate copies to the Architect and Owner at two -week intervals. Record the following information concerning events at the site:

1. List of subcontractors at the site, and approximate count of personnel.
2. Accidents, unusual events, and emergency procedures.
3. High and low temperatures, general weather conditions (when exterior work is in Progress)
4. Meetings and significant decisions.
5. Stoppages, delays, shortages, losses.
6. Emergency procedures.
7. Orders and requests of governing authorities.
8. Change Orders received, and implemented.
9. Services connected, disconnected.
10. Meter readings and similar recordings.
11. Equipment or system tests and start -ups.
12. Partial Completions/occupancies.
13. Substantial completions authorized.

C. “Look Ahead” activity reports: Prepare each week throughout the term of construction a listing of upcoming construction activities. Each weekly report shall include a listing of planned construction activities for the upcoming 2 weeks (14 calendar days). Submit a Look Ahead Activity Report at each job meeting to all participants. If no meeting is planned on a given week, mail the reports directly to both Architect/Engineer and Owner’s Project Representative.

1. Maintain a record of all Look Ahead Activity Reports in a 3-ring binder in the Contractor’s field office and make available for review by Architect/Engineer and Owner’s Project Representative.

D. Special Reports:

1. Unusual Event Reporting: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information.

1.4 AFFIRMATION OF PURCHASE ORDERS

A. Several items specified in individual specification sections are products requiring long lead time. To ensure smooth progress of the Project without unwarranted delays, and to confirm compliance with the Contract Documents, the Contractor shall furnish affirmation of purchase orders for those items indicated in the individual specification sections as being long lead items.

B. Affirmation shall include cover letter to Architect naming the purchased products, anticipated dale of delivery, and referencing applicable specification section. Attach to letter, copy of Bill of Sale, or other term of receipt, indicating payment or downpayment for each of the indicated products. Bill of Sale shall clearly show date of purchase, product identification, quantities ordered and amount paid.

1. In lieu of Bill of Sale, Contractor may obtain from vendor a notarized letter, on the vendor's letterhead. Vendor's, letter shall certify placement of order and identify date of purchases products and quantity purchased.

1.5 WORK DOCUMENTATION – PERIODIC SITE OBSERVATIONS

A. Observe and maintain a record of tests. Record the following:

1. Specification section number, product(s), and name of subcontractor or installer.
2. Name of testing agency and name of inspector.
3. Name of manufacturer's representative present.
4. Date, time and duration of tests.
5. Type of test and results.
6. Retesting required.

B. Observe startup and adjustments; record time and date of equipment start -up and results.

C. Observe equipment demonstrations to Owner; record times and additional information required for operation and maintenance manuals.

D. Assist Architect/Engineer with final inspections. Prepare list of items to be completed and corrected.

1.6 WORK DOCUMENTATION – CONSTRUCTION PROGRESS PHOTOGRAPHS

A. Furnish digital photographs of site and construction through -out the progress of Work, produced by an experienced photographer acceptable to Architect.

1. Submittals:
   a. Discs: 2 copies, monthly and at final project completion.

B. Views: Take photographs from differing direction s indicating the relative progress of the Work. Take photographs monthly on date for Application of Payment, and at final completion.

1. Prior to start of demolition work and site clearing take one set of 10 photographs showing existing conditions (interior and exterior).
2. As a minimum, furnish 10 photos each month during the Work, furnish the following minimum number of views (as appropriate to Work being performed)
   a. Views of site construction: 2
   b. Exterior views of building: 2
   c. Interior views: 6.
3. Take additional photographs for the following major portions of work:
   a. Start and completion of site preparation.
   b. Completion of demolition.
   c. Completion of foundations.

C. Discs: Identify each disc on the back with the following information:

1. Project identification.
2. Date and time of exposure and orientation(s) of view.
3. Photographer's name, address and phone number.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUBMITTAL COORDINATION

A. Make submittals in a proper and timely fashion, allowing for administrative procedures, Architect's review, corrections to submissions and re-submittal, if necessary, and fabrication of products without delaying the project. Minimum processing times required by the Architect are as follows:

1. Review for Architect's Office only: **Allow a minimum of 10 working days** for review and processing. Some submittals may require additional time.
   a. Simultaneous submission of a large number of shop drawings and product data may require longer than 10 working days for review. (In particular submittals for Divisions 7, 23, 26 and 28).
   b. Complex Systems (structural, mechanical, electrical, fire protection) may require longer than 10 working days for review each time shop drawings, layout drawings, and product data are submitted or resubmitted.
2. Review by Architect and its consultant(s): Allow 10 working days for review and processing of submittals by Architect plus an additional 5 working days for review by each consultant as applicable.
3. Reprocessing of submittals: For submittals requiring re-submittal, re -processing time required shall be the same as first submittal.
4. No extension of Contract Time will be authorized due to failure to transmit submittals sufficiently in advance of scheduled performance of Work.

B. Make submittals of similar items, systems, or those specified in a single specification section together.

C. Make submittals for products which other products are contingent upon, first.

D. The Contractor is fully responsible for delay in the delivery of materials or progress of work caused by late review of shop drawings due to failure of the Contractor to submit, revise, or resubmit shop drawings in adequate time to allow the Architect checking and processing of each submission or resubmission.

1.2 SCHEDULE OF SUBMISSIONS

A. Schedule procedure: **Immediately after being awarded the Contract, meet with the Architect to discuss the schedule of submissions and then prepare and submit within 14 calendar days for approval a schedule of submissions for the Work.** The schedule of submissions shall be related to the entire Project, and shall contain the following:

1. Shop Drawing Schedule (for shop and setting drawings to be provided by the Contractor).
2. Sample Schedule (for samples to be provided by the Contractor).
3. With respect to portions of the Work to be performed by Subcontractors, such schedule of submissions for the work of each Subcontractor shall be submitted for approval within 30 calendar days after execution of a subcontract with such Subcontractor.

B. List all submissions required of each trade:

1. Include the Specification Section number, name of subcontractor or vendor, submittal type, item, description, type, quantity and size (where applicable) of each submission.
2. For each submission, provide the following dates, as estimated:
   a. Scheduled date of submission.

b. Required date of approval. (permit time for appropriate review and resubmissions as may be required).
c. Estimated date of beginning fabrication or manufacture of product (where applicable).
d. Required date of submission of product to testing laboratory.
e. Required date of testing laboratory approval.
f. Required date for delivery of product to site.
g. Required date for beginning of installation of product.
h. Required date for completion of installation (and in -place testing).

C. For each submittal, schedule to allow adequate time for review by the Architect and its consultants. The Architect will not be responsible for Work performed in shop or field prior to approval. Long-lead items requiring expedited action must be clearly indicated.

1. The schedule shall be reviewed and resubmitted as necessary to conform to approved modifications to the construction Project Schedule, and shall be updated as may be required by the Architect.

D. Posting of submittal schedule: Print and distribute the submittal schedule to Architect, Owner, subcontractors and other parties affected. Post copies in field.

E. Update schedule throughout progress of the Project, coordinated with scheduling changes in the Work, and redistribute monthly in conjunction with submittal of Application for Payment.

1.3 SUBMITTAL TRANSMITTAL FORM AND SUBMITTAL REQUIREMENTS

A. Each submittal shall carry the following information and be forwarded to the Architect / Engineer accompanied by a transmittal form established of this Project. One copy of the transmittal form shall be submitted to the Architect / Engineer.

1. The Project Name and Number.
2. The CSI number of the submittal.
3. The date of the submittal.
4. The Owner's name and address.
5. The Contractor's name and address.
6. The Subcontractor's name and address.
7. The Supplier's name and address.
8. The name of manufacturer.
9. The specification section, including paragraph and sub-paragraph as appropriate (CSI format).
10. The drawing reference and detail reference.
11. On the transmittal record, note the date sent and the requested due date from the Architect / Engineer.
12. Note the quantity and type of submittal.
13. Listing of the individual items in the submittal, cross referencing by sheet or item numbers the individual submittal items contained therein.
14. Notice of any deviations from the Contract Documents. Listing of the individual items in the submittal, cross referencing sheet numbers by itemizing by number individual submittal items contained therein, the case of Product Data or Samples.
15. The Contractor's certification, signed and dated, that he has reviewed the submittal and that it is in compliance with the requirements.
16. Field dimensions identified as such.
17. Any other pertinent information.
18. All attachments to the transmittal record will be identified with the submittal number.
19. Incomplete submittals will be returned without review.

1.4 SUBMITTAL NUMBERING SYSTEM

A. Submittals shall be numbered by CSI six-digit specification number with a subscript number for the particular submittal number (if there is more than one submittal per specification section).

Resubmittals shall be followed by a subscript "-R1", "-R2", "-R3", etc., as necessary for each resubmission. For example:

1. The first Panelboard submittal (say Power Panelboards) shall be "262416-001".
2. The first resubmittal of Power Panelboards shall be "262416-001 R1".
3. The second Panelboard submittal (say Power Panelboards) will be 262416-002, again with resubmittals being 262416-002 R1.

B. The Contractor shall keep each submittal and resubmittal intact with the original number and will not add new drawings or information outside the scope of the original submittal nor will the Contractor provide a new number for a resubmittal.

1.5 SUBMITTAL PROCEDURES AND GRADING

A. Prepare and submit to the Architect a Construction Schedule, a Schedule of Values, a Schedule of Environmental Submissions, and a Schedule of shop drawings, product data, and samples.

B. Provide space for Construction Manager, Architect and engineering consultant review stamps, on the front page of each item's submittal copy. Apply Construction Manager's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction Work, and coordination of information, is in accordance with the requirements of the Work and the Contract Documents. The Architect's stamp shall contain the following data (Engineering consultant review stamps may vary in language, but intent of language is similar):

_____NOT REVIEWED
_____REVIEWED
_____REVIEWED – With Comments
_____REVIEWED – With Comments, Resubmit for Record
_____RESUBMIT – See Comments
_____REJECTED – See Transmittal

1. The Architect will insert the date of action taken and an identification of the person taking the action.
2. Submittal grading:
   a. NOT REVIEWED – The submittal was not requested nor reviewed.
   b. REVIEWED - No corrections, no marks. All items can be fabricated as noted, without further correction and resubmission of original submission; review is complete and all corrections are deemed obvious without ambiguity.
   c. REVIEWED – With Comments or REVIEWED – With Comments, Resubmit for Record - Minor corrections required are as noted; all items can be fabricated as noted, without further correction and resubmission of original submission; review is complete and all corrections are deemed obvious without ambiguity. If noted as Resubmit for Record, the Contractor is to resubmit.
   d. RESUBMIT - See Comments - Resubmission is required; checking may be incomplete; details of items noted by checker are to be clarified further before full review can be given. Correct and resubmit, do not fabricate noted items requiring correction.
   e. REJECTED – See Transmittal - Submittal is rejected as not in accord with the Contract Documents, too many corrections, or other justifiable reasons. When returning submission, Architect will state reasons for rejection. Correct and resubmit, do not fabricate.
3. Review/approval neither extends nor alters any contractual obligations of the Architect, Engineer or Construction Manager.

C. Identify all variations from Contract Documents, and product or system limitations which may be detrimental to successful performance of the completed work.

D. Coordinate related submittals and schedule submissions to expedite the Project; deliver to Architect at the following address:

Integrated Design Group, Inc.
133 Federal Street
Boston, Massachusetts 02110

E. Transmit submittals to Architect at the above address, with individual transmittal forms, Document xx xx xx.xx - VENDOR SUBMITTAL/SHOP DRAWING REVIEW FORM for each submission. Forms are specific to specified portions of the work: Architecture, Mechanical Systems, and Electrical Systems. These three forms are bound into the Project Manual.

1. On transmittal form, identify Project, Construction Manager, subcontractor, installer, or supplier, pertinent Drawing sheet and detail number(s), and specification Section number, as appropriate. Transmittals received by the Architect from sources other than the Construction Manager will be returned without any action taken.
2. Construction Manager shall number submittals sequentially by Specifications Section prior to submittal. Resubmitted items shall retain number and be noted as resubmitted.

F. Construction Manager's review: Review all shop drawings, product data and samples. Include, without limitation, verification of the following:

1. Proper title, original date, drawing number (which shall be changed if resubmitted), revision numbers and dates, designation of project, subcontractor and/or supplier.
2. Identification of Shop Drawings, Product Data or Samples by Specification Section and subsection or paragraph where appropriate and identification of Contract Drawings by number and detail.
3. On each submittal, as a minimum, Construction Manager shall identify the following:
   a. Errors, inconsistencies, and omissions discovered in the contract documents and field conditions must be reported at once to the Architect.
   b. Any variations from code requirements contained in the contract documents must be reported promptly in writing to both the Architect and Owner.
   c. Promptly report to the Architect information that any design, process, or product infringes on a patent.
   d. Names of subcontractor(s) and supplier(s). Include name(s) of contact person(s), address, telephone and fax number(s).

G. Revise and resubmit submittals as required, identify all changes made since previous submittal. Distribute copies of reviewed submittals to concerned parties; instruct parties to promptly report any inability to comply with provisions.

1.6 SUBMITTAL QUANTITY REQUIREMENTS

A. Furnish Architect with the following quantities of each submittal:

1. Portable Document File (PDF), bookmarked and search-able, with materials / equipment / options clearly noted.
   a. Shop drawings: 3 blackline prints per drawing.
   b. Product data, manufacturer’s instructions and certificates and similar submissions: 4 copies.
2. Samples: Sets of 3 identical samples of each submission required.
3. Emergency addresses: 1 copy to Architect, and 1 copy direct to Owner.
4. Environmental policy submittals: 4 copies

1.7 SHOP DRAWINGS

A. General: Provide accurately prepared, large scale and detailed shop drawings prepared specifically for this Project. Show adjacent conditions and related work. Show accurate field dimensions where appropriate. Identify materials and products shown. Note all conditions where require coordination with other trades and special installation procedures. Standard information prepared without specific reference to Project are not considered shop drawings.

1. Shop drawings include fabrication and installation drawings, setting diagrams, schedules, patterns, templates and similar drawings.
2. Show every component of fabricated items, notes regarding manufacturing process coatings and finishes, identifying numbers conforming to the Contract Documents (i.e. stair numbers, door numbers and similar items), dimensions, and appropriate trade names. Show anchorage and fastening details, including type, size and spacing. Show material gage and thickness. Indicate welding details and joint types.
3. Review each submittal for conformity with the Contract requirements prior to submittal, certify such review on each shop drawing with Contractor's stamp, signature and date. Reference on shop drawings to other sections, installers, suppliers, or trade(s) shall designate the appropriate specification sections, and the term "by others" shall not be used.

B. Size of Format: Not less than 8 -1/2 by 11 inches and no larger than 30 by 42 inches, except for templates, patterns and similar full -size drawings.

C. The Architect's comments and corrections will be made on the PDF copy and returned to the Contractor. If necessary, the Contractor then shall make the necessary corrections on the original drawings and resubmit the corrected drawings in manner specified. The Contractor is responsible to furnish (at no additional cost to Owner) all prints needed for use by the Contractor, subcontractors, installers, vendors and suppliers.

D. Submittals returned "REVIEWED " or "REVIEWED – With Comments" or REVIEWED – With Comments, Resubmit for Record" as set forth below: Contractor shall obtain and distribute adequate prints for construction, including one print of each for the Owner's project representative, and then return the transparencies to the subcontractor or supplier from whom he originally received them.

E. Submittals returned "RESUBMIT – See Comments" or "REJECTED – See Transmittal", as set forth below: Contractor shall first obtain a record print and then forward them to source for correction of original drawings, and resubmission of a new reproducibles and prints as above.

F. Each drawing shall have a title block on the right hand side containing the following data. **Note each suite number to be infilled where it states "L 224"**.

Name of project –	**DIGITAL REALTY** **IAD39 Building L 224** **ASHBURN, VA**
Architect –	Integrated Design Group, Inc.
Contractor -	DPR Construction
Subcontractor/supplier -	
Date of submission -	

G. Each drawing shall have a clear space on the right hand side for review stamps of both the Architect and Contractor.

1.8 PRODUCT DATA

A. Submit Product data as specified, and as the Architect may additionally prescribe. Product data includes, but is not limited to:

1. Catalog cuts.
2. Complete specifications.
3. Standard color charts.
4. Performance data.
5. Environmental data including, but not limited to:
   a. Chemical composition.
   b. Recycled (pre and post consumer) content.
   c. Locations of material extraction/harvest and manufacture, with respective distances to site.
   d. VOC content.
   e. Material certifications as applicable to product.
6. Certified laboratory test report data.
7. Health and safety precautions.
8. Illustrated capacities, characteristics, wiring diagrams, controls, and other pertinent information for complete product and product use description.

B. If more than one size or type is shown on any printed sheet, indicate clearly intended item(s).

C. When accepted or not accepted, the Architect will retain three copies. Submit sufficient copies for all other parties. No copies stamped “RESUBMIT – See Comments” or "REJECTED – See Transmittal" shall be sent to the job site.

1.9 SAMPLES

A. Submit samples clearly labeled as to its material, type or make, manufacturer, size or gauge, and other pertinent data, accompanied by an appropriate transmittal form. Samples shall show full range of color and texture variation that can be expected.

1. When accepted or not accepted, the Architect will retain one set of samples and return the other to the Contractor. Samples will not be permitted for use in the project.

1.10 MANUFACTURER’S INSTRUCTIONS

A. When specified in individual specification Sections, submit manufacturer’s printed instructions for delivery, handling, storage, assembly, installation, start -up, adjusting, and finishing.

B. Identify conflicts between manufacturer’s instructions and Contract Documents.

1.11 MANUFACTURER’S CERTIFICATES

A. When specified in individual specification Sections, submit manufacturer’s certificates and installer certificates to Architect for review.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference date, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.

1.12 EMERGENCY ADDRESSES

A. Within 15 days of Notice to Proceed, submit in writing, the name, addresses and telephone numbers of key members of their organization including Contractor’s Superintendent and personnel at the site, to be contacted in the event of emergencies at the building site, which may occur during non -working hours.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 35 00
METHODS OF PROCEDURE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Agreement, Part 0, Special Conditions and Forms, and Division 01 Specifications Sections, apply to this Section.

B. Related Sections include the following:

1. Special Conditions and Forms: MOP for Protection of Equipment and Personnel.
2. Section 01 32 00, Construction Progress Documentation
3. Section 01 50 00, Temporary Facilities and Controls

1.2 SUMMARY

A. Section includes: Requirements for developing and implementing a Method of Procedure (MOP) during the construction of this Project.

1.3 DEFINITIONS

A. Method of Procedure: Method of Procedure (MOP) is a written plan which describes the activities and procedures to safeguard the building's occupants, network equipment, and contents and to interface with the building's management, operations, and security.

1.4 REQUIREMENTS

A. An MOP is required when a construction activity may affect the safety or routine operation of the occupants, network equipment, or valuable contents; or essentially affects the building's management, operations, security, or exterior integrity, and/or when requested or deemed necessary by Owner.

B. Development:

1. Contractor shall develop the MOP.
2. Contractor shall develop the MOP within the constraints of the approved Construction Schedule. Refer to subsequent Sections for detail of the requirements and time allowed for Owner's Representative approval. Additional time shall be provided for Architect / Engineer review.

C. Form: Each MOP shall be written document in narrative, descriptive or outline form supplemented with drawings, diagrams and schedules as necessary. The detailed format shall be as approved by the Owner's Representative.

D. Review and Approval: Contractor shall submit (via e-mail) each MOP to the Owner's Representative, Architect / Engineer and Owner's designated on-site technicians for review. All MOPs require Owner's Representative approval. Review and approval durations vary based on the nature of the work to be completed. Contractor to plan accordingly.

E. Implementation: Contractor shall implement the MOP when approved by the Owner's Representative in writing. No construction activity which requires an MOP shall proceed until the MOP is approved. Construction may proceed forty-eight (48) hours after approval has been obtained from the Owner's Representative.

F. Compliance: Contractor shall comply with the approved MOP. Owner reserves the right to stop the Work for non-compliance with the MOP. Any cost or time delay resulting from the Work stoppage shall be borne by the Contractor.

G. Successful completion of the Project may require detailed MOPs to be developed by the contractor. An anticipated MOP list will be required at the preconstruction meeting. The Architect / Engineer and Owner's Representative will review the MOP list and subsequent MOPs to determine which will require additional review by the Owner. Ten (10) working days (minimum) are required for MOP development and approval by the Owner's Representative. An additional five (5) working days will be required for any critical power cutovers that will require Power and Grounding Review. The connection of the portable diesel generator, refeeding of existing AC panels and HVAC units to new distribution system, refeeding of branch circuits from existing panels and energization and testing of new service and standby plant will require review by Power and Grounding, as indicated. An MOP walk-through and list must occur prior to the Work. MOP walk through to be coordinated through designated Owner's Representative. All General Contractors are required to have active e-mail systems to conduct this process.

H. All MOPs shall be completed, reviewed, and signed-off, prior to performing that particular task. Owner, Owner's Representative, and Architect / Engineer will review all MOPs and offer assistance for their development. However, the contractor shall be responsible for development, sign-off, and implementation of all MOPs.

I. In addition, the Owner and the Architect / Engineer shall be notified prior to starting any MOP Work.

J. MOPs are required for all facets of the Work that affect Owner equipment or Owner's personnel. An MOP may be required when:

1. Construction activity may impact the safety of occupants.
2. Construction activity may impact "live" network operation or DC power systems.
3. Construction activity may impact any system that supports these types of systems, including AC power, HVAC, fire alarm, security, etc.
4. Any activity that may generate building or system alarms.
5. Any activity deemed necessary by the Architect / Engineer or Owner's Representative.
6. All AC power and HVAC cutovers may require an MOP if network equipment and DC power equipment is energized.
7. All fire alarm and FM-200 Work will require an MOP if network equipment and DC power equipment is energized.
8. All core drilling and trenching will require an MOP if near energized AC power, DC power and network equipment.
9. AC power, generator, HVAC, security, fire alarm and FM-200 testing may require an MOP if network equipment and DC power equipment is energized.
10. Installation of dust and equipment protection may require an MOP.
11. In portions of the building that are designated as early turn over rooms for Owner equipment installation and Contractor's work is not complete per milestone schedules.

K. The Contractor's bid shall include development and completion of all MOPs and associated Work.

1.5 CONSIDERATIONS

A. General: The following are some considerations:

1. Identify the construction area and its boundaries.
2. Identify access of trades and materials to location.
3. Identify the sequence of Work and impact on occupants and equipment in the area.

4. Identify impact or possible impact on central building systems including HVAC, chilled water, electricity, alarms, etc.
5. Identify the protection and separation required for access to Work and Work area.
6. Determine the exact amount of materials required and availability at time of Work.
7. Determine the duration of the Work.
8. Request temporary facilities for occupants and office equipment if necessary.
9. Notify occupants via Owner's Representative in pre-established time frame.
10. Require the presence of Owner technical personnel for some additional procedures in sensitive areas.
11. Develop together with Owner technical personnel for some additional procedures in sensitive areas.

B. Specific Construction Activity: The following are some considerations:

1. Desired date of the activity.
2. Desired time of the activity.
3. Location of the activity.
4. Brief description of the activity.
5. The length of the activity.
6. Step-by-step procedure of the activity.
7. A contingency plan to retreat from the activity and place facility and equipment back in normal operating configuration.
8. List the name of persons, companies, and telephone numbers of contact in case of emergency.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 41 00
REGULATORY REQUIREMENTS

PART 1 - GENERAL

1.1 DEFINITIONS

A. Regulations include laws, ordinances, statutes and lawful orders issued by authorities having jurisdiction, and rules, conventions and agreements within the construction industry that control performance of the Work, whether lawfully imposed by authorities having jurisdiction or not.

1.2 APPLICABLE CODES AND REGULATIONS

A. All work shall be performed in accordance with the latest version, except as indicated otherwise, of all applicable codes including the following:

1. The Commonwealth of Virginia Uniform Statewide Building Code – 2012 Edition, as amended, and incorporates the following major codes:
   a. Commonwealth of Virginia Construction Code 2012 ED (based on the International Building Code, 2012 edition)
   b. Commonwealth of Virginia Electrical Code 2012 ED
   c. Commonwealth of Virginia Mechanical Code 2012 ED
   d. Commonwealth of Virginia Plumbing Code 2012 ED
   e. International Code Council/American National Standards Institute, code standard: ICC/ANSI A117.1
   f. Americans with Disabilities Act
   g. Commonwealth of Virginia Energy Conservations Code 2012 ED
   h. Commonwealth of Virginia Fire Prevention Code 2012 ED
2. Loudoun Country Virginia, Zoning Ordinance, as amended.
3. United States Occupational Safety and Health Administration (OSHA): Standard Nº. 29-CFR-1926.59 - HAZARD COMMUNICATION STANDARD.

B. Publication Dates: Where the date of issue of a code or regulation is not specified, comply with the standard in effect as of date of Contract Documents, or as otherwise required by authorities having jurisdiction.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 41 17
UTILITIES NOTIFICATION

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. Comply with all regulations and laws concerning excavation, demolition, or explosive work and be advised of utility notification requirements under all applicable local codes and ordinances.

1.2 REGULATORY REQUIREMENTS

A. Contractors/subcontractors must notify the local utility by telephone or teletype before performing any earth moving or building demolition operations including: building demolition, digging, trenching, boring, site demolition, excavation, backfilling, grading, explosive work in all public ways and private property.

B. This notification must be made at least forty -eight (48) hours but not more that fifteen (15) days (Saturdays, Sundays and legal holidays excluded) before commencement of the contemplated Work.

1. Provide the following information:
   a. Name and title of individual serving notice to the Utility.
   b. Specific location of work site:
      1) Location of Work.
      2) Site Address and Intersecting street.
      3) Site location information (landmarks).
      4) Site boundary identification.
   c. Company name of contractor/subcontractor (excavator) performing subgrade work and mailing address.
   d. Phone number, fax number and email address of excavator performing subgrade work.
   e. Excavator's field telephone number, if available. If not furnish General Contractor's field office telephone number.
   f. Type and extent of the proposed work.
      1) Description of Work.
      2) Type of work.
      3) Proposed depth of work.
      4) Extent and method of excavation.
      5) Proposed starting date and duration of work.
   g. Name and title contact person if questions arise, phone number and extension, fax number and email address.
   h. Best time for the Utility Customer Service Representative to return calls.
2. Caller must record the Utility serial number and lawful dig dates.

C. Do not commence work until the Utility has been properly notified and has responded in writing.

1.3 PROTECTION

A. The Contractor is fully responsible for protection of the utility location markings, wherever these occur, on or off -site.

B. Perform Work in such a manner, and with reasonable precautions taken to avoid damage to utilities under the surface in said areas of work. Immediately notify any known or suspected damage to underground utilities to the owner of such utilities.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 42 00
REFERENCES

PART 1 - GENERAL

1.1 ABBREVIATIONS AND ACRONYMS

A. The following list of common abbreviations are referenced in individual specification sections. This list is provided for convenience to the Construction Manager and is not intended to define all abbreviations use in the Contract Documents.

1. Abbreviations for contract and specifications.

EPA	United States Environmental Protection Agency
HVAC&R	Heating, ventilating, air conditioning, and refrigeration systems
IAQ	Indoor Air Quality
IEQ	Indoor Environmental Quality
MSDS	Material Safety Data Sheet
NIC	Not in Contract
OFCI	Owner Furnished, Construction Manager
Installed OFI	Owner Furnished and Installed
OFOI	Owner Furnished and Installed
VOC	Volatile Organic Compounds

2. Abbreviations for measurements and quantities.

C	Celsius
cm	Centimeter
F	Fahrenheit
Hrs	Hours
Kg	Kilogram
L	Liter
m	Meter
m2 or SM	square meter
m3 or CM	cubic meter
mm	Millimeter
Mths	Months
psi	Pounds per square inch
t	ton

1.2 DEFINITIONS

A. Definitions of contracting parties (Owner, Owner's Project Manager, Construction Manager, and Architect): Refer to Section 01 10 00 – PROJECT SUMMARY.

B. Definitions for terms utilized in the Contract Documents:

1. "As necessary," "as directed," "when directed," "satisfactory," "good and sufficient," "approved," or other general qualifying terms are used on the Drawings: These terms are deemed to be followed by the words, "in the opinion of the Architect," or "by the Architect," as the case may be."
2. "Addenda": written or graphic instruments issued prior to the execution of the Contract which modify or interpret the Bidding Documents, including the Drawings and Specifications, by additions, deletions, clarifications or corrections.
3. "Approval," "approved, "approved equal," "or equal," or "other approved" means as approved by the Architect."
4. The term "Day": is defined as the following:

    a. The term "calendar day" is a full 24 hour period, starting from 12 AM (midnight), and includes all weekends and legal holidays.
    b. The term "working day" shall mean any calendar day except Saturdays, Sundays, and legal holidays at the place of the building.
    c. Where the term "day" is used without the adjective of "calendar" or "working", it shall mean "calendar day".

5. Furnish and Install" or "Provide": items identified shall be furnished and installed under this Contract. The term "Furnish", when used separately, shall mean that the items referred to shall be furnished, only. Similarly the term "install", when used separately, shall mean that the items referred to shall be installed, only.
6. "Knowledge," "recognize" and "discover," their respective derivatives and similar terms in the Contract Documents, as used in reference to the Construction Manager, shall be interpreted to mean that which the Construction Manager knows (or should know), recognizes (or should recognize) and discovers (or should discover) in exercising the care, skill and diligence required by the Contract Documents. Analogously, the expression "reasonably inferable" and similar terms in the Contract Documents shall be interpreted to mean reasonably inferable by a Construction Manager familiar with the Project and exercising the care, skill and diligence required of the Construction Manager by the Contract Documents.
7. "Not in Contract" or "N.I.C.": equipment, furnishings, or other materials not included as a part of this Contract.
8. "Product": materials, systems and equipment.

C. Definitions pertaining to sustainable development: As defined in ASTM E 2114 - *Standard Terminology for Sustainability Relative to the Performance of Buildings,* and as specified herein.

1. "Biobased Materials": As defined in the Farm Security and Rural Investment Act, for purposes of Federal procurement of biobased products, "biobased" means a "commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials." Biobased materials also include fuels, chemicals, building materials, or electric power or heat produced from biomass as defined by The Biomass Research and Development Act of 2000.

a. "Biobased Content": The amount of biobased carbon in the material or product as a percentage of weight (mass) of the total organic carbon in the material or product.

2. "Chain-of-Custody: Process whereby a product or material is maintained under the physical possession or control during its entire life cycle.
3. "Composite panel products": Manufactured wood products including, but are not limited to particle board (PB), Medium Density Fiberboard (MDF), wheatboard and strawboard and similar manufactured products
4. "Deconstruction: Disassembly of buildings for the purpose of recovering materials.
5. "DfE (Design for the Environment)": A technique that includes elements of resource conservation and pollution prevention as applied in various product sectors. A technique that incorporates approaches which are part of product (or assembly) concept, need and design. Considerations involve material selection, material and energy efficiency, reuse, maintainability and design for disassembly and recyclability. Refer to ISO Guide 64, and EPA's website at http://www.epa.gov/dfe/ for additional clarification on Design for the Environment for additional clarification
6. "Environmentally preferable products": Products and services that have a lesser or reduced effect on the environment in comparison to conventional products and services. Refer to EPA's Final Guidance on Environmentally Preferable Purchasing for more information <http://www.epa.gov/epp/guidance/finalguidancetoc.htm>.
7. "Non-Renewable Resource": A resource that exists in a fixed amount that cannot be replenished on a human time scale. Non-renewable resources have the potential for renewal only by geological, physical, and chemical processes taking place over of millions of years. Examples include: iron ore, coal, and oil.
8. "Perpetual Resource": A resource that is virtually inexhaustible on a human time scale.
9. Examples include solar energy, tidal energy, and wind energy.
10. "Recycled Content Materials": Products that contain preconsumer or post-consumer materials as all or part of their feedstock. Recycled content claim shall be consistent with Federal Trade Commission (FTC) Guide for the Use of Environmental Marketing Claims.
11. "Renewable Resource": A resource that is grown, naturally replenished, or cleansed, at a rate which exceeds depletion of the usable supply of that resource. A renewable resource can be exhausted if improperly managed. However, a renewable resource can last indefinitely with proper stewardship. Examples include: trees in forests, grasses in grasslands, and fertile soil.

1.3 REFERENCE STANDARDS

A. For products or workmanship specified by association, trade, or Federal Standards comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by DATE OF ISSUE for Contract Documents, current on date of Owner-Construction Manager Agreement.

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

D. The contractual relationship to the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

E. Schedule of References

1. Listed below are abbreviations for the names and titles of trade association names, federal government agencies and similar organizations which are referenced in the individual specification sections. The addresses and phone numbers provided are for the Construction Manager's convenience and are believed to be current and accurate, however addresses and phone numbers frequently change, and no assurance is made on their accuracy:

AA	Aluminum Association 900 19th Street N.W., Suite 300 Washington, DC 20006 www.aluminum.com
AAMA	American Architectural Manufacturer's Association 1827 Walden Office Sq., Suite 104 Schaumburg, IL 60173-4268 www.aamanet.org
ACI	American Concrete Institute, International 38800 Country Club Drive, Farmington Hills, Michigan 48331 www.aci-int.org
ADC	Air Diffusion Council 104 S. Michigan Ave, Suite 1500, Chicago, IL 60603 www.flexibleduct.org
AFPA	American Forest & Paper Association (Formerly NFPA National Forest Products Association) 1111 19th St. N.W., Suite 800, Washington, DC 20036 www.afandpa.org
AGA	American Gas Association Inc. 1515 Wilson Blvd. Arlington, VA 22209-246 www.agagas.com
AGAI	American Galvanizers Association Inc. 12200 E.Lliff Ave, Suite 204, Aurora, CO 80014-1252 www.galvanizeit.org
AIA	American Institute of Architects 1735 New York Avenue, N.W., Washington, DC 20006-5292 www.aia.org
AIHA	American Industrial Hygiene Association 2700 Prosperity Ave, Suite 250, Fairfax VA 22031 www.aiha.org
AISC	American Institute of Steel Construction 1 E. Wacker Dr., Suite 3100, Chicago, IL 60601-2001 www.aisc.org
AMCA	Air Movement and Control Association 30 W. University Drive, Arlington Heights, IL 60004-1893 www.amca.org
ANSI	American National Standards Institute

	11 W. 42nd Street, 13 Floor, New York, NY 10036 www.ansi.org
APA	The Engineered Wood Association (formerly APA American Plywood Association) P.O. Box 11700, Tacoma, WA 98411-0070 www.apawood.org
ARI	Air-Conditioning and Refrigeration Institute 4301 N. Fairfax Dr., Suite 425, Arlington, VA 22203 www.ari.org
ASCA	Architectural Spray Coaters Association 230 West Wells Street, Suite 311, Milwaukee WI 53203 www.aecinfo.com
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers 1791 Tullie Circle NE, Atlanta GA.30329 www.ashrae.org
ASME	American Society of Mechanical Engineers 345 East 47th Street, New York, NY 10017-2392 www.asme.org
ASTM	American Society for Testing and Materials 100 Barr Harbor Drive, West Conshohocken, PA 19428 www.astm.org
AWI	Architectural Woodwork Institute 1952 Isaac Newton Square W., Reston, VA 20190 www.awinet.org
AWPA	American Wood Preservers' Association P.O. Box 286, Woodstock, MD 21163-0286 www.awpa.com
AWPI	American Wood Preservers' Institution 1945 Old Gallows Rd., Suite 150, Vienna, VA 22182 www.oas.org
AWS	American Welding Society 550 LeJeune Road, N.W., Miami, FL 33126 www.aws.org
BHMA	Builders Hardware Manufacturers Association, Inc. 355 Lexington Ave., 17 Floor New York, NY 10017 www.buildershardware.com
CISCA	Ceilings & Interior Systems Construction Association 579 W. North Ave., Suite 301, Elmhurst, IL 60126 www.cisca.org
CRI	Carpet and Rug Institute 310 Holiday Ave, Dalton, GA 30720 ww.carpet-rug.com
CRSI	Concrete Reinforcing Steel Institute 933 N. Plum Grove Road, Schaumburg, IL 60173-4758 www.crsi.org

CTIOA	Ceramic Tile Institute of America 12061 W. Jefferson BLVD, Culver City, CA 90230-6219 www.ctioa.org
DHI	Door and Hardware Institute 14170 Newbrook Dr., Chantilly, VA 22021-2223 www.dhi.org
FM	Factory Mutual Engineering & Research Corp. 1151 Boston-Providence Turnpike Norwood, MA 02062 www.fmglobal.com
FSC	Forest Stewardship Council (United States Chapter) 1155 30th Street NW, Suite 300, Washington, DC 20007 www.c-f-c.com
GA	Gypsum Association 6525 Belcrest Road, Suite 480, Hyattsville, MD 20782 www.gypsum.org
GANA	Glass Association of North America 2945 S.W. Wanamaker Dr., Suite A, Topeka, KS 66612-5321 www.glass.org
GICC	Glazing Industry Code Committee 3310 Harrison St., Topeka, KS 66611-2279 www.glazingcodes.net
IGCC	Insulating Glass Certification Council 3933 US Route 11, PO Box 2040, Cortland, NY 13045 www.igcc.org
LSGA	Laminators Safety Glass Association 3310 Harrison Street, Topeka KS 66611-2279 www.glass.org
MIL	Military Specifications and Standards Naval Publications and Forms Center 5801 Tabor Avenue, Philadelphia, PA 19120 www.milspec.com
NAAMM	National Association of Architectural Metal Manufacturers 8 South Michigan Avenue, Suite 1000, Chicago, IL 60603 www.naamm.org
NEBB	National Environmental Balancing Bureau 8575 Government Circle, Gaithersburg, MD 20877-4121 www.nebb.org
NEMA	National Electrical Manufacturers' Association 1300 N. 17th St., Suite 1846, Rosslyn, VA 22209 www.nema.org
NFPA	National Fire Protection Association

	1 Battery March Park, PO Box 9101, Quincy, MA 02269 www.nfpa.org
NRCA	National Roofing Contractors Association O'Hare International Center 10255 W. Higgins Road, Suite 600, Rosemont, IL 60018-5607 www.nrca.net
PCA	Portland Cement Association 5420 Old Orchard Road, Skokie, IL 60077-1083 www.cement.org
PS	Product Standard U. S. Department of Commerce www.omg.org
SDI	Steel Deck Institute P.O. Box 25, Fox River Grove, IL 60021-0025 www.sdi.org
SDI	Steel Door Institute 30200 Detroit Road, Cleveland, OH 44145-1967 www.steeldoor.org
SGCC	Safety Glass Certification Council RMS, P.O. Box 9 Henderson Harbor, NY 13651 www.sgcc.org
SIGMA	Sealed Insulating Glass Manufacturers Association 401 N. Michigan Ave., Suite 2400, Chicago, IL 60611 www.glasschange.com
SJI	Steel Joist Institute 3127 10th Ave. N., Myrtle Beach, SC 29577 www.steeljoist.org
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association 4201 Lafayette Center Dr., Chantilly, VA 22022-1209 www.smacnapa.org
SPIB	Southern Pine Inspection Bureau 4709 Scenic Highway, Pensacola, FL 32504-9094 www.spib.org
SSMA	Steel Stud Manufacturer's Association 8 South Michigan Avenue, Chicago IL 60603 www.ssma.com
SSPC	The Society for Protective Coatings 40 24th Street, 6th Floor, Pittsburgh PA 15222-4623 www.sspc.org
SWRI	Sealant, Waterproofing & Restoration Institute 2841 Main Street, Suite 585, Kansas City, MO 64108 www.swrionline.org

TCNA	Tile Council of North America, Inc. 100 Clemson Research Blvd., Anderson, SC 29625 www.tileusa.com (formerly TCA, Tile Council of America)
UL	Underwriters' Laboratories, Inc. 333 Pfingston Road, Northbrook, IL 60602 www.ul.com
WCLIB	West Coast Lumber Inspection Bureau 6980 S.W. Varns Road, Box 23145, Portland, OR 97223 www.wclib.org
WDMA	Window & Door Manufacturers Association (formerly National Wood Window & Door Association, NWWDA) 205 E. Touhy Avenue, Suite G-54, Des Plaines, IL 60018 www.nwwda.org
WWPA	Western Wood Products Association 522 SW Fifth Avenue, Yeon Building, Portland, OR 97204 www.wwpa.org

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 45 00
QUALITY CONTROL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General quality assurance.

B. Field samples and mock -ups.

C. Source quality control.

D. Manufacturer's field services and quality control.

E. Field quality control, Owner's right for confirmation.

1.2 RELATED SECTIONS

A. Section 01 45 29 – Testing Laboratory Services.

1.3 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

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

B. Comply fully with manufacturers' instructions, including performance of each step in sequence. Notify Architect when manufacturers' instructions conflict with the provisions and requirements of the Contract Documents; obtain clarification before proceeding with the work affected by the conflict.

C. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate high standards or more precise workmanship.

D. Perform work by persons qualified to produce workmanship of specified quality.

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

1.4 FIELD SAMPLES

A. Install field samples demonstrating quality level for the Work, at the site as required by individual specifications Sections for review and acceptance by Architect. Remove field samples prior to date of Final Inspection, or as directed.

1.5 MOCK-UPS

A. Where requested by Architect, or as specified in individual specification section s, assemble and erect specified items, with specified attachment and anchorage devices, flashings, seals, and finishes. Remove mock -up assemblies prior to date of Final Inspection, or as directed.

B. Mock-ups, when approved by the Architect/Engineer, will be used as datum for comparison with the remainder of the Work for the purposes of acceptance or rejection.

C. Demolish and remove from site prior to requesting inspection for certification of Substantial Completion, all Mock-ups which are not permitted to remain as part of the finished work.

1.6 MANUFACTURER'S FIELD SERVICES AND REPORTS

A. When called for by individual Specification Sections, provide at no additional cost to the Owner, manufacturers' or product suppliers' qualified staff personnel, to observe site conditions, start -up of equipment, adjusting and balancing of equipment, conditions of surfaces and installation, quality of workmanship, and as specified under the various Sections.

1. Individuals shall report all observations, site decisions, and instructions given to applicators or installers. Immediately notify Architect of any circumstances which are supplemental, or contrary to, manufacturer's written instructions.
2. Submit full report within 30 calendar days from observed site conditions to Architect for review.

1.7 FIELD QUALITY CONTROL

A. The Owner reserves the right to take samples and perform, at random, tests of approved materials delivered to the job site to verify compliance of actual materials with specifications.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 45 29
TESTING LABORATORY SERVICES

PART 1 - GENERAL

1.1 SELECTION AND PAYMENT

A. Contractor shall employ and pay for services of an Owner approved independent testing laboratory to perform specified inspection and testing.

1. Submit to Owner's Project Manager a minimum of three independent testing laboratories for each type of testing specified by individual specification sections and those required by the referenced applicable codes, regulations and standards.

B. Employment of testing laboratory shall in no way relieve Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.2 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 REFERENCES where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ANSI/ASTM D 3740 -Standard Practice for Minimum Requirements for Agencies Engaged in the. Testing and/or Inspection of Soil and Rock
2. ANSI/ASTM E 329 -Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
3. ASTM F 1869 Standard Test Method for Measuring Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
4. ASTM F 2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In-Situ Probes
5. ASTM F 710 - Standard Practice for Preparing Concrete Floors and Other Monolithic Floors to Receive Resilient Flooring.

1.3 QUALITY ASSURANCE

A. Comply with requirements of ANSI/ASTM D 3 740 and ANSI/ASTM E 329.

B. Laboratory: Authorized to operate in state in which Project is located.

C. Laboratory staff: Maintain a full time specialist on staff to review services.

D. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to either the National Bureau of Standards (NBS) Standards or accepted values of natural physical constraints.

1.4 LABORATORY RESPONSIBILITIES

A. Cooperate with Architect and Contractor in performance of services; provide qualified personnel promptly on notice.

1. Attend preconstruction conferences and progress meetings, as requested.

B. Acquaint Owner, Architect, and Contractor's superintendent with testing procedures and with all special conditions encountered at the site.

C. Perform specified Inspection, sampling, and testing of products and construction methods in accordance with specified standards as specified in individual technical specification sections:

1. Comply with specified standards, ASTM, ANSI, and other recognized authorities.

2. Conduct and interpret the tests and state in each report whether the test specimens comply with the requirements, and specifically state any deviations therefrom.
3. Obtain Contractor's written acknowledgment of each inspection, sampling, and test made. Test samples of mixes submitted by Contractor.
4. Ascertain compliance of materials and mixes with requirements of Contract Documents.

D. Promptly notify Architect and Contractor of irregularities, deficiencies, or non-conformance of Work or Products which are observed during performance of services.

E. Promptly submit written report of each test and inspection; one copy each to Architect, Owner, Contractor, and one copy to Project Record Documents File.

F. Perform additional inspections and tests required by Architect/Engineer.

1.5 LABORATORY REPORTS

A. After each test, promptly distribute directly from the testing laboratory, copies of laboratory report to:

1. Architect's office: 3 copies.
2. Contractor's office: 1 copy.
3. Municipal Inspectional Services Department: copies as required.

B. Include in report t he following information:

1. Date issued,
2. Project title and number,
3. Testing laboratory name, address, and telephone number.
4. Name and signature of laboratory inspector.
5. Date and time of sampling,
6. Record of temperature and weather conditions (as appropriate t o test).
7. Identification of product and Specifications Section,
8. Location of sample or test in the Project.
9. Type of inspection or test.
10. Results of tests and compliance with Contract Documents.
11. Interpretation of test results, when requested by Architect.
12. Observations regarding compliance with Contract Documents

1.6 LIMITS ON TESTING LABORATORY AUTHORITY

A. Laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.

B. Laboratory may not approve or accept any portion of Work.

C. Laboratory may not assume any duties for Contractor.

D. Laboratory has no authority to stop the Work.

1.7 CONTRACTOR RESPONSIBILITIES

A. Coordinate and cooperate with laboratory personnel, provide access to Work.

1. Monitor each inspection, sampling, and test.
2. Provide Laboratory or Agency with written -acknowledgment of each Inspection, sampling, and test.
3. Within 24 hours notify Architect and Owner in writing of reasons for not acknowledging Laboratory results.

B. Secure and deliver to the Laboratory or designated location, adequate quantities of representational samples of materials proposed to be used and which require testing, along with proposed mix designs.

C. Furnish incidental labor and facilities:

1. To provide access to Work to be tested.
2. To obtain and handle samples at the Project site or at the source of the Product to be tested.
3. To facilitate inspections and tests.
4. For storage and curing of test samples.

D. Furnish verification of materials and equipment compliance with Contract Documents.

E. Notify Architect/Engineer and laboratory 24 hours prior to expected time for operations requiring inspection and testing services.

F. Identify materials to be tested or inspected by Testing Laboratory or Agency.

G. Make arrangements with laboratory and pay for additional samples and tests required for the following conditions:

1. Initial testing indicates Work does not comply with Contract Documents.
2. Contractor requested testing for additional testing and laboratory services beyond specified requirements.

1.8 CONDUCT OF INSPECTIONS AND TESTS

A. The Contractor shall notify the Architect, and Testing Laboratory a minimum of 72 hours before the performance of work to permit the proper conduct of Owner -authorized inspections and tests.

B. Representatives of Testing Laboratory will inspect the manufacture, assembly, and placement of materials as required and as authorized by the Owner, and report their findings to the Architect, Owner, and Contractor.

C. Work shall be checked as it progresses, but failure to detect any defective work or materials shall in no way prevent later rejection when such defect is discovered nor shall ft obligate the Owner to accept such work.

1.9 SCHEDULE OF TESTING AND LABORATORIES BY CONTRACTOR

A. General Contractor shall employ and pay for services of an approved independent testing laboratory to perform inspection and testing specified under this Article and as additionally in individual specification sections

1. Submit to Architect/Engineer a minimum of three independent testing laboratories for each type of testing specified by individual specification sections and those required by the referenced applicable codes, regulations and standards.
2. Employment of testing laboratory shall in no way relieve Contractor of obligation to perform work in accordance with requirements of Contract Documents.

B. Earthwork: Lab tests to determine suitability of all fill materials shall be paid for by Contractor.

1. Owner reserves the right to retain and pay for his own testing for checking purposes

C. Concrete Paving and General Concrete Work: Concrete mix design testing shall be paid for by Contractor. Owner reserves the right to retain and pay for his own testing for checking purposes.

D. Moisture content testing of interior and exterior wood prior to application of field painted coatings.

E. Concrete slabs and floors: Relative Humidity, Moisture Vapor Emission and acidity/alkalinity (pH)Testing:

1. General Contractor shall employ and pay for services of an independent testing laboratory to perform relative humidity, moisture vapor emission, and pH tests on concrete slabs as follows The test shall be witnessed by the Contractor, flooring subcontractors and Owner's Project Representative.
   a. Relative Humidity, Moisture Vapor Emission and pH Testing on all concrete floors over which a finished floor is to be installed, including flooring installed under the following Section(s), but not limited to:
      1) Section 03 05 13 – Concrete Sealers
      2) Section 09 69 00 – Access Flooring
   b. Perform moisture and pH tests on all concrete floors over which a floor coating or sealer is to be applied.
2. Requirements: As specified under Part 3 of this Section.
   a. Submit 1 copy of test data to the installers of all flooring materials or coating materials scheduled to be installed.
   b. Provide additional testing in the event test results indicate higher moisture content than recommended by the flooring material and coating material manufacturers for the installation of their products. Perform such additional testing, at no additional cost to the Owner, after procedures have been performed to reduce moisture content to ratings acceptable to the various flooring and coating manufacturers.

F. Local Authority Inspections: The Contractor is also responsible for coordinating and cooperating with local requirements for inspections by local Authorities.

1.10 SCHEDULE OF TESTING AND LABORATORIES BY SUB-CONTRACTORS

A. Respective subcontractors shall employ and pay for services of an approved independent testing laboratory to perform inspection and testing specified under this Article and as additionally in individual specification sections

1. Submit to Owner's Project Manager a minimum of three independent testing laboratories for each type of testing specified by individual specification sections and those required by the referenced applicable codes, regulations and standards.
2. Employment of testing laboratory shall in no way relieve Contractor of obligation to perform work in accordance with requirements of Contract Documents.

B. Plumbing: At least the following tests shall be performed. Conform to requirements specified in individual Division 22 Specification Sections. The test shall be performed and paid for by the subcontractor and witnessed by the Contractor, and authorities having jurisdiction:

1. Water supply piping hydrostatic pressure test.
2. Sanitary piping test before fixture installation: Cap pipes and fill to highest point in system.

C. Fire Protection System: At least the following tests shall be performed. Conform to requirements specified in individual Division 21 Specification Sections. The test shall be performed and paid for by the subcontractor and witnessed by the Contractor, and authorities having jurisdiction:

1. Fire protection system flushed and pressure tested.

D. HVAC Testing: All HVAC work shall be tested by an independent testing and balancing agency, approved by Owner. Conform to requirements specified in individual Division 23 Specification Sections. The tests shall be performed and paid for by the subcontractor and witnessed by the Contractor, and authorities having jurisdiction. Adjustments shall be made by the subcontractors directed by the Owner. At least the following tests shall be performed:

1. Air and water balancing.
2. Thermostat control monitoring and testing.
3. Energy Management System operation.

E. Electrical Power System Testing: At least the following tests shall be performed. Conform to requirements specified in individual Division 26 Specification Sections. The tests shall be

performed and paid for by the subcontractor and witnessed by the Contractor, and authorities having jurisdiction:

1. Polarity tests.
2. Operation of all circuits.
3. Testing of emergency system.
4. Security systems.
5. Generation system.
6. Grounding systems.
7. Voice/Video/Data networking testing.

F. Electrical Lighting System Testing: Conform to requirements specified in individual Division 26 Specification Sections. At least the following tests shall be performed and paid for by the subcontractor:

1. Operation of every component of entire system.

G. Fire Alarm System Testing: At east the following tests will be performed. Conform to requirements specified in individual Division 26 Specification Sections. The test shall be performed and pa id for by the subcontractor and witnessed by the Contractor:

1. All smoke and heat detectors.
2. Proper operation as required by authorities having jurisdiction.

H. Where no testing requirements are described but the Owner or Architect/Engineer decides that testing is required, testing will be performed under current pertinent standards for testing.

1.11 FOLLOW-UP AND CORRECTIVE ACTION

A. The Contractor and the Owner will note the test record on the Testing Log to acknowledge test procedures and results. If follow -up or corrective action is needed, the Contractor shall submit to the Owner two written copies of proposed follow -up or corrective plans and obtain the Owner's written approval before proceeding.

1. Cost of Testing: If tests indicate that materials or work do not comply with requirements, the Contractor shall pay for all retesting, and shall remove and replace non -complying work at no additional cost to the Owner.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 CONCRETE IN SITU RELATIVE HUMIDITY, CALCIUM CHLORIDE AND ACIDITY/ALKALINITY TESTING

A. Scope:

1. Provide in situ concrete relative humidity and surface pH testing to all concrete slabs specified to be covered with floor coverings or resinous coatings. Includes concrete placed as part of this Work which occurs below grade, above grade (suspended slabs), and slabs on grade.
   a. Existing building suspended slabs may be excluded from this requirement.

B. Scheduling:

1. Testing shall take place after allowing concrete to dry for a minimum of 90 days. Testing to be scheduled no less than one, nor more than three weeks prior to scheduled flooring installation.
   a. DO NOT conduct testing unless the slab environment is identical to that In which the finished flooring Is to be installed.

2. In the event new flooring is to be installed over existing resilient flooring, remove the portion of the existing flooring and adhesive directly under the area where testing will be conducted. Patch flooring to match existing construction after completion of testing.

C. Test result submittals:

1. Report all test results in chart form listing test dates, time, depth of test well, in situ temperature, relative humidity, moisture vapor and pH levels.
2. List test locations on chart and show same on marked up Floor Plan Drawings.
3. Submit results In duplicate. Deliver copies directly to Architect, and General Contractor.

D. Testing equipment: shall be equal to the following

1. For relative humidity testing:
   a. Digital Meter and Calibrated Humidity and Temperature probe kit as manufactured by Vaisala Inc. (Boston Office) 10D Gill Street, Woburn, MA, 01801 (telephone 781 – 933-4500).
      1) Minimum 2 point probe calibration.
2. For calcium chloride testing:
   a. Anhydrous calcium chloride testing in accordance with Rubber Manufacturer's Association (RMA) Test requirements.
   b. Test kits: Vaprecision, inc. 2941 West MacArthur Boulevard, Suite 135. Santa Ana, CA 92704 (telephone 800-449-6194).
3. For pH testing:
   a. pH test paper by Micro Essential Laboratory, Inc., P.O. Box 100824 4224 Avenue “H”, Brooklyn, NY 11210, (telephone 718 -338-3618).
   b. Distilled or de ionized water.

E. Testing Procedures Quantification of Relative Humidity

1. The test site should be maintained at the same temperature and humidity conditions as those anticipated during normal occupancy. These temperature and humidity levels should be maintained for 48 hours prior and during test period. If meeting this criteria is not possible, then minimum conditions should be 75 degrees F (plus or minus 10 degrees F), and 50 percent (plus or minus 10 percent) relative humidity. When a building is not under HVAC control, a recording hygrometer or data logger shall be in place recording conditions during the test period. A transcript of this information must be Included with the test report.
2. The number of In situ relative humidity test sites is determined by the square footage of the facility. The minimum number of tests to be placed is equal to 3 in the first 1,000 square feet and 1 per each additional 1,000 square feet.
3. Drill test holes utilizing a roto hammer drill. Hole diameter shall not exceed outside diameter of the insertable test sleeve by more than 0.04 inch. Drilling operation must be dry. Determine the thickness of the concrete slab from Construction Documents. Depths of test holes shall be as follows:
   a. For elevated slabs (not poured in pans): Drill test ho les to a depth equal to 20 percent of the concrete thickness.
   b. For slabs on grade and elevated slabs in pans: Drill test holes to a depth equal to 40 percent of the concrete thickness.
4. Vacuum all concrete dust from test hole.
5. Insert a hole liner, or sleeve, to the full depth of test hole, assuring that the liner is capped or plugged at the end protruding from the concrete surface.
6. Permit the test site to acclimate, or equilibrate, for 72 hours prior to taking relative humidity readings.
7. Remove the sleeve plug and place a probe into the sleeve assuring that it reaches the bottom of the test hole.
8. Allow the probe to sit in the test sleeve for 30 minutes before taking readings.
9. Read and record temperature and relative humidity at the test site.

F. Testing Procedures Quantification of Concrete Moisture Vapor Emission through Calcium Chloride Testing.

1. The test site should be maintained at the same temperature and humidity conditions as those anticipated during normal occupancy. These temperature and humidity levels should be maintained for 48 hours prior and during test period. If meeting this criteria is not possible, then minimum conditions should be 75 degrees F (plus or minus 10 degrees F) and 50 percent relative humidity (plus or minus 10 percent). When a building is not under HVAC control, a recording hygrometer or data logger shall be in place recording conditions during the test period. A transcript of this information must be included with the test report.
2. The number of vapor emission test sites is determined by the square footage of the facility. The minimum number of tests to be placed is equal to 3 In the first 1,000 square feet and I per each additional 1,000 square feet.
3. Tests sites are to be cleaned of all adhesive residue, curing compounds, paints, sealers, floor coverings, and similar materials. 24 hours prior to the placement of test kits.
4. Weigh test dish on site prior to start of test. Scale must report weight to 0.1 grams. Record weight and start time.
5. Expose Calcium Chloride and set dish on concrete surface.
6. Install test containment dome and allow test to proceed for 60 to 72 hours.
7. Retrieve test dish by carefully cutting through containment dome. Close and reseal test dish.
8. Weigh test dish on site recording weight and stop time.
9. Calculate and report results as pounds of emission per 1,000 square feet per 24 hours."

G. Testing Procedures Quantification of Acidity/Alkalinity (pH) Level

1. At or near the relative humidity test site and each vapor emission (calcium chloride) test site, perform pH test.
   a. At each testing site, lay down a loose 2 foot by 2 foot sheet of rubber flooring or non perforated polyethelene sheet backed by plywood. Leave in place for 48 hours.
   b. Remove rubber sheet/polyethelene and place several drops of distilled or de ionized water onto t he concrete surface to form a puddle approximately 1 inches in diameter.
   c. Allow the water to set for approximately 60 seconds.
   d. Dip the pH paper into the water and remove immediately, compare color to chart provided by paper supplier to determine pH reading
2. Record and report results.

H. Testing Procedures:

1. Initial testing: Provide 3 tests for the first 1,000 square feet.
2. Add one test for each additional 1,000 square feet.
3. Concrete surface, area to be tested shall be completely clean. Remove all adhesives, residue debris and sealing compounds. Remove all dust by vacuum or other methods. Do not use chemicals of any kind to clean concrete.
4. Perform moisture tests in strict accordance with the kit manufacturer's Instructions. Moisture tests shall remain undisturbed for 60 to 72 hours.
5. Immediately after moisture test has been removed from test area, conduct pH test in area previously covered by plastic dome of moisture test kit.
6. After completion of tests submit 2 copies of test data to the Architect. Submit a copy of the test data to all installers of flooring materials and resinous flooring materials scheduled to be installed.
7. Provide additional testing in the event test results indicate higher moisture content than recommended by the flooring material and coating material manufacturers for the installation of their products. Perform such additional testing, at no additional cost to the Owner, after procedures have been performed to reduce moisture content to ratings acceptable to the various flooring and coating manufacturers.

END OF SECTION

SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Requirements for temporary facilities and controls.

1.2 GENERAL REQUIREMENTS

A. The General Contractor shall provide and maintain all temporary facilities, controls, and construction aids as specified here-in, until they are replaced by permanent work, or until Project Substantial Completion, as appropriate.

1. Temporary facilities removed from the Project shall remain the property of the Contractor, except as otherwise specified.

B. Except where specifically noted otherwise, cost or us e charges for temporary facilities, utility services, controls, and construction aids and similar items specified in this Section or as required to perform the Work, are not chargeable to the Owner or Architect, and will not be accepted as a basis of claim s for a Change Order.

C. Establish and initiate use of each temporary facility at time first reasonably required for proper performance of the Work. Terminate use and remove facilities at earliest reasonable time when they are no longer needed, or when permanent facilities have, with authorized use, replaced the temporary facilities.

1. Locate temporary facilities where they will serve Project adequately and result in minimum interference with performance of the Work.

1.3 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 SUBMITTAL PROCEDURES:

1. Reports of tests, inspections, meter readings and similar procedures performed on temporary utilities.
2. Schedule showing implementation and termination of each temporary utility within 15 days of commencement of the Work.
3. Shop drawings:
   a. Temporary signage.
   b. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.4 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 REFERENCES.

1. ANSI A 10 -Safety Requirements for Construction and Demolition.
2. NFPA 70 -National Electrical Code.
3. NFPA 241 -Building Construction and Demolition Operations.

1.5 TEMPORARY UTILITIES, GENERAL REQUIREMENTS

A. General Installation: Install temporary utility service(s), or connect to existing service(s) as indicated, and as specified. Comply with all applicable laws, regulations, and requirements of authorities having jurisdiction.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

1.6 TEMPORARY UTILITIES, ELECTRICITY

A. Temporary electricity: The Owner will pay for electrical energy required for temporary light and power. The Contractor is required to hire an electrician licensed where project is located to provide temporary feeders of sufficient capacity from the facility's power lines, at the point coordinated with the Owner, to furnish electric light and power requirements for the work, while under construction.

1. Metering: The Owner reserves the right to require separate metering and for the Contractor to pay for electricity used, if, in the Owner's opinion, electricity is being wasted.
2. Electric power service: Use of existing electric power service will be permitted, as long as equipment is sufficient for Contractor's needs and is maintained in a condition acceptable to Owner. Provide additional weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics as required to furnish temporary electricity for construction operations. Include meters, transformers, overload protected disconnects, automatic ground-fault interrupters and main distribution switch gear.
   a. Connect temporary service to Owner's existing power source, as directed by Owner.
   b. Heavy electrical loads such as welding and other equipment with similar special power requirements must be powered by individual installers using portable electric generators at each users own cost.
      1) Except as otherwise specifically provided, all additional costs resulting from such use shall be borne by the Contractor.
3. Distribution: A grounded receptacle (outlet) for an extension cord shall be provided by the Contractor within one hundred (100) feet of any part of the building. Each user is responsible for its own work lamps and extension cords.

1.7 TEMPORARY UTILITIES, LIGHTING

A. Temporary lighting: Provide lighting with local switching to fulfill security requirements and provide illumination for construction operations and traffic conditions. Maintain lighting and provide routine repairs.

1. Maintain a minimum lighting intensity of at least one 200 watt lamp per 1000 square feet of floor area of building. Provide higher lighting intensities necessary for finish work or special construction operations, when required.
2. Permanent building lighting may be utilized. Immediately prior to the Architect's inspection for substantial completion the Contractor is required to replace all used lamps which are broken or have burned out.
3. Install and operate temporary lighting with switching, that fulfills security and protection requirements without operating entire system.

1.8 TEMPORARY UTILITIES, TELEPHONE

A. Temporary telephone service: Provide telephone service at time of project mobilization, and pay all costs for installation, maintenance, and removal. The Contractor shall pay service charges for local calls; toll charges shall be paid by party who places call. Service and equipment required includes the following:

1. For Contractor's Field Office.
   a. Provide one direct line service dedicated for use by the Contractor, and personnel engaged in construction.
   b. Cellular (mobile) phone service for Contractor's Superintendent, continuously maintained until Project Substantial Completion.
   c. One (direct) separate line for facsimile (FAX) machine.

1.9 TEMPORARY UTILITIES, WATER\

A. Temporary water: Contractor is permitted to use existing hose bib(s). Owner will pay for water necessary for the Work; exercise measures to conserve water.

1. Protect piping and fittings against freezing.

1.10 TEMPORARY HEATING AND COOLING

A. Temporary heat: Provide heat for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Provide vented self -contained liquid propane gas or fuel oil heaters with individual space thermostatic control, UL approved and acceptable to local fire department. Use of gasoline-burning space heaters, open flame, or salamander type units is prohibited.

1. Vent heaters directly to outside air, in areas where concrete is less than 15 days old.
2. In enclosed areas, maintain a minimum temperature of 50 degrees Fahrenheit; provide higher temperatures where required by individual specification sections.

1.11 TEMPORARY VENTILATION AND HUMIDITY CONTROL

A. General:

1. Humidity Control: Monitor and regulate relative humidity as required for the installation of all interior products. Relative humidity shall be maintained within the limits set by manufacturers of all interior materials and equipment. Refer to individual specification sections in Divisions 6, 8, 9, and 10 for additional environmental requirements.
   a. Contractor shall enclose interior work areas, protect from weather, and maintain specified temperature and humidity prior to commencement of construction activities relating to interior finishes.
2. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases. Extend and supplement equipment with temporary fan units as required to maintain clean air for construction operations.
   a. During construction, Contractor shall meet or exceed the minimum requirements of the SMACNA IAQ Guideline for Occupied Buildings under Construction 1995, Chapter 3.

B. Monitor Humidity: Provide Hygrometer to measure temperature and relative humidity in each construction area.

1. Provide dehumidifier(s), as required to maintain humidity of enclosed areas below 70 percent. Humidity level shall be maintained in all areas where interior finish work is being performed, and all areas where interior finishes has been completed.
2. Provide fans as specified herein, and as required to eliminate significant variation in humidity levels within enclosed spaces.

C. Temporary Construction Ventilation: Contractor shall maintain sufficient temporary ventilation of areas where materials are being used that emit VOC's and maintain ventilation continuously during installation and until emissions dissipate after installation. If continuous ventilation is not possible via the building's HVAC system(s) then Contractor shall supply ventilation via open windows and temporary fans, sufficient to provide no less than three air changes per hour.

1. Vent all areas directly to outside. Areas shall not be vented to other enclosed areas.
2. During dust producing activities (e.g. drywall installation and finishing) Contractor shall turn off ventilation system and protect openings in supply and return HVAC system from dust infiltration. Provide temporary ventilation as required.
3. Dissipation of VOC's: The period after installation shall be sufficient to dissipate odors and elevated concentrations of VOCs. A minimum time period of 72 hours is required except where longer periods of time are specified under individual specification sections.

D. Preconditioning: Prior to installation, Contractor shall allow products which have odors and VOC emissions to off -gas in dry, well -ventilated space outside of building for 14 calendar days, in order to allow for reasonable dissipation of odors and emissions.

1.12 FIELD OFFICES AND SHEDS

A. General: Designated existing spaces may be used for field offices and for storage.

1. Availability: Provide offices ready for occupancy within 15 days after date fixed in Notice to Proceed.
2. Availability: Provide offices ready for occupancy within 15 days after date fixed in Notice to Proceed.
3. Location: The location of the field office(s) and storage areas for equipment and materials shall be located where accepted by the Owner's Project Manager.
   a. Offices and sheds located within the construction area, or within 30 feet of building lines shall be of noncombustible construction. Comply with requirements of NFPA 241.
4. General:
   a. Contractor shall provide periodic cleaning and maintenance
   b. of field offices and storage areas.
   c. Provide air conditioning and heating to maintain a temperature range of 65 to 78 degrees F.

B. Contractor's field office(s): Provide habitable office(s) or space, of size to accommodate personnel, include as a minimum the following:

1. Size: For Contractor's needs and to provide space for project meetings.
2. Furnishings:
   a. Conference table and chairs to seat at least 12 persons;
   b. Racks and files for Contract Documents, submittals and Project Record Documents.
3. Hard-hats for site visitors.
4. Duplex convenience outlets, at least one per wall.
5. Telephone service as specified herein above.
6. Other equipment and furniture as the Contractor deems necessary.

C. Storage and fabrication sheds: Provide as required, sheds, equipped to accommodate materials and equipment involved.

1. Subcontractors are responsible for their own storage facilities, coordinate locations.

D. When permanent facilities are enclosed with operable utilities, relocate offices and storage into building, with written agreement of Owner, and remove temporary buildings.

1.13 SANITARY FACILITIES

A. Sanitary facilities: Provide self-contained single -occupant chemical toilet units, wash facilities and drinking water fixtures.

1. Existing facilities located in the building may not be used by the Contractor's personnel.

B. Provide toilet tissue, paper towels, paper cups, cleaning compounds and similar materials.

C. Maintain facilities and keep clean, provide covered waste containers for used material.

1.14 FIRST AID AND FIRE EXTINGUISHERS

A. First aid supplies: Comply with governing regulations.

B. Fire extinguishers: Provide and maintain on site, adequate fire extinguishers UL rated for A-B-C type fires. Provide red -painted plywood standards for each extinguisher. Additionally provide a dry chemical fire extinguisher at each location where welding, torch cutting and other similar hazardous work is in progress.

1.15 CONSTRUCTION AIDS – TEMPORARY HOISTS AND CRANES

A. Hoisting equipment and machinery: Furnish all hoisting equipment, crane services and lift machinery required to perform the Work of this Contract. Install, operate and maintain in safe condition.

1. Do not charge applicators and installers for these services during normal working hours.

1.16 CONTRUCTION AIDS – SCAFFOLDING, PLATFORMS, STAGING, CHUTES

A. Provide all ladders, ramps, runways, platforms, railings, chutes, and other mounted or installed construction aids as specified herein and as required to facilitate the Work. Furnish and erect construction aids and maintain in safe condition for the use of all subcontractors, installers and applicators.

B. Furnish and erect scaffolds, staging, and maintain in safe condition, dismantle when no longer required. The Contractor shall provide scaffolds, staging, and other similar raised platforms, required to access the Work.

C. Ladders, temporary stairs, platforms and railings, shall comply with OSHA guidelines.

1. Provide and maintain temporary stairs until permanent stairs are in place and functional. When permanent stairs are erected, provide temporary railings and guards. Protect permanent stair s with temporary covers and protective treads.
2. Portable ladders and mobile platforms of all required heights, shall be provided by individual users.

1.17 VEHICULAR ACCESS AND PARKING

A. Provide and maintain access to fire hydrants free of obstructions. Provide unimpeded access for emergency vehicles. Maintain 20 foot width driveways with turning space between and around combustible materials.

B. Vehicular Parking: Designated on -site parking spaces will be made available for the Contractor’s use.

C. The Contractor shall not close or obstruct any portion of any street public or private, without obtaining permits therefore from the proper authorities.

1.18 DUST CONTROL

A. Provide positive means to prevent air -borne dust from dispersing into atmosphere.

1. Take all necessary measures an d provide equipment and materials to minimize dust from rising and blowing across the site and also to control surface water throughout the operation so that it does not run onto paved ways without being filtered. Control all dust created by construction operations and movement of construction vehicles, both on site and on paved ways.
2. During the progress of the work, maintain the areas of construction activities including sweeping and sprinkling of streets as necessary. Provide and use calcium chloride for more effective dust control, when deemed necessary by regulatory agencies, without additional cost to the Owner.

B. Prevent air -borne dust from dispersing into occupied spaces. Provide interior dust -tight temporary partitions as specified under the Article en titled “Interior enclosures”.

1. Provide air filters over openings and grilles in air -return ducts occurring within construction areas.
2. Provide openings in temporary partitions where air -return grilles occur outside of work areas. In each opening, provide standard 2 inch thick, throw -away type filter having a

rated efficiency of 35 percent. Review with Architect size requirements of filtered openings, locations of openings and how many are required.
3. Replace air filters as required to maintain their efficiency.

1.19 NOISE CONTROL

A. Develop and maintain a noise-abatement program and enforce strict discipline over all personnel to keep noise to a minimum.

B. Execute construction work by methods and by use of equipment which will reduce excess noise.
   1. Equip air compressors with silencers, and power equipment with mufflers.
   2. Manage vehicular traffic and scheduling to reduce noise

C. Interior work involving cutting, drilling, hammering or noise generating procedures shall be completed during times schedule with the Owner in advance.

1.20 TEMPORARY WEATHER PROTECTION

A. Protect building interior and all materials and equipment from weather at all times. Where removal of existing roofing, roof sheathing, windows, doors, and other items is necessary to accomplish work, have materials and workmen ready to provide adequate and approve temporary covering of exposed areas.
   1. Temporary coverings shall be attended as necessary to insure effectiveness and to prevent displacement.
   2. Contractor shall repair or replace all elements of the building damaged by failure to properly protect them from the weather to the satisfaction of the Architect at no additional cost to the Owner.

1.21 TEMPORARY INTERIOR (ISOLATION) ENCLOSURES

A. Provide temporary partitions and ceilings to separate work areas from adjacent occupied are as, to prevent penetration of dust and moisture into occupied areas and to prevent damage to existing materials and equipment.
   1. Temporary enclosures must seal construction areas and prohibit passage of dust and debris, and inhibit noise transmission.
   2. Temporary enclosures and doors through them, shall be erected in manner to provide code mandated egress from the occupied portions of the building. Provide fire -resistant rated enclosures where required to maintain protected paths of egress.

B. Construction: Wood or metal framing and gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces with STC rating 35 in accordance with ASTM E90 and with Flame Spread Rating of 75 or less in accordance with ASTM E84.
   1. Where fire-resistant rated enclosures are required, construct barriers utilizing 1 hour fire resistance rated construction, consisting of Type "X" gypsum wallboard and studs. Thickness of wallboard and the type of studs to be used, shall be as required by any of manufacturer's or industry's tests to obtain a 1 hour fire rated wall.
   2. Construct closures, using new materials only, in accordance with the general carpentry requirements in Section 06100 – Rough Carpentry and Section 09250 – Gypsum Board.
   3. Doors in temporary closures must be constructed of solid new lumber and must be positively latching.

1.22 TEMPORARY PROTECTION OF EXISTING FINISHES

A. General: Take all required measures to protect the existing building (contents, surfaces, or materials) and site from damage of any kind when performing the Work.

1. Take any special steps necessary to protect entrances and areas around building and to prevent persons from coming in contact with material or construction operations.
2. Protect utility services, pavements, sidewalks, landscaping, and all other site elements scheduled to remain.

B. Provide all temporary protections as may be required to ensure that all components of existing building indicated to remain are not damaged during the execution of the Work.

1. Protection may be required to remain in place for the duration of the project. As such, materials should be installed to provide adequate protection throughout the full extent of construction activities. Repair or reinstall protection throughout the duration of construction as required.

C. Dust Protection Path: Areas where demolition work is required.

1. Seal all floor, wall and ceiling openings to prevent the intrusion of dust into these spaces. Provide dust curtains at doors.
2. Construct temporary partitions surrounding the area of construction in these areas.
3. Dust-Proof Wrap: Cover surfaces with polyethylene plastic. Seal seams completely with duct tape. Anchor to protection wherever possible. Attach to historic materials with preservation tape. Do not use duct tape or mechanical fastener s on historic materials.
4. Dust-Proof Temporary Partitions: Comply with Article above entitled TEMPORARY INTERIOR (ISOLATION) ENCLOSURES.

1.23 TEMPORARY BARRICADES

A. Provide barriers and barricades to prevent unauthorized entry to construction areas.

1. Comply with standards and code requirements for erection of barricades, where required provide lighting, including flashing lights.
2. Paint with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against.

B. Provide temporary enclosures, as required, for protection of existing facilities and new construction from exposure to weather, other construction operations and similar activities. Where heat is needed and the building envelope is incomplete, provide enclosures where there is no other provision for containment of heat.

1. Provide doors with self -closing hardware and locks.

C. Provide temporary roofing as needed to maintain the building water tight.

1.24 TREE AND PLANT PROTECTION

A. Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, skinning or bruising of bark, smothering of trees by stockpiling construction materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line.

B. Provide temporary guards to protect trees and vegetation to be left standing. Protect plant life by placing boards, planks, poles or fencing around them.

1.25 POLLUTION CONTROL

A. Provide methods, means, and facilities required to prevent contamination of soil, water, or atmosphere by, the discharge of noxious substances from construction operations.

1. Comply with all applicable Federal, State, County, and municipal laws regarding pollution.
2. Prevent pollution of streams, lakes, or reservoirs with fuels, oils, bitumens, calcium chloride, acids, waste products, effluents, chemicals or other harmful substances. Prevent from such substances from entering storm drains and sanitary sewers.

B. Provide equipment and personnel, perform emergency measures required to contain any spillage and to remove contaminated soils or liquids.

1. Excavate and legally dispose of any contaminated earth off -site, and replace with suitable compacted fill and topsoil.

1.26 FIRE PREVENTION MEASURES

A. The Contractor shall take all necessary precautions for the prevention of fire during construction. Install and maintain temporary fire protection facilities of the types needed to protect against reasonably predictable and controllable fire losses. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways, and other access routes. Ascertain and comply with requirements of Project insurance carrier, local fire department and the state fire marshal.

1. Maintain the area within contract limits orderly and clean.
   a. Remove combustible rubbish promptly from the site and when required, store combustible materials in containers in fire-safe locations.
2. Maintain clear access to exits from within the building.
3. Smoking is not permitted in the building or adjacent areas.

B. Establish procedures for fire protection for welding, cutting and open torch work, and other potentially hazardous operations. Obtain permission from local authorities having jurisdiction for such work as required by law. Provide special fire extinguishers at welding and torch cutting work.

1. Maintain a fire watch when existing fire protection and warning systems have been temporarily de-activated. Maintain watch during all working hours for full period of de - activation.
2. The Contractor will assign personnel to inspect all construction areas at the end of each day's work for fire hazards prior to lock-up.

C. Provide for outside storage of gas tanks, sufficiently clear of any structure. Promptly remove welding and cutting equipment from the building when no longer required. Do not store welding or cutting materials within the building when work is not being performed.

D. Permanent fire protection system may be activated to meet these requirements. Replace fusible link heads and other expended or discharged components at time of Substantial Completion.

1.27 SECURITY MEASURES

A. Protect Work, from theft, vandalism, and unauthorized entry.

B. Initiate a security program in coordination with Owner's existing security system at job mobilization.

C. Maintain security program throughout construction period until Owner occupancy.

1.28 PROJECT IDENTIFICATION AND TEMPORARY SIGNAGE

A. General: Signs other than those specified herein are not permitted, except those required by law or expressly authorized by the Owner.

1. At all times during the project, signage must clearly direct occupants and the general public in the safe use of the building. Signs must clearly indicate areas of no admittance, and further must clearly define and direct users to building entries, exits, and [school offices] and other important destinations. All such interim signage must be painted by a professional sign painter on 3/4 -inch medium density overlay plywood with letters no less than 3 inches in height. Coordinate required signage with Architect/Engineer.

B. Project sign:

1. Provide 8 foot wide by 4 foot high foot project sign of exterior grade MDO plywood and wood frame construction, painted, with self -adhesive color printed text with reproduction of building rendering. Owner's Project Manager will approve signage design.
   a. Color prints for rendering shall be 3M Scotchprint marking film series 8640 or equal, 4 mil thickness, "ControlTac" vinyl film as manufactured by 3M company having a positionable pressure activated pigmented adhesive.
   b. Overlay protecting film, Scotchprint Film, clear overlaminating film, as manufactured by 3M company.
2. List title of project, names of Owner, Architect/Engineer, [professional sub -consultants,] Contractor, [and major subcontractors].
3. Erect on site at location established by Architect/Engineer.

C. Signage at perimeter of construction site: Provide clear and visible warning signage with appropriate language such as: "Prohibited Access Hard Hat Only No Admittance Authorized Personnel Only".

1.29 REMOVAL OF TEMPORARY UTILITIES, CONTROLS, AND FACILITIES

A. Remove temporary materials and construction at Substantial Completion.

B. Restore existing facilities used during construction to original conditions. Restore permanent facilities used during construction to specified condition.

C. Clean and repair damage caused by installation or use of temporary work.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 DEFINITIONS

A. “Products” is defined as new material, machinery, components, equipment, fixtures, and systems used in the Work. Products do not include machinery and equipment used for preparation, fabrication, conveying and erection of the Work. Products may also include existing materials or components required for re-use.

B. "Materials" are products that are shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed, or installed to form a part of the Work.

C. "Equipment" is a product with operational parts, whether motorized or manually operated, that requires service connections such as wiring or piping.

D. Definitions in this article are not intended to negate meaning of other used in Contract have terms Documents, including " specialties", "systems", "structure", "finishes", "accessories", "furnishings", the self "special construction", and similar terms, which are self-explanatory and recognized meanings in the construction industry.

1.2 BASIC PRODUCT REQUIREMENTS

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

1. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

B. To the fullest extent possible, provide products of the same kind, from a single source.

C. Provide interchangeable components of the same manufacturer, for similar components.

D. When the Contractor has the option of selecting two or more products, ensure that products selected shall be compatible with products previously installed or approved.

E. Provide all products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.

F. Galvanic Corrosion: Install materials in manner which will effectively isolate dissimilar metals which may potential for galvanic corrosion. Use non -absorptive dielectric material, isolation coatings, or other protective isolator approved by Architect.

G. Fasteners, Anchors, and Connections: Engineer and provide all fasteners, anchors, and connections needed to safely, securely, and appropriately permanently secure all Work in place.

1. The Contractor is solely responsible for the capacity, suitability, adequacy, and safety of all welded, fastened and anchored connections.

H. Permanent Labels:

1. Restrictions:
   a. Do not provide labels, nameplates, or trademarks which are not required by code, or regulations.
   b. Do not provide labels, nameplates, or trademarks when individual specification sections specifically exclude them.

c. Do not expose manufacturers, suppliers, or installer's name, logo, or trade names on normally visible surfaces.
2. Data Plates: Provide permanent data plate on each item of equipment stating manufacturer, model, serial number, date of manufacture, capacity, ratings, power requirements, and all other essential data.
3. Generally, locate required permanent labels on inconspicuous surfaces.

1.3 GENERAL ENVIRONMENTAL REQUIREMENTS FOR PRODUCTS

A. General: Prohibit the use of or incorporation into the work of materials which contain toxic, hazardous and harmful materials.

1. Hazardous materials: Defined as pesticides, biocides, and carcinogens as listed by recognized authorities, such as the Environmental Protection Agency (EPA), the International Agency for Research on Cancer (IARC) or regulated under OSHA Hazard Communication Standard, 29 CFR 1910.1200.
2. Harmful materials: Defined as materials which contain the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances; or degrade the utility of the environment for aesthetic, cultural, or historical purposes.
3. Owner restricted materials: Defined as all products to which the Owner has a reasonable objection because of its content, composition, properties, or characteristics.

B. Vapors, Gases, Fumes, Odors:

1. General: Comply with all state and federal VOC requirements. Where ever possible use non-VOC materials.
   a. Limit use of products to the greatest extent possible which have "off -gassing", fumes, flammability, and other harmful characteristics.
      1) Prohibit use of products which contain substances that contribute significantly to the production of photochemical smog, tropospheric ozone, or poor indoor-air quality.
   b. Limit use ozone-depleting compounds to the greatest extent. An ozone-depleting compound is any compound with an ozone-depletion potential greater than 0.01 (CFC 11 = 1).
   c. Use organic and biodegradable cleaners to the greatest extent possible.
2. Do not install, use for installation, and use for cleaning those materials which may produce objectionable (to Owner and public) vapor s, gases, fumes, odors, or similar conditions.
3. Do not install or use products which may have possible chemical or biological reactions with other on -site materials.

C. Toxicity of prefabricated wood products: Products shall contain no urea -formaldehyde.

D. Adhesives: Provide adhesives approved by the manufacturers of the products being adhered which are Low -VOC or non -VOC, non -flammable, water-proof after cured, odor free.

E. Interior Paints: Provide products that comply with specified VOC requirements:

F. Sealants: Provide products that comply with specified VOC requirements. Avoid the use of the following products: Butyl Rubber; Solvent Acrylic; Neoprene; Styrene Butadiene Rubber; Nitril.

G. Material Safety Data Sheets (MSDS): Obtain and maintain on -site record data sheets for each product brought onto the Site.

1. Maintain an organized file of Material Safety Data Sheets at the job -site for quick reference.
2. Furnish MSDS for all finishes, paints, coatings, curing compounds, sealers, adhesives, mastics, waterproofing, dampproofing, sealants, cleaning chemicals, carpets, upholstery, fabrics and all similar products.

H. Cleaning and maintenance products:

1. Provide data on manufacturers' recommended maintenance, cleaning, refinishing and disposal procedures for materials and products utilized. These procedures are for final Contractor cleaning of the project prior to substantial completion and for provided materials and products as required by the specific specification sections.
   a. Where chemical products are recommended for these procedures, provide documentation to indicate that no component present in the cleaning product at more than 1% of the total mass of the cleaning product is a carcinogen or reproductive toxicant as defined in the lists in this specification section.
   b. For purposes of reporting, identification of product VOC contents shall not be limited to those regulated.
2. Avoid cleaning products containing alpha-pinene, d-limonene or other unsaturated carbon double bond alkenes due to chemical reactions with ozone to formaldehydes, acidic aerosols, and ultra fine particulate matter in indoor air.

I. Establish written Contractor's safety and emergency response procedures for safety precautions, accidents, emergency conditions, and clean-up methods.

1.4 OWNER FURNISHED PRODUCTS

A. Owner Furnished Products: As provided in the General Conditions, the Owner will provide products by others under a separate agreement.

1. Owner's responsibilities regarding Owner furnished products:
   a. Arrange for and deliver Owner reviewed shop drawings, product data, and samples to Contractor.
   b. Arrange and pay for product delivery to site.
   c. On delivery, inspect products jointly with Contractor.
   d. Submit claims for transportation damage, and replace damaged, defective, o r deficient items.
   e. Arrange for manufacturers' warranties, inspections, and service agreements.
2. Contractor's responsibilities regarding Owner furnished products:
   a. Review Owner reviewed shop drawings, product data, and samples to Contractor.
   b. Receive and unload products at site, inspect for completeness or damage, jointly with Owner.
   c. Handle, store, and provide temporary protection.
   d. Repair or replace items damaged after receipt.
   e. As required by this Contract, finish, install, and clean products.
   f. Provide protection of installed work.
   g. When not installed under this Contract, the Contractor shall coordinate Owner installed work with interfacing work of this Contract. The Contractor shall provide temporary protection and final cleaning of Owner installed products, except as directed otherwise.
3. Items noted in Drawings as "Not in Contract" or "N.I.C.", identify work or products which either exist, or are furnished by Owner; such work requires coordination with the Work of this Contract and may even require installation by this Contractor.

B. The Contractor has coordinating responsibility for Testing laboratory services as identified under Section 01 45 29 TESTING LABORATORY SERVICES and as specified under individual specification sections.

1.5 PRODUCT DELIVERY AND HANDLING REQUIREMENTS

A. Transport and handle products in accordance with manufacturer's instructions and as specified in individual specification sections.

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

B. Packaging: Deliver materials in recyclable or in reusable packaging such as cardboard, wood, paper, or reusable blankets, which will be reclaimed by supplier or manufacturer for recycling.

1. General: Minimize packaging materials to maximum extent possible while still ensuring protection of materials during delivery, storage, and handling.
   a. Unacceptable Packaging Materials: Polyurethane, polyisocyanurate, polystyrene, polyethylene, and similar plastic materials such as “foam” plastics and “shrink -fit” plastics.
   b. Reusable Blankets: Deliver and store materials in reusable blankets and mats reclaimed by manufacturers or suppliers for reuse where program exists or where program can be developed for such reuse.
   c. Pallets: Where pallets are used, suppliers shall be responsible to ensure pallets are removed from site for reuse or for recycling.
   d. Corrugated Cardboard and Paper: Where paper products are used, recycle as part of construction waste management recycling program, or return to material’s manufacturer for use by manufacture r or supplier.
   e. Sealants, Paint, Primers, Adhesives, and Coating Containers: Return to supplier or manufacturer for reuse where such program is available.

C. Schedule deliveries to avoid delays in installation of products, to minimize long -term storage, to prevent overcrowding of construction spaces and to limit potential damage to stored materials. Coordinate with installation to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.

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

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

1.6 PRODUCT STORAGE AND PROTECTION REQUIREMENTS

A. Store and protect products in accordance with manufacturer’s instructions and as specified in individual specification sections.

1. Provide all necessary equipment and personnel to store products by methods to prevent soiling, disfigurement and damage.
2. Avoid excessive material handling and potential product damage, locate storage areas convenient to work areas.
3. Store and protect products with seals and labels intact and legible.
4. Store and handle materials in a manner as to prevent loss from weather and other damage.

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

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

1. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation.
2. Store sensitive products in weather -tight, climate controlled enclosures.
3. Prevent contact with material that may cause corrosion, discoloration, or staining.

D. Store loose granular materials on solid flat surfaces in a well -drained area; prevent mixing with foreign matter.

E. Arrange storage of products to permit access for inspection. Periodically inspect to assure products are undamaged and are maintained under specified conditions.

F. Store heavy materials in locations and in a manner that will not damage or disfigure existing, or new construction.

1.7 MOLD PROTECTION

A. General:

1. Keep building materials dry to prevent the growth of mold and bacteria, including, but not limited to: gypsum wallboard, wood, porous insulation, paper, and fabric.
2. Cover materials to prevent rain damage, and if resting on the ground, use spacers to allow air to circulate between the ground and the materials.
3. Thoroughly dry all water damaged materials within 24 hours from time of moisture damage. Materials that have been damp or wet for more than 24 hours shall be jointly reviewed by General Contractor and Architect, or Owner's Project Representative to determine whether damp/wet materials need to be disposed.
   a. Review moisture damaged materials for signs of mold and mildew, including any with moisture stains, from the site and properly dispose of them.
   b. Replace water damaged and moldy materials with new, undamaged materials.

1.8 CONSTRUCTION WASTE MANAGEMENT

A. Source separation: Separate, store, protect, and handle at the site identified recyclable and salvageable waste products in order to prevent contamination of materials and to maximize recyclability and salvageability of identified materials. Refer to the Waste Management Requirements Plan specified under Section 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.

B. Return: Set aside and protect misdelivered and substandard products and materials and return to supplier for credit.

C. Reuse and Salvage: Set aside, sort, and protect separated products and materials for collection, re use by Owner, as designed for re-use on-site or designated for salvage by Owner's separate waste recycling contractor.

D. Recycling: Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials. Refer to the Waste Management Requirements and Plan specified under Section 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 73 00
EXECUTION

PART 1 - GENERAL

1.1 EXAMINATION OF AND ACCEPTANCE OF EXISTING CONDITIONS

A. The Contractor, its subcontractors shall inform themselves of existing conditions before submitting his bid, and shall be fully responsible for carrying out all work required to completely and properly execute the work of the Contract, regardless of the conditions encountered in the actual work. No claim for extra compensation or extension of time will be allowed on account of actual conditions inconsistent with those assumed, except those conditions described in the General Conditions.

B. Prior to commencement of selective demolition work, inspect areas in which work will be performed. Photograph existing damage to structure surfaces, equipment, or to surrounding proper ties which could be misconstrued as damage resulting from selective demolition work; file with Architect prior to starting work.

1.2 SURVEYING AND FIELD ENGINEERING

A. Employ a Land Surveyor or Professional Engineer registered in the Commonwealth of Virginia and acceptable to the Architect.

1. Submit evidence of Surveyor's Errors and Omissions (E&O) Insurance coverage in the form of an Insurance Certificate.

B. Submittals

1. Submit name, address, and telephone number of at least three proposed Land Surveyors and obtain Architect's acceptance before starting survey work.
2. On request, submit documentation verifying accuracy of survey work.
3. Submit a copy of registered site drawing and certificate signed by the Land Surveyor, that the elevations and locations of the Work are in conformance with the Contract Documents.

C. Examination

1. Verify locations of survey control points prior to starting work.
2. Promptly notify Architect / Engineer of any discrepancies discovered.

D. Survey Reference Points

1. Contractor shall locate and protect survey control and reference points.
2. Control datum for survey is that established by Owner provided Survey.
3. Protect survey control points prior to s tar ting site work; preserve permanent reference points during construction.
4. Promptly report to Architect/ Engineer the loss or destruction o f any reference point or relocation required because o f changes in grades or other reasons.
5. Replace dislocated survey control points based on original survey control. Make no changes without prior written not ice to the Architect.

E. Survey Requirements

1. Provide field engineering services. Utilize recognized engineering survey practices.
2. Prior to const ruction, verify the location and invert elevation at points of connect ion of sanitary sewer, storm sewer and water service piping.
   a. The existence and location of underground utilities and construction indicated on Drawings as existing are not guaranteed. Before beginning site work, verify the existence and location of underground utilities and other construction.

3. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
   a. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
   b. Grid or axis for structures.
   c. Building foundation, column locations, and ground floor elevations.
4. Periodically verify layouts by same means.

F. Project Record Documents

1. As-built survey, progress submissions: Surveyor shall develop an as-built survey for the work-in-place. Copies of survey shall be submitted a long with request for payments for foundation work, site utilities and paving work.
2. Surveyor's log: Maintain a complete and accurate surveyor's log of control and other surveys, as required by Owner and authorities having jurisdiction. Make this log available for reference.
3. Submit Final Property Survey and log under the provisions of Section 01 78 00 – CLOSEOUT SUBMITTALS.

1.3 PROTECTION OF ADJACENT ELEMENTS

A. Protect installed Work and provide special protection where called for in individual specification Sections.

B. Protect existing facilities and adjacent properties from damage from construction and demolition operations. Provide temporary and removable protection for installed products and occupied areas.

C. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials. Coordinate with requirements under individual specification sections.

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

E. Protect all existing landscape areas not indicated to be cleared. Do not deface, injure, or destroy trees or other plant life. Do not remove or cut trees or other plant life, without authorization from the Owner. Do not attach any anchorages, ropes, cables or guys to any trees scheduled to remain.

1. Prohibit traffic from landscaped areas.

F. Protect non-owned vehicles, stored materials, site and structures from damage.

G. Refer to respective Sections for other particular protection requirements.

1.4 EXECUTION REQUIREMENTS FOR INSTALLATION, APPLICATION AND ERECTION

A. Inspection of conditions: The Installer of each component shall inspect the substrate and conditions under which Work is performed. Do not proceed until unsatisfactory conditions have been corrected.

B. Recheck measurements and dimensions, before starting installation.

C. Manufacturer's instructions: Comply with manufacturer's installation instructions and recommendations, to the extent that they are more stringent than requirements in Contract Documents.

D. Inspect material immediately upon delivery and again prior to installation Reject damaged and defective items.

E. Install each component during weather conditions and project status that will ensure the best results. Isolate each part from incompatible material as necessary to prevent deterioration.

F. Coordinate temporary enclosures with inspections and tests, to minimize uncovering completed construction for that purpose.

G. Limiting exposures: Supervise operations to ensure that no part of construction, completed or in progress, is subject to harmful or deleterious exposure.

H. Provide attachment and connection devices and methods necessary for securing each construction element. Secure each construction element true to line and level. Allow for expansion and building movement.

I. Visual effects: Provide uniform joint widths in exposed Work. Arrange joints to obtain the best effect. Refer questionable choices to the Architect for decision.

J. Mounting heights: Where mounting heights are not indicated, review heights with Architect, prior to commencement of Work.

K. Cleaning and protection: During hand ling and installation, clean and protect construction in progress and adjoining materials in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

L. Clean and maintain completed construction as often as necessary through the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

1.5 PROGRESS CLEANING AND DISPOSAL OF WASTE MATERIALS

A. General: Maintain site in a clean and orderly condition. Maintain work and surrounding areas free of waste materials, debris, and rubbish; remove from site on a on-going basis through-out the term of construction.

   1. Adjacent Areas: Keep adjacent areas, neighboring properties, public ways, and all nearby areas clean and free of construction debris and dirt including wind blown debris.

B. Control accumulation of waste materials and rubbish; periodically dispose of off-site. The Contractor shall bear all costs, including fees resulting from such disposal.

C. Conduct cleaning and disposal operations to comply with local ordinances and anti -pollution laws.

   1. Do not burn or bury rubbish and waste materials on site.
   2. Do not dispose of volatile waste s such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
   3. Do not dispose of wastes into streams or water ways.
   4. Comply with requirements of authorities having jurisdiction including, without limitation, requirements related to fire prevention, rodents, pests, vermin, waste storage, waste trucking, waste removal, waste disposal, street cleaning, truck tire cleaning, and other requirements.

D. Clean interior areas prior to start of finish work and maintain areas free of dust and other contaminants during finishing operations.

E. Maintain project in accordance with all local, Commonwealth of Virginia, and Federal Regulatory Requirements.

F. Store volatile wastes in covered metal containers, and remove from premises daily.

G. Prevent accumulation of wastes which create hazardous conditions.

H. Provide adequate ventilation during use of volatile or noxious substances.

1. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
2. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

I. Use only those materials which will not create hazards to health or property and which will not damage surfaces.

J. Use only those cleaning materials and methods recommended by manufacturer of surface material to be cleaned.

K. Execute cleaning to ensure that the buildings, the sites, and adjacent properties are maintained free from accumulations of waste materials and rubbish and windblown debris, resulting from construction operations.

L. Provide on-site containers (dumpsters) for collection and containment of, waste materials, debris and rubbish.

1. Trash Barrels and Containers: Use containers with tightly fitting lids. Use only steel containers and lids when there is any evidence of rodent or pest activity.
2. Returnables: Provide special, labeled containers for deposit returnables such as soda cans.

M. Remove waste materials, debris, and rubbish from site at least once weekly, and dispose off-site. Comply with NFPA 241 for removal of combustible waste.

N. Handle material in a controlled manner with as few handlings as possible. Do not drop or throw materials from heights.

O. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not damage surrounding surfaces.

1.6 SITE MAINTENANCE AND CLEANING

A. Maintain traffic and parking areas in a sound condition, free of excavated material, construction equipment, products, mud, snow, and ice.

1. Provide means of removing mud from vehicle wheels before entering public streets and Owner's parking areas and access.
2. Architect shall have designated parking space, which shall not be used by others. Space shall be broom swept prior to Architect's arrival at site.

B. Maintain existing paved areas used for construction.

1. If any street or private way shall be rendered unsafe by the Contractors operations, the Contractor shall make such repairs or provide such temporary ways or guards as shall be acceptable to the governing authority.
2. Promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

1.7 FINAL CLEANING

A. Scheduling: Perform final cleaning immediately prior to the Architect's review of the project for issue of the Certificate of Substantial Completion.

1. Re-clean all surfaces, materials and products of the Work immediately prior to Owner's occupancy of the Project.
   a. Should the Owner occupy any portion of the Work prior to completion of the Contract, the responsibilities for interim and final cleaning shall be in accordance with the General Conditions.

B. Qualifications: Commercial cleaning firm, with a minimum of 3 years experience specializing in the post-construction cleaning of critical facilities.

C. Protection: During the operation of final cleaning, protect surrounding materials and finishes against undue damage by the exercise of reasonable care and precautions. Clean, or repair all products and surfaces which are soiled or otherwise damaged by Work of this Section, to match original profiles and finishes. Materials and finishes which cannot be cleaned, or repaired shall be removed and replaced with new work in conformance with the Contract Documents.

D. General cleaning requirements:

1. Control accumulation of waste materials and trash. Recycle or dispose of off-site at intervals approved by the Owner and in compliance with waste management procedures specified in Section 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.
2. Remove from the job site all tools, surplus materials, equipment, scrap, debris, and waste.
3. Remove all advertising matter and temporary instructional material from exposed surfaces throughout.
4. Use only methods and cleaning materials which are compatible with and as recommended by the manufacturer of the material being cleaned.
5. Finished surfaces: Remove paint smears, spots, marks, dirt, mud and dust and similar disfigurement created by the Work, from all exposed to view existing or new interior and exterior finished surfaces.
6. Polished surfaces: Apply the polish recommended by the manufacturer of the material being polished.
7. Cleaning Materials: Only non-hazardous cleaning materials shall be used in the final cleanup.
8. All surfaces in computer room and infrastructure spaces shall be "white glove" clean.

E. Waste Management and Recycling during Final Cleaning:

1. Recycle, salvage, and return construction and demolition waste from Project in accordance with requirements in Section 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL.
2. Arrange for pick -up of salvageable materials in accordance with the Waste Management Plan.
3. Disposal Operations: Promptly and legally transport and dispose of all trash. Do not burn, bury, or otherwise dispose of trash on the Project site.

F. Exterior building surfaces:

1. Visually inspect exterior surfaces and remove all traces of soil, waste materials, smudges, and other foreign matter.
2. Remove all traces of splashed materials from adjacent surfaces.
3. If necessary to achieve a uniform degree of cleanliness, hose down the exterior of the structure.
4. In the event of stubborn stains not removable with water, the Architect may require light sand blasting or other cleaning at no additional cost to the Owner.
5. Concrete: Clean exposed concrete free of all foreign matter. If, in the opinion of the Architect, further cleaning of specific areas is required, they shall be scrubbed with water or other cleaning agents. Acid cleaners shall not be used, except as may otherwise specifically permitted in the trade sections.

G. Bright metal: Clean metal surfaces, hardware, fixtures, appliances, equipment, and similar items free of all foreign matter. As required, lightly scrub specific stains with clean water, mild soap, and soft rags, thoroughly rinsed and wiped with clean, soft white rags. Do not use abrasive cleaners.

H. Glass: Replace broken, chipped and defective glass. Remove from glass: stains, spots, marks, paint smears; dirt and foreign materials. Clean and polish both surfaces of all interior and exterior glass. Clean and polish mirrors.

I. Carpet: Vacuum clean carpet and remove all spots and stains.

J. Hardware: Clean and polish finished hardware, remove marks, stains, scratches and blemishes.

K. Raised Floor System: Thoroughly HEPA vacuum sub-floor slab, piping, conduits, etc. after all miscellaneous debris and materials have been removed.

L. Tile: Clean and polish floor and wall tile, remove grout film and excess grout.

M. Woodwork: Dust and clean architectural woodwork and finish woodwork items, remove all stains, spots, and foreign matter using methods and cleaning agents which w ill not harm the various finishes.

N. Site: Sweep exterior paved surfaces broom clean; rake clean unpaved surfaces.

O. Equipment: Thoroughly clean all items of mechanical and electrical equipment; remove dust, oils and grease from exposed surfaces.

1. Clean permanent filters and replace disposable filters if ventilating units were operated during construction.
2. Clean ducts, blowers and coils, if units were operated without filters during construction.

1.8 PROTECTING INSTALLED WORK

A. Floor and Finished Surfaces Protection: After installation, provide coverings to protect products from damage due to traffic and construction operations. Replace protective coverings which may become wet, torn, or ineffective. Remove coverings when no longer needed.

1. Save plastic covering. At completion o f Project, reuse if practical; if not, then recycle if local market exists.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Examination of existing conditions and acceptance of conditions.

B. Administrative and procedural requirements for cutting and patching, including attendant excavation and backfill as required to complete the Work. Contractor is responsible for all cutting and patching work, including but not limited to:

1. Perform all cutting, altering, patching, and fitting of the Work (new and existing) as necessary for the Work and the existing improvements. Fully integrate with existing and new construction, all cutting, alterations and patching, to present the visual appearance of an entire, completed, and unified project.
   a. Make all products and their components of the work fit together properly.
2. Provide openings in elements of the Work, and the patching of same, for penetrations required by all trades, including but not limited to mechanical, plumbing, fire protection and electrical work.
   a. Individual trades are responsible for designated types of coring and drilling penetrations for piping, conduit, ducts and other penetrations as defined elsewhere in this Section.
3. Uncover work to provide for installing, inspecting, or both, of ill-timed work;
4. Remove and replace work not conforming to requirements of the Contract Documents or as otherwise determined to be defective.
5. Patch and match all surfaces and products disturbed or damaged by the Work.
6. Remove samples of installed work as specified for testing.

1.2 RELATED SECTIONS

A. Special administrative and procedure requirements related the Owner's goals of energy conservation and efficiency, indoor air quality, and natural resource efficiency.

B. Individual product specification Sections:

1. Cutting and patching of not -exposed -to-view materials incidental to work of the Section.
2. Core drilling (up to 8 inches in diameter) of interior building components, incidental to work of individual Sections.
3. Cutting and Patching work of particular exposed -to-view finish work, performed by trades as specified herein.

1.3 SUBMITTALS

A. Submit written proposals to perform cutting and patching under provisions of Section 01 33 00 SUBMITTAL PROCEDURES Describe cutting and patching procedures in advance of the time cutting and patching.

1. Submit a written request when cutting work affects the following:
   a. Structural integrity of any element in the project.
   b. Integrity of weather-exposed or moisture -resistant elements.
   c. Integrity of any fire suppression, fire alarm, or life safety system.
   d. Interruption or disturbance of utilities service. List utilities that will be relocated and those that will be temporarily out -of-service. Indicate how long service will be disrupted.
   e. Efficiency, maintenance, or safety of operational elements and systems.
   f. Aesthetic and visual qualities of exposed -to-view elements.

g. Efficiency, operational life, maintenance, or safety of operational elements.
h. Work of Owner or work performed under separate Contract.
i. Owners on -going operations or schedule.

2. Include in the request:
   a. Identification of project.
   b. Location and description of affected work.
   c. Necessity for cutting or alteration.
   d. Alternatives to cutting and patching.
   e. Scope of proposed cutting, patching, alteration or excavation.
   f. List of tradespeople who will execute the work.
   g. Description of products to be used.
   h. Extent of refinishing and cleaning to be performed.
   i. Effect on work by Owner or work performed under separate Contract, and written permission of affected party.
   j. Date and time cutting and patching is scheduled to be executed.
   k. Cost proposal, when applicable.
   l. Written permission of separate contractor(s) whose work will be affected.
3. Review by the Architect does not waive the Architect's right to later require complete removal and replacement of Work found to be unsatisfactory.
4. Should conditions of Work or the schedule indicate a change of products from original installation, Contractor shall submit a request for substitution for technical review by Architect and approval by Owner's Project Manager.

1.4 PERFORMANCE REQUIREMENTS

A. General performance requirements: Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.

B. Structural elements: Do not cut and patch structural elements in a manner that would reduce the load-carrying capacity or load deflection ratio. Always obtain written approval of the cutting and patching proposal before cutting and patching structural elements.

   1. Do not drill through structural beams, slabs or columns. Core drilling through concrete block walls and stair platforms must be approved by the Structural Engineer.
   2. Where cutting and patching involves adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with the original structure.

C. Exposed elements:

   1. Employ original installer of new construction to perform cutting and patching for weather exposed and moisture resistant elements, and sight exposed surfaces.
   2. Employ an appropriate tradesperson to perform cutting and patching of existing weather exposed and moisture-resistant construction, and exposed -to-view surfaces.

D. Penetrating elements: Fit work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces. At penetrations of fire rated walls, partitions, ceiling or floor construction, completely seal voids with fire rated materials in accordance to applicable codes and regulations, and compatible to surrounding construction.

E. Visual requirements: Do not cut and patch construction exposed on the exterior or in occupied spaces, in a manner that would, in the Architect's opinion, reduce the building's aesthetic qualities, or result in visual evidence of cutting and patching. Remove and replace Work cut and patched in a visually unsatisfactory manner.

   1. General: Restore work with new products in accordance with the requirements of the Contract Documents.
   2. Engage a firm recognized and experienced in the trade or specialty operation required to cut and patch the exposed -to-view work listed below.
      a. Processed concrete finishes, including cast stone and pre-cast architectural concrete

b. Acoustical ceilings.
c. HVAC enclosures, cabinets, or covers.

3. Engage a firm recognized and experienced in firestopping for patching of existing firestopping, smoke seals and firesafing in compliance with applicable codes and as additionally required by authorities having jurisdiction. Comply with requirements of Section 07 84 00 – FIRESTOPPING.

F. Operational and safety limitations: Do not cut and patch operating elements or safety components in a manner that would reduce their capacity to perform as intended, or would increase maintenance, or decrease operational life or safety.

1. Obtain approval of the cutting and patching proposal before cutting and patching the following operating elements or safety related systems:
   a. Primary operational systems and equipment.
   b. Fire resistance rated barriers and smoke barriers.
   c. Fire protection systems.
   d. Noise and vibration control elements and systems.
   e. Control systems.
   f. Communication systems.
   g. Electrical wiring systems.

1.5 WARRANTY

A. Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void existing applicable warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Patching Materials: Use patching materials identical to existing materials. If identical materials are not available or cannot be used where exposed surfaces are involved, use materials that match existing adjacent surfaces to the fullest extent possible. Use materials whose installed performance will equal or surpass that of the existing materials. Comply with specifications and standards for each specific product involved.

1. All materials used shall be approved by the Architect for consistency with the existing surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

1. Pre-bid examination: General Contractor and its subcontractors shall inform themselves of existing conditions before submitting bids, and are fully responsible for carrying out all work required to completely and properly execute the work of the Contract, regardless of the conditions encountered in the actual work. No claim for extra compensation or extension of time will be allowed on account of actual conditions which are inconsistent with those assumed, except for fully concealed conditions.
2. Examination: Inspect existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, inspect conditions affecting performance of work. Take corrective action before proceeding, if unsafe or unsatisfactory conditions are encountered.

3.2 PREPARATION

1. Protection:
   a. Provide temporary supports to ensure structural integrity of the Work.
   b. Protect existing construct ion during cutting and patching to prevent damage.
   c. Provide protection from adverse weather conditions.

d. Provide protection from elements for areas which may be exposed by uncovering work.

3.3 GENERAL CUTTING AND PATCHING

A. Performance: Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive repairs, patching, and finishing.

B. Execute cutting, fitting, and patching, including excavation and fill, to complete the work.

1. Cut rigid materials using masonry saw or core drill. Pneumatic tools are not permitted without prior approval, from Architect
2. Fit products together, to integrate with other work.
3. Uncover work to install ill -timed work.
4. Remove and replace defective or non -conforming work.
5. Remove samples of installed work for testing, when requested.
6. Provide openings in the work for penetration of mechanical and electrical work.

C. Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original Installer; comply with the original Installer's recommendations.

1. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
3. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
4. Comply with requirements of applicable Sections where cutting and patching requires excavating and backfilling.
5. Where services are required to be removed, relocated, or abandoned, by-pass utility services, such as pipe or conduit, before cutting. Cut -off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

3.4 FINISHING OF PATCHED AREAS

A. General: Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break; for assemblies, refinish entire unit.

1. Patching: Patch with durable seams that are as invisible as possible, showing no evidence of patching and refinishing. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction Comply with specified tolerance s.
   a. At penetrations of fire rated walls, partitions, ceiling or floor construction, completely seal voids with fire rated materials in accordance to applicable codes and regulations, and compatible to surrounding construction.
   b. Fit work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces. Provide vapor and air seal when penetrating existing vapor and air seals.
   c. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
2. Where removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, extend final paint coat over entire unbroken surface containing the patch after the area has received primer and

second coat. Extend re-painting to entire surface plane up to where plane changes direction.

3. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.5 CORING AND DRILLING

A. Coring and Drilling of holes incidental to work of individual sections shall be performed by t he trade requiring the penetration, except as follows:

1. Coring and Drilling of holes greater than 8 inches in diameter in concrete decks and slabs.
2. The Contractor is responsible for performing core drilling in wall and roof surfaces leading to, or from, the outside of the Building.
3. The Contractor is responsible for coordination of all coring and drilling and resultant patches necessary for the completion of this Contract and for the quality and appearance of all patch Work in exposed-to-view finished materials.

3.6 CLEANING

A. Cleaning patched areas: Thoroughly clean areas and spaces where cutting and patching is performed or used as access. Remove paint, mortar, oils, putty and similar items.

END OF SECTION

SECTION 01 74 00
CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Agreement, Part 0, Special Conditions and Forms, and Division 01 Specifications Sections apply to this Section.

1.2 SUMMARY

A. This Section describes the requirements for cleaning.

1. The Contractor shall, at all times, exercise the greatest care to prevent damage to Owner's operations and building equipment, and refrain from using equipment or methodology which might endanger or interfere with Owner's operations, and refrain from using equipment or methodology which might endanger or interfere with the Owner's ability to provide service. Should the Contractor use any such equipment or methods, the Owner or Owner's Representative may, at its discretion, order all or any part of the Work stopped.
2. Keep the Site and surrounding premises including public property free from accumulations of waste, debris, and rubbish caused by construction activities. On the interior of the building the Contractor is hereby prohibited from the storage of rubbish, debris, waste lumber, combustible or flammable materials, volatile substances, or other matter having a low flash point.
3. If the Contractor fails to properly clean up, the company may do so and costs thereof shall be charged to the Contractor.
4. At completion of Work, the Contractor shall remove waste materials, rubbish, tools, equipment, machinery, and surplus materials, and clean all exposed surfaces and shall leave the area clean and spotless unless more exact requirements are specified. This clean condition shall prevail in all areas that, in the opinion of the Architect / Engineer and/or Owner's Representative, is a result of the construction activities.
5. At the completion of work the contractor shall provide technical cleaning to meet ISO 14644-1:2015 Class 8 requirements for the data hall space.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ISO 14644-1:2015.

1.4 SAFETY REQUIREMENTS

A. Standards: Maintain the Project in accordance with state and local safety and insurance standards.

B. Hazards Control:

1. Store volatile wastes in covered metal containers and remove from premises daily.
2. Prevent accumulation of wastes that create hazardous conditions.
3. Provide adequate ventilation during use of volatile or noxious substances.

C. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws and Owner requirements stipulated elsewhere in these Contract Documents.

1. Do not burn or bury rubbish and waste materials on Project Site.
2. Do not dispose of volatile wastes such as mineral spirits, oils, or paint thinner in storm or sanitary drains.
3. Do not dispose of wastes into streams or waterways.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

B. Use cleaning materials only on surfaces recommended by cleaning materials manufacturer.

PART 3 - EXECUTION

3.1 CLEANING DURING CONSTRUCTION – INTERIOR

A. The Contractor shall provide and install a dust proof barrier separating the construction activities from the Owner's equipment. This is a requirement in all cases whether or not it is shown on the drawings. The dust proof barrier may be erected of a variety of materials from antistatic fire resistant Visqueen to steel studs and sheetrock so long as the barrier maintains the physical security, the environmental integrity, and the cleanliness necessary for the proper function of the Owner's equipment. The Architect / Engineer and Owner's Representative shall be the final authority on the viability of dust proof partitions. The primary dust proof barrier on this Project is, out of necessity, a quickly installed, easily removable system that must be pre-approved by the Owner and Architect / Engineer.

B. The Contractor shall perform clean up daily and shall transport rubbish off Site. The Contractor shall remove the rubbish from the area daily or as often as required to keep a clean and safe work area for both the Contractor and the telephone company. Daily clean up will include sweeping, vacuuming, and wet mopping of all floors within the Contractor's work area to prevent the tracking of dust into the equipment areas and other interior areas of the building.

C. Upon completion of Work in any given area, the Contractor shall remove all waste materials, rubbish and other debris from the area as well as all tools, scaffolding, construction equipment, machinery, and surplus material and shall leave the area clean and spotless unless otherwise specified. Such clean up shall include as applicable and without limitation of the following:

1. Removal of all marks, stains, fingerprints, and other soil and dirt from any or all printed or decorated surfaces.
2. Cleaning and waxing of all floors including removal of stains, paint, dirt, dust, etc.
3. Cleaning and polishing of all hardware including removal of all stains, dust, dirt, paint, etc.
4. Cleaning of and removing of stains, paint, dirt, and dust from all fixtures and equipment.
5. Restoration to their original conditions, those portions of the Site that were not designated for construction by the Contract Documents, but which have been affected by the Contractor's operations.
6. Removal of all temporary construction or protection devices and removal from the premises of all items of any nature which were installed or used for temporary purposes during the construction period.

D. If a dispute arises between the separate Contractors as to their responsibility to clean up as herein otherwise provided for, the company may at its option, undertake the clean up and charge the costs thereof to the separate Contractors in an equitable manner determined by the Owner's Representative and/or Owner.

E. The Contractor shall provide the means, procedures, and equipment in sufficient quantity and capacity to keep all areas free and clean at all times from moisture and water from any source whatsoever.

3.2 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ professional cleaners for final cleaning in cooperation with Owner's Representative recommendations. Clean each surface or unit to condition expected in the Owner's cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
   a. Clean Project Site, yard, and grounds in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
   b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
   c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
   d. Remove tools, construction equipment, machinery, and surplus material from Project Site.
   e. Remove snow and ice to provide safe access to building.
   f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
   g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
   h. Sweep concrete floors broom clean in unoccupied spaces.
   i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; shampoo if visible soil or stains remain.
   j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
   k. Remove labels that are not permanent.
   l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
      1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
   m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
   n. Replace parts subject to unusual operating conditions.
   o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
   p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
   q. Clean ducts, on top of ducts, blowers, and coils if units were operated without filters during construction.
   r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective

and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

s. Clean non-occupied spaces and limited-access spaces (such as plenums, shafts, equipment vaults, attics, and similar spaces) broom clean and free of surface dust.

t. Except as otherwise indicated or requested by Owner's Representative, remove temporary protection devices and facilities.

u. In preparation of substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces, and or concealed spaces.

v. Data Hall spaces will be cleaned to meet the requirements of ISO 14644-1:2015 Class 8 at the completion of work and prior to occupancy.
   1. Particle measured micron sizes: 5.0µ and 0.5µ.

w. Keep Project clean until it is occupied by Owner.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project Site and dispose of lawfully.

D. Where extra materials of value remain, dispose of these to Owner's best advantage as directed.

END OF SECTION

SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes: Special administrative and procedural requirements and procedures as required for the Project waste management and recycling activities and as described herein.

1. Recycling goals and waste management program intent.
2. List of recyclable materials.
3. Waste management plan.
4. Waste management plan implementation.
5. Waste management reporting.

1.2 RELATED SECTIONS

A. Section 01 60 00 PRODUCT REQUIREMENTS

1. Requirements for recycling packaging materials.
2. Product conservation, reuse and waste management.

B. Section 01 73 00 EXECUTION:

1. Waste Management and Recycling during Final Cleaning.

1.3 RECYCLING GOALS AND WASTE MANAGEMENT PROGRAM INTENT

A. Program Goal: It is the Owner’s determination that this Project shall generate the least amount of construction waste possible. This program goal shall be accomplished by the following processes:

B. Program Goal: It is the Owner’s determination that this Project shall generate the least amount of construction waste possible. The Owner's goal is to salvage and recycle as much non-hazardous demolition and construction waste as possible (**minimum 75% waste diversion**). This program goal shall be accomplished by the following processes:

1. Efficiently use demolition waste materials to the maximum extent as economically feasible:
   a. Reuse and renovation of existing structures in lieu of demolition as shown in the Contract Documents.
   b. Segregate and salvage existing materials and items for salvage and reuse on site where possible.
   c. Segregate demolished materials for salvage and recycling, or to be recycled as mixed debris.
2. Ensure the reduction of waste generated due to errors, poor planning, breakage, mishandling, contamination, or other factors shall be employed.
3. Efficiently use waste material to the fullest extent possible in the completion of this Project, including the following.
   a. Reuse of materials on site where possible.
   b. Recycling of waste generated during the construction processes.
4. The Contractor is encouraged to include additional resource efficient methods in the Project.
5. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates.

C. Contractor Participation: The Contractor shall take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort.

1. The Contractor is responsible for implementation of special programs involving rebates or similar incentives related to recycling of waste.
2. Revenues or other savings obtained for salvage, or recycling shall accrue to the Contractor. Firms and facilities used for recycling, reuse, and disposal shall be appropriately permitted for the intended use to the extent required by federal, state, and local regulations.

D. Waste disposal: In no case shall material be disposed of in a landfill or incinerator where an approved and less costly recycling or reuse alternative exists. Waste disposal in landfills and incinerators shall be minimized and shall be considered the alternative of last resort.

1.4 DEFINITIONS

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

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

1. Construction and demolition waste includes excess or otherwise unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work.

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

D. Non-hazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitability, corrosiveness, toxicity, or reactivity.

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

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

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

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

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

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

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

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

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

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

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

P. Volatile Organic Compounds (VOCs): Chemical compounds common in and emitted by many building products over time through outgassing: solvents in paints and other coatings; wood preservatives; strippers and household cleaners; adhesives in particleboard, fiberboard, and some plywoods; and foam insulation.

Q. Waste Management Plan: A Project -related plan for the collection, transportation, and disposal of the waste generated at the construction site. The purpose of the plan is to ultimately reduce the amount of material being landfilled.

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

1.5 LIST OF RECYCLABLE MATERIALS

A. Materials to be recycled, salvaged, or reused during this project include, but are not limited to, the following:

1. Beverage Containers
2. Carpet and carpet pad trim
3. Concrete, concrete block, concrete masonry units (CMU), slump stone (decorative concrete block), and rocks
4. Fluorescent light tubes, per local regulatory requirements.
5. Furnishings
6. Glass
7. Green materials (i.e. tree trimmings and land clearing debris).
8. Gypsum wallboard
9. Insulation
10. Metals including, but not limited to, stud trim, ductwork, piping, reinforcing steel (rebar), roofing, other trim, steel, iron, galvanized sheet steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze. (ferrous and non -ferrous).
11. Paint
12. Paper, including bond, newsprint, cardboard, mixed paper, packing materials, and packaging
13. Plastics, plastic buckets and plastic sheeting.
14. Porcelain plumbing fixtures
15. Rigid foam insulation and packing materials.
16. Wood, including clean dimensional wood, pallet wood, plywood, oriented strand board (OSB), particle board

1.6 WASTE MANAGEMENT PLAN

A. Draft Waste Management Plan: Within 14 calendar days after receipt of Notice of Award of Bid, and prior to any waste removal, the Contractor shall submit a Draft Waste Management Plan to both Architect and Owner. The Draft Waste Management Plan shall include as a minimum the following:

1. Analysis of the jobsite waste expected to be generated, categorized by material types and approximate quantities.
   a. List waste materials that will be salvaged for resale, salvaged and reused, or recycled.
2. Disposal options: The name of all landfills and incinerators proposed for trash disposal, the respective tipping fees for each of these disposal options including transportation costs, and the projected cost of disposing of all Project waste in the landfills.
3. Alternatives to Incineration or Landfill Disposal: A list of each material proposed to be salvaged, reused, or recycled during the course of the Project. Include the following information:
   a. The proposed end use or market for each material.

b. The respective tipping fees for each end use or market (including transportation costs).
c. The estimated net cost savings or additional costs resulting from separating and recycling each material (versus landfilling or other disposal).
1) "Net" means that the following have been subtracted from t he cost of separating and recycling: (a) revenue from the sale of recycled or salvaged materials and (b) landfill tipping fees saved due to diversion of materials from the landfill.

B. Final Waste Management Plan: Once the Owner has reviewed the draft Waste Management Plan and made appropriate suggested modifications, the Contractor shall submit, within 14 calendar days of receiving such suggested modifications, a Final Waste Management Plan, incorporating Owner's input. The Final Waste Management Plan shall contain the following:

1. Analysis of the jobsite waste expected to be generated, categorized by material types and approximate quantities.
   a. List specific waste materials that will be salvaged for resale, salvaged and reused, or recycled.
2. Materials Handling Procedures: A description of the means by which any waste materials identified to be salvaged, reused, or recycled, will be protected from contamination, and a description of the means to be employed in recycling the above materials consistent with requirements for acceptance by designated facilities.
3. Markets: A list of the markets or other on -site or off -site end uses that will be used for each material that will be separated for reuse, salvage, or recycling.
   a. Identify (and utilize) local and regional reuse programs, including non -profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks, and Habitat for Humanity.
4. Transportation: Describe the means of transportation of the recyclable materials and destination of all waste materials.
   a. Transported materials include:
      1) Materials that will be site-separated and hauled to designated centers
      2) Mixed materials will be collected by a waste hauler and removed from the site).
      3) Mixed materials that will be removed from site and later separated for recycling.
5. Disposal options: The name of all landfills and incinerators proposed for trash disposal, the respective tipping fees for each of these disposal options including transportation costs, and the projected cost of disposing of all Project waste in the landfill(s).
   a. Alternatives to Incineration or Landfill Disposal: A list of each material proposed to be salvaged, reused, or recycled during the course of the Project.
6. Cost of Reuse, Salvage, or Recycling. An estimate of the cost, including separation, transportation, and marketing, to reuse, salvage, or recycle the materials identified.
7. Schedule of special meetings to required to address waste management implementation.

1.7 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: The Contractor shall designate a specific party (or parties) responsible for instructing workers in recycling and overseeing and documenting results of the Waste Management Plan for the Project.

B. Distribution: The Contractor shall distribute copies of the Waste Management Plan to the Job Site Foreman, each Subcontractor, the Owner, and the Architect.

C. Instruction: The Contractor or his designated waste manager shall provide on -site instruction regarding appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all involved parties at the appropriate stages of the Project.

D. Separation facilities: As appropriate during each stage of the Project, the Contractor shall lay out and label a specific area(s) to facilitate separation of materials for potential recycling,

salvage, reuse, and return Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.

E. Hazardous wastes: Hazardous wastes shall be separated, stored, and disposed of according to local regulations.

1.8 WASTE MANAGEMENT REPORTING

A. Application for Progress Payments: The Contractor shall submit with each Application for Progress Payment a Summary of Waste generated by the Project. Failure to submit this information shall render the Application for Payment incomplete and shall delay Progress Payment. The Summary shall be submitted on a form acceptable to the Owner and shall contain the following information:

1. The amount (in tons or cubic yards) of material landfilled from the Project, the identity of the landfill, the total amount of tipping fees paid, transportation costs (if separate) and the total disposal cost. Include manifests, weight tickets, receipt, and invoices.
2. For each material recycled, reused, or salvaged from the Project, the amount (in tons or cubic yards), the date removed from the jobsite, the receiving party, the transportation cost, the amount of any money paid or received for the recycled or salvaged material, and the net total cost or savings of salvage or recycling each material. Attach manifests, weight tickets, receipts, and invoices.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL WASTE MANAGEMENT

A. Use detailed material estimates to reduce risk of unplanned and potentially wasteful cuts.

B. Arrange for vendors and material suppliers is to take back shipping and packing materials for re -use or recycling to the maximum extent economically feasible.

1. Include in material purchasing agreements a waste reduction provision requesting that materials and equipment be delivered in packaging made of recyclable material, that they reduce the amount of packaging, that packaging be taken back for reuse or recycling, and to take back all unused product. Insure that subcontractors require the same provisions in their purchase agreements.

C. Provide clearly labeled containers for recycled waste that is to be recycled, with a list of acceptable and unacceptable materials. The list of acceptable materials must be the same as the materials recycled at the receiving material recovery facility or recycling processor.

1. Separate corrugated cardboard in accordance with the Waste Management Plan and place in designated areas for recycling.
2. Separate and recycle waste materials in accordance with the Waste Management Plan and to the maximum extent economically feasible.
3. Place materials defined as hazardous or toxic waste in designated containers.

D. Provide labeled containers for all recycled waste that is to be disposed in a landfill.

E. Handle and transport recyclable materials in manner to prevent contamination of materials from incompatible products and materials.

F. Conduct regular visual inspections of dumpsters and recycling bins to remove contaminants.

3.2 SOURCE SEPARATION

A. General: Separate recyclable materials from general construction waste. Separate recyclable materials by type.

1. Provide containers, clearly labeled, by type of separated materials or provide other storage method for managing recyclable materials until they are removed from Project site.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from demolition area. Do not store within drip line of remaining trees.
4. Store components off the ground and protect from weather.

B. Source Separation Methods:

1. Waste products and materials that are recyclable shall be separated from trash and sorted into appropriately marked separate containers and then transported to t he respective recycling facility for further processing.
2. Co-Mingled Method: Recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.
   a. Do not put recycled waste that will be disposed in a landfill into a co -mingled waste recycling container.
3. Other Methods: Other methods proposed by the Contractor may be used when approved by the Architect and Owner.

C. Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling whenever economically feasible.

3.3 REMOVAL OF CONSTRUCTION AND DEMOLITION WASTE MATERIALS

A. Remove recycled waste materials from project site on a regular basis. Do not allow recycled waste to accumulate on -site.

B. Transport recycled waste materials off Owner's property and legally dispose of them.

1. Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

END OF SECTION

SECTION 01 75 00
STARTING AND ADJUSTING

PART 1 - GENERAL

1.1 TESTING, ADJUSTING, AND BALANCING

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

B. Contractor will employ services of an independent firm to perform testing, adjusting and balancing. Submit to Owner at least three qualified testing firms for Owner's review and acceptance.

C. The independent firm will perform services specified under Division 23 -Heating, Ventilating and Air Conditioning.

D. Reports will be submitted by the independent firm to the Architect/Engineer indicating observations and results of tests and indicating compliance or non -compliance with specified requirements and with the requirements of the Contract Documents.

1.2 AIR QUALITY TESTING

A. Air quality testing: The Owner reserves the right to employ the services of an independent testing agency to perform air quality testing. Testing will occur prior to Contractor's request for inspection for Substantial Completion. The intent of testing is to certify that the building is "Clear" of airborne contaminants.

1.3 OPERATION, MAINTENANCE, AND SERVICE

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

B. Notify Architect/Engineer and Owner 7 days prior to start -up of each item.

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

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

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

F. Execute start -up under supervision of responsible Contractors' personnel in accordance with manufacturers' instructions.

G. Submit a written report in accordance with Section 01 77 00 CLOSEOUT PROCEDURES that equipment or system has been properly installed and is functioning correctly.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 PUNCH LIST REQUIREMENTS AND PROCEDURES

A. Definitions:

1. Contractor's Punch List: Complete list of incomplete and incorrect Work prepared by the Contractor prior to request of Architect's inspection for Certification of Substantial Completion. Contractor shall prepare List prior to requesting Architect's Punch List. As a minimum the List shall include the following information for each work item:
   a. Location identification organized by Building, Area, Room Number, or combination thereof as appropriate to project.
   b. Clear identification of each incomplete work item, including all subcontractor's work.
   c. Estimated value of each incomplete work item.
   d. A short statement of why work is not complete.
   e. Identify subcontract responsibility, as appropriate to each item.
2. Architect's Punch List: A list of incomplete and incorrect Work prepared by the Architect, which modifies the Contractor's Punch List, following review and acceptance of the Contractor's Punch List.

B. Pre-Closeout requirements: Prior to requesting initial Architect's inspection for Certification of Substantial Completion, submit to the Architect a full and complete list of all incomplete work items (Contractor's Punch List).

C. Punch list procedures at Substantial Completion:

1. **Architect will review submitted Contractor's Punch List** and determine whether it is suitable to proceed with the Substantial Completion Process.
   a. If the Architect determines that the amount of completed work is insufficient to be considered for Substantial Completion, the Architect will not proceed with the Punch lists process until sufficient completion of the Project is achieved.
   b. The Architect will review the Contractor's Punch List and if the Architect determines that it does not reflect proper identification of the incomplete and incorrect work, he/she will request revision and resubmission of the Contractor's Punch List.
   c. If the Architect determines that the amount of work indicated on the Contractor's Punch List is excessive, the Architect will suspend its review until the scope of Work identified in the Contractor's Punch is reduced to a level satisfactory to the Architect.
   d. When the Architect reviews and accepts the Contractor's Punch List as being an accurate reflection of incomplete and incorrect work; the Architect will prepare and issue to the Contractor the "Architect's Punch List".
      1) The Architect's Punch List will be based on the Contractor's Punch List with modifications and additions as may be required.
      2) The Architect's Punch List includes Work which must be completed and corrected prior to Final Completion.
2. Upon receipt of the Architect's Punch List, the Contractor shall immediately distribute the list to all subcontractors.

D. Completion of Punch List Work: Make reasonable efforts to ensure that all "Architect's Punch List" items are completed or corrected within 14 calendar days from the date of the Architect's Punch List" or within the Contract Time, whichever is earlier.

E. Architect's Final Inspection and review of Punch List Work:

1. After Contractor certification that all punch list Work has been properly completed the Architect will then perform the Final Inspection.

a. Incomplete Items: If the Architect discovers any incomplete or incorrect "Architect's Punch List" items or any other deficiency in the work, the Architect will prepare a "Revised Punch List" which may also include other incomplete Contract requirements such as record documents, owner's operation and maintenance manuals, warranties, and other Contract requirements. Architect's site reviews of the Work for this "Revised Punch List" and any subsequent revised Punch Lists shall be performed as additional service to Owner, back -charged to the Contractor.
b. The Architect may assign a dollar value for each item of incomplete or incorrect work remaining.

F. Additional Inspections and related additional services fee: The Architect and the Architect's consultants will provide two site inspections, one at Substantial Completion, and one to confirm that the "Architect's Punch List" has been completed.

1. "Revised Punch List: If the Architect prepares and issues a "Revised Punch List: because of the Contractor's failure to complete the Work, then the Owner shall compensate the Architect and the Architect's consultants for their additional services and additional inspections. The payment for additional services and inspections will be back -charged to Contractor. The Owner will deduct the amount of the Architect's additional services fee from final payment to the Contractor by Change Order.

1.2 CLOSEOUT PROCEDURES – SUBSTANTIAL COMPLETION

A. Prior to requesting inspection for certification of Substantial Completion, complete the following:

1. 1. On Application for Payment, show 100 percent completion for portions of work claimed as substantially complete.
   a. Submit list of incomplete items (Punch List), value of incomplete work, and reasons work is not complete.
2. Obtain evidence of compliance with requirements of governmental agencies having jurisdiction including, but not necessarily limited to:
   a. Certificate of Final Inspections, "signed off" by authorities having jurisdiction.
   b. Certificate of Occupancy.
3. Submission of product and installation warranties, workmanship bonds, maintenance agreements, installer certifications and similar documents specified in individual sections.
4. Submission of test/adjust/balance reports.
5. Change-over permanent locks and transmit keys to the Owner.
6. Remove temporary facilities and services that are no longer required.
7. Remove mock -ups, field samples and similar items.
8. Complete Final Cleaning, including repair and restoration, or replacement of damaged Work.
9. Remove surplus materials, rubbish and similar elements.
10. Documentation of completed flush-out procedures.
11. Application for reduction of retainage.
12. Consent of Surety.
13. Advise the Owner of the change -over in security provisions.
14. Notification of shifting insurance coverage.
15. Final progress photographs.

B. Within 2 weeks after receipt of the notice of Substantial Completion from the Contractor, the Architect will inspect to determine status of completion.

1. Should the Architect determine that the Work is not substantially complete:
   a. The Architect will notify the Contractor in writing, stating the reasons therefore.
   b. The Contractor shall remedy the deficiencies and send a second written notice of Substantial Completion to the Architect, requesting re -inspection.

C. When the Architect concurs that the Work is substantially complete:

1. The Architect will prepare AIA Document G 704 CERTIFICATE OF SUBSTANTIAL COMPLETION in accordance requirements of the GENERAL CONDITIONS and with the SUPPLEMENTARY CONDITIONS accompanied by the Contractor's list of items to be completed or corrected, as verified by the Architect.
2. The Architect will submit the Certificate to the Owner, and to the Contractor, for their written acceptance of the responsibilities assigned to them in the Certificate.

1.3 CLOSEOUT PROCEDURES – FINAL ACCEPTANCE

A. Prior to requesting inspection for certification of Final Acceptance and final payment, perform the following:

1. Completion of incomplete Work. Submit a copy of the final inspection list stating that each item has been completed or otherwise resolved for acceptance.
2. Prove that all taxes, fees and similar legal obligations have been paid.
3. Submit final payment requests with release of all liens, and supporting documentation.
4. Provide written assurances that all unsettled claims are in the process of and will be resolved.
5. Submit updated final statement, including accounting for final additional changes to the Contract Sum. Show additional Contract Sum, additions and deductions, previous Change Orders, total adjusted Contract Sum, previous payments and Contract Sum due.
6. Submit consent of surety to Final Payment.
7. Submit evidence of continuing insurance coverage complying with insurance requirements.
8. Transmit certified property survey.
9. Remove remaining temporary facilities and services.
10. Deliver to Owner and obtain receipts for:
    a. Operation and Maintenance Manuals for items so listed in individual Sections of the Specifications, and for other items when so directed by the Architect.
    b. Project Record Documents (as-builts), including AutoCAD format drawings on discs.
    c. Warranties and bonds specified in individual Sections of the Specifications.
    d. Keys and keying schedule.
    e. Spare parts and materials extra stock.
    f. List of subcontractors, service organizations, and principal vendors, including names, addresses, and telephone numbers where they can be reached for emergency service at all times including nights weekends, and holidays.
11. Submit Certification stating Work has been inspected for compliance with the Contract Documents.
12. Submit Certification stating equipment and systems have been tested in presence of Owner’s representative and are fully operational.
13. Submit Certification stating that Work is 100 percent complete and ready for final inspection.

B. Within 2 weeks after receipt of the request for Final Acceptance from the Contractor, the Architect will inspect to determine status of completion.

1. Should the Architect determine that the Work is incomplete or defective:
    a. The Architect will notify the Contractor in writing, stating the reasons listing the incomplete or defective work.
    b. The Contractor shall take immediate steps to remedy the deficiencies and send a second written notice of request for Final Acceptance to the Architect.
    c. Costs relative to the Architects re-inspection due to failure of Work to comply with claims made by the Contractor, will be compensated by the Owner, who will deduct the amount of such compensation from the Final Payment due to the Contractor.

C. After the Architect finds the Work acceptable, the Architect will review the Final Close -out submittals.

D. Application for Final Payment: Submit Application for Final Payment in accordance with procedures and requirements of the General Conditions and Supplementary Conditions.

1. The Architect will prepare a Final Change Order, reflecting approved adjustments to the Contract Sum not previously made by other Change Orders.

1.4 CONFERENCES AFTER SUBSTANTIAL COMPLETION

A. The Owner reserves the right to call for conferences commencing with the date of Substantial Completion and continuing for one year thereafter, for purposes of inspecting the Work and to plan correction of any deficiencies or failures discovered during this period.

1. Attendance is required by Contractor's Project Manager, Architect, and each applicator, installer, and supplier as the Owner may direct or the Contractor may wish to have present. All representatives attending such meetings shall be the same persons, or shall have the same powers and authority, as those attending progress meetings occurring prior to the Date of Substantial Completion.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 00
CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Project record documents.

B. Record Project Manual.

C. Project Record Drawings (As-builts).

D. Operation and maintenance data, preventive maintenance instructions.

E. Product warranties and bonds.

F. Maintenance contracts.

G. Spare parts and maintenance materials.

1.2 RELATED SECTIONS

A. Section 01 31 00 – PROJECT MANAGEMENT AND COORDINATION:

1. Coordination Drawing Requirements.
2. CAD File Requirements for base sheets to prepare Project Record Drawings (As-builts).

1.3 PROJECT RECORD DOCUMENTS

A. General: Record documents shall reflect actual “as-built” condition and the products installed. Include all changes and deviations from original Contract Documents, and incorporate information from:

1. Original Contract Documents.
2. Addenda.
3. Change orders.
4. Construction change directives.
5. Field directives, and instructions from the Owner, Architect or regulatory authorities having jurisdiction.

B. Project Record Documents include, but are not limited to:

1. Record Project Manual.
2. Project record drawings (as-builts).
3. Final Site Survey.
4. Operation and maintenance data, preventive maintenance instructions.
5. Materials and finishes manual.
6. Product warranties and bonds.
7. Maintenance contracts.
8. Record of all test reports and inspections.
9. Wall charts and data such as valve diagrams, electrical panel board directories, and similar information.

C. Labeling and identification of Record Documents

1. Clearly label all record documents with name of Project and the words “Record Document”.
2. Date progressive entries of information as appropriate.
3. Date Record Documents with the final submission date.

1.4 SUBMITTAL QUANTITY REQUIREMENTS

A. Furnish Architect with the following quantities of each submittal:

1. Record Project Manual: 3 bound copies.
2. Project record drawings (as-builts):
   a. 2 sets of Drawings in Autocad™ version 2003 format. Verify release version and disc type with Owner prior to submittal.
   b. 1 “blackline print” set of Drawings.
3. Final Site Survey: 4 copies.
4. Operation and maintenance data, preventive maintenance instructions: 3 bound copies.
5. Product warranties and bonds: 2 copies
6. Maintenance contracts: 2 copies
7. Record of all test reports and inspections: 4 copies.

1.5 RECORD PROJECT MANUAL

A. The Contractor is responsible to maintain a Project Manual reflecting revisions and changes to the Original Issue Project Manual.

1. Clearly label the Record Project Manual as “Record Document Specifications, in a three ring binder.
2. Do not use Record Project Manual for construction purposes; protect from loss in a secure location.
3. Record all variations and deviations to the Contract Documents, including changes made by Addenda, Bulletin, Change Order, Change Directive and other modifications to the Contract.
   a. Cut and paste revisions into their applicable specification section.
   b. Identify all changes with cross-reference to appropriate Addendum Number, Modification Number, Change Order Number etc.
4. In each individual Specification Section, under “Part 2 – Products”, identify all manufacturers and products which are actually used as part of the Work.
5. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

B. B. Record Project Manual: Provide prior to request for Final Acceptance.

1. Manuals shall be in 8-1/2 by 11 inch pages and bound in 3-ring (D-shape) binders with durable plastic covers. Internally subdivide the binder contents by Division with permanent page dividers.
2. Label front cover and spine of each binder with laser printed titles, dates, and project information.
3. All information from “in-progress” manual shall be clearly and completely transferred.
4. Pages shall be undamaged.

1.6 PROJECT AS-BUILT DRAWINGS

A. The General Contractor is responsible to maintain a clean, undamaged set of blue or black line whiteprints of Contract Drawings and shop drawings for preparing the AS-BUILT drawings.

1. Where shop drawings are used, record a cross-reference at the corresponding location on the Contract Documents.

B. Do not use AS-BUILT Documents for construction purposes; protect from loss in a secure location. Mark-up these drawings to show clearly and completely the actual installation reflecting all changes made in the Work during construction.

1. Mark whichever drawing is most capable of showing conditions accurately.
2. Record all variations and deviations to the Contract Documents, including changes made to schedules, details, and all architectural changes to structure, exterior enclosure, interior partitions and ceilings.

3. Record new information that is important to the Owner, but was not shown on the Contract Drawings or shop drawings.
4. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

C. The fire protection, plumbing, mechanical and electrical trades shall be responsible to the Contractor to keep the record documents for their portions of the work marked currently to record all changes in the mechanical and electrical work made during construction.

D. The Architect may periodically inspect these record drawings, and their proper maintenance may be a condition precedent to approval of applications for periodic payments.

E. Deliver all Project Record Documents, shop drawings, product data, and samples to the Architect for the Owner's use, upon completion of the Work and prior to request for Final Acceptance of the Work.

F. In addition, at the completion of the work, the General Contractor is responsible for the preparation and submittal of neat, clean well drafted, and complete AS-BUILT drawings, at no additional costs to the Owner. These reproducible Project AS-BUILT Documents shall be transmitted to the Architect as a condition precedent to final payment, and include documents prepared by the fire protection, plumbing, mechanical and electrical trades.

1.7 OPERATION AND MAINTENANCE MANUALS

A. Prepare data in the form of an instructional manual. Furnish manuals which contain all of the following groups of equipment:

1. Fire protection system.
2. Utilities and plumbing systems.
3. Heating, ventilation and air conditioning system.
4. Electrical systems.

B. Furnish bound and properly identified Manuals prior to request for Final Acceptance.

1. Manuals shall be in 8-1/2 by 11 inch pages and bound in three "D ring" capacity binders with durable plastic covers. Internally subdivide the binder contents with permanent page dividers.
   a. Arrange content by section number and systems, process flow, under section numbers and sequence as listed in the Table of Contents of this Project Manual.
   b. Drawings: Preferable 11 inches in height bound in with text with reinforced punched binder tab. Fold drawings larger than 8-1/2 by 11 inches to size of text pages. Provide a drawing pocket for Drawings larger than 11 by 17 inches; locate pocket inside rear cover or bound in with text.
2. Each manual shall include the same following minimum information:
   a. Table of Contents.
   b. Directory of Contractor, subcontractors, and major equipment supplies listing addresses, phone numbers and appropriate emergency phone numbers.
      1) Include local sources of supplies and replacement parts.
   c. Directory of Architect and consultants listing addresses and phone numbers.
   d. Operation and maintenance instructions. Provide schematic diagrams of control systems, circuit directories for each electric panel and charts showing the tagging of all valves.
   e. Air and water test and balancing reports.
   f. Maintenance and cleaning instructions for finishes.
   g. Product and manufacturer's Certificates.
   h. Photocopies of all extended warranties and bonds.
3. Submit one copy of completed volume in final form 21 days prior to Final Inspection. This copy will be returned after final inspection with Architect's comments; Revise and submit all volumes to Owner.

C. For each item of equipment, include description of equipment, component parts and accessories. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts. Additionally provide the following for each item:

1. Panelboard circuit directories: Provide electrical service characteristics, controls and communications.
2. Include color coded wiring diagrams as installed.
3. Operating procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
4. Maintenance requirements: Include routine procedures and guide for trouble-shooting; disassembly, repair, and re-assembly instructions; alignment, adjusting, balancing, and checking instructions.
   a. Maintenance drawings: Supplement product data to illustrate relation of component parts of equipment and systems, to show control and flow diagrams. Do not use project Record Documents as maintenance drawings.
5. Provide servicing and lubrication schedule, and list of lubricants required.
6. Include manufacturer's printed operation and maintenance instructions.
7. Include sequence of operation by controls manufacturer.
8. Provide control diagrams by controls manufacturer as installed.
9. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
10. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
11. Provide original manufacturer's parts (OEM) list, illustrations assembly drawings, and diagrams required for maintenance.
    a. Provide list of original manufacturer's spare parts (OEM), current prices, and recommended quantities to be maintained in storage.
    b. Include local source of supplies and replacement parts, and any other data pertinent for procurement procedures.
12. Additional requirements: As specified in individual specification Sections.

D. Standards:

1. Measurements: Provide all measurements in U.S. standard units such as feet and inches, pounds, and cfm; provide additional measurements in the "International System of Units" (SI).
2. Abbreviations: Provide complete nomenclature of all parts of all equipment; include part numbers of all replaceable parts.

1.8 PRODUCT WARRANTIES AND BONDS

A. Categories of Specific Warranties: Warranties on the work are in several categories, including those of General Conditions, and including (but not necessarily limited to) the following specific categories related to individual units of work specified in sections of Divisions 2 through 32 of these Specifications:

1. Special Project Warranty (Guaranty): A warranty specifically written and signed by contractor for a defined portion of the work; and, where required, countersigned by subcontractor, installer, manufacturer or other entity engaged by Contractor.
2. Specified Product Warranty: A warranty which is required by Contract Documents, to be provided for a manufactured product incorporated into the work; regardless of whether manufacturer has published a similar warranty without regard for specific incorporation of product into the work, or has written and executed a special project warranty as a direct result of Contract Document requirements.
3. Coincidental Product Warranty: A warranty not specifically required by Contract Documents (other than as specified in this Section), but which is available on a product incorporated into the work, by virtue of the fact that manufacturer or product has

published warranty in connection with purchases and use of product without regard for specific applications except as otherwise limited by terms of warranty.

B. Refer to individual section of Divisions 2 through 28 for the determination of units of work which are required to be specifically or individually warranted, and for the specific requirements and terms of those warranties (or guarantees).

C. General Limitations: It is recognized that specific warranties are intended primarily to protect Owner against failure of the work to perform as required, and against deficient, defective, and faulty materials and workmanship, regardless of sources. Except as otherwise indicated, specific warranties do not cover failures in the work which result from: 1) Unusual and abnormal phenomena of the elements, 2) The Owner's misuse, maltreatment or improper maintenance of the work, 3) Vandalism after time of substantial completion, or 4) Insurrection or acts of aggression, including war.

1. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties with the Contractor.

D. Related Damages and Losses: In connection with Contractor's correction of warranted work which has failed, remove and replace other work of project which has been damaged as a result of such failure, or must be removed and replaced to provide access for correction of warranted work.

1. Consequential Damages: Except as otherwise indicated or required by governing regulations, special project warranties and product warranties are not extended to cover damage to building contents (other than work of Contract) which occurs as a result of failure of warranted work.

E. Reinstatement of Warranty Period: Except as otherwise indicated, when work covered by a special project warranty or product warranty has failed and has been corrected by replacement or restoration, reinstate warranty by written endorsement for the following time period, starting on date of acceptance of replaced or restored work.

1. A period of time ending upon date original warranty would have expired if there had been no failure, but not less than half of original warranty period of time.

F. Replacement Cost, Obligations: Except as otherwise indicated, costs of replacing or restoring failing warranted units or products is Contractor's obligation, without regard for whether Owner has already benefited from use through a portion of anticipated useful service lives.

G. Rejection of Warranties: Owner reserves the right, at time of substantial completion or thereafter, to reject coincidental product warranties submitted by Contractor, which in opinion of Owner tend to detract from or confuse interpretation of requirements of Contract Documents.

H. Contractor's Procurement Obligations: Do not purchase, subcontract for, or allow others to purchase or sub-subcontract for material or units of work for project where a special project warranty, certification or similar commitment is required, until it has been determined that entities required to countersign such commitments are willing to do so.

I. Specific Warranty Forms: Where a special project warranty (guaranty) or specified product warranty is required, prepare a written document to contain terms and appropriate identification, ready for execution by required parties. Submit draft to Owner (through Architect) for approval prior to final executions.

1.9 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification Sections.

B. Deliver materials to on-site location designated by the Owner; obtain receipt.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 78 36
WARRANTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings, Agreement, Part 0, Special Conditions and Forms, and Division 01 Specifications Sections apply to this Section.

1.2 SUMMARY

A. See Agreement for construction services.

B. All warranties shall commence upon final acceptance of the facility by Owner.

1. Contractor: Provide required warranty as indicated by Owner's Representative. Verify requirements prior to submittal of proposal.

1.3 STANDARD PRODUCT WARRANTIES

A. Provide preprinted written warranties published by individual manufacturers for particular products and specifically endorsed by the manufacturer to the Owner.

1.4 SPECIAL WARRANTIES

A. Written warranties required by or incorporated in the Contract Document either to extend time limits provided by standard warranties or to provide greater rights for Owner.

1.5 DISCLAIMERS AND LIMITATIONS

A. Manufacturer's disclaimers and limitations on product warranties do not relieve the Contractor of the warranty on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and Subcontractors who are required to countersign special warranties with the Contractor.

1.6 RELATED DAMAGES AND LOSSES

A. When correcting warranted Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted Work.

1.7 REINSTATEMENT OF WARRANTY

A. When Work covered by a warranty has failed and been corrected by replacement or rebuilding, reinstate the warranty by written endorsement. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

1.8 REPLACEMENT COST

A. Upon determination that Work covered by a warranty has failed, replace or rebuild the Work to an acceptable condition complying with requirements of Contract Documents. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether Owner has benefited from use of the Work through a portion of its anticipated useful service life.

1.9 OWNER'S RECOURSE

A. Written warranties made to Owner are in addition to implied warranties and shall not limit the duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which Owner can enforce such other duties, obligations, rights, or remedies.

B. Rejection of Warranties: Owner reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.

C. Owner reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment is required on such Work or part of the Work until evidence is presented that entities required to countersign such commitments are willing to do so.

1.10 WARRANTY REQUIREMENTS

A. Submit written warranties to the Architect / Engineer and Owner's Representative prior to completion.

B. When a designated portion of the Work is completed and occupied or used by Owner by separate agreement with the Contractor during the construction period, submit properly executed warranties to the Architect / Engineer and Owner's Representative within fifteen (15) days of completion of that designated portion of the Work.

C. When a special warranty is required to be executed by the Contractor, or the Contractor and a Subcontractor, supplier, or manufacturer, prepare a written document that contains appropriate terms and identification ready for execution by the required parties. Submit a draft to the Owner's Representative through the Architect / Engineer for approval prior to final execution within fifteen (15) days of receipt.

   1. Refer to individual Sections of Divisions 02 through 21, 22, 23, 26, and 28 for specific content requirements, and particular requirements for submittal of special warranties.

D. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.

   1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
   2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
   3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

E. Include copies of all warranties in O&M manual.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Demonstrating equipment.

B. Instruction and training of owner's personnel.

1.2 DEMONSTRATING EQUIPMENT

A. Demonstrate operation and maintenance of Products to Owner's personnel 2 weeks prior to date of Substantial Completion.

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

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

D. Demonstrate start -up, operation, control, adjustment, trouble -shooting, servicing, maintenance, and shutdown of each item of equipment at agreed -upon times, at equipment location.

E. Prepare and insert additional data in operations and maintenance manuals specified under Section 01 78 00 CLOSEOUT SUBMITTALS when need for additional data becomes apparent during instruction.

1.3 INSTRUCTION AND TRAINING OF OWNER'S PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon times.

B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.

C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

D. Formal instructional time for training Owner's personnel:

1. General overview of Record Documents: Not less than 3 hours, which shall include:
   a. Record Drawings.
   b. Record Project Manual.
   c. Operation and Maintenance Manuals.
   d. Finishes Manuals.
   e. Warranty and maintenance agreements.
   f. Test reports and inspections.
2. Fire protection systems and equipment: Not less than 6 hours.
3. Fire alarms systems and equipment: Not less than 8 hours.
4. HVAC systems and equipment: Not less than 32 hours.
5. Plumbing systems and equipment: Not less than 6 hours.
6. Electrical systems and equipment (including emergency generator): Not less than 32 hours.

7. Audio-visual systems, sound systems and similar equipment: Not less than 4 hours.
8. Other utility connected systems, control systems, security systems, and similar equipment: Not less than 8 hours.

E. Construction Manager's personnel designated for owner training shall be competent and knowledgeable and have good communication skills.

1. Instructors shall arrive at scheduled training sessions on time and be fully prepared to teach using a preplanned training program.
2. All instructors are subject to the Owner's approval. Replace unacceptable instructors and reschedule training as directed by the Owner at no increase cost to the Owner.

F. Video Training Record: Video record the instruction and training of the Owner's personnel.

1. Submit 2 DVD copies to Owner upon completion of training sessions.

G. Final payment is condition precedent on completion of Owner training (instruction).

Construction Manager is required to submit affidavit that training and instruction of Owner's personnel is completed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 01 91 00
GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.

B. Commissioning is a quality oriented process for achieving, verifying, and documenting the facility's performance to meet its operational needs within the capabilities of the design as well as to meet the design documentation and the owner's functional criteria.

C. The commissioning process does not alleviate the requirement for the Contractor and all Installers and suppliers to be responsible to provide a completely finished, tested and fully functional project based on the contract documents.

D. Commissioning is for the benefit of the owner and is led by a Commissioning Authority (CxA) selected by the Owner. It is not a substitution for project testing, or acceptance testing, but is a process to document and assure the testing desired by the Owner has been accomplished satisfactorily.

E. Acceptable testing results and completion of required documentation is a condition for payment. Identify in bid, costs included for test equipment and load banks for all testing and for labor included for level 5 integrated system testing (IST).

F. Commissioning shall:

1. Verify that applicable equipment and systems are installed according to the contract documents, manufacturer's recommendations and installation instructions, and industry minimum standards and that they receive adequate operational checkout by Installers.
2. Verify and document proper performance of equipment and systems.

G. Commissioning shall include HVAC, Electrical, fire alarm and fire suppression systems, control systems and building monitoring systems (BMS). Refer to DLR's Commissioning and Benchmarking Process Guidelines and the mechanical and electrical specification sections for additional information on systems to be commissioned.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Owner's Project Requirements (OPR) and Basis of Design (BoD) documentation are included by reference for information only.

C. DLR Commissioning and Benchmarking Process Guidelines.

D. Commissioning Authority's commissioning plan specifications.

E. Related Sections:

1. Division 23 Section 23 08 00 "Mechanical General Commissioning Requirements" for commissioning process activities for mechanical systems, assemblies, equipment, and components.

2. Division 26 Section 26 08 00 "Electrical General Commissioning Requirements" for commissioning process activities for electrical systems, assemblies, equipment, and components.

1.3 DEFINITIONS

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

B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

C. CxA: Commissioning Authority.

D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information. This includes the DLR Commissioning Process Overview documentation and the system design basis (developed by the Design Team).

E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 COMMISSIONING TEAM

A. Members Appointed by Contractor(s), Sub-Contractor(s) and Installer(s): Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of each Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

A. Provide the OPR documentation to the CxA and each Contractor for information and use.

B. Owner has prepurchased equipment for the project. Copies of prepurchase specifications or Bill of Materials (BOM) will be made available. The prepurchased equipment has been bought with the following manufacturer's services.

Equipment	Start-up	Level 4 Acceptance Testing	Level 5 Integrated System Testing
ATS	As required	Refer to specs/BOM	Refer to specs/BOM
Switchboard	As required	Refer to specs/BOM	Refer to specs/BOM
UPS Systems	As required	Refer to specs/BOM	Refer to specs/BOM
PDU Systems	As required	Refer to specs/BOM	Refer to specs/BOM
Generators	Bought through local rep	Refer to specs/BOM	Refer to specs/BOM
CRAC Units/Condensers	As required	Refer to specs/BOM	Refer to specs/BOM
Exhaust Fans	As required	Refer to specs/BOM	Refer to specs/BOM
Make Up Air Units	As required	Refer to specs/BOM	Refer to specs/BOM
Square D Meters	As required	Refer to specs/BOM	Refer to specs/BOM

C. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

D. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and each Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 COMMISSIONING TEAM'S RESPONSIBILITIES

A. Each Contractor, Sub-Contractor and Installer shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Attend commissioning team meetings held on a weekly basis at the normal meetings and more frequently as level 4 and 5 commissioning get closer and daily during level 4 and 5 commissioning.
2. Integrate and coordinate commissioning process activities with the construction schedule.
3. The construction schedule shall incorporate the commissioning process. Start-up, Testing and Balancing (TAB), Level 4 Acceptance Testing and Level 5 Integrated Systems Testing shall be detailed for each system/area. CxA will identify duration of level 4 and 5 tasks.
4. Review and accept construction checklists provided by the CxA.
5. Complete paper and electronic construction checklists as Work is completed and provide to the Design Team and the Commissioning Authority on a weekly basis.
6. Review, comment and accept commissioning process test procedures provided by the Commissioning Authority.
7. Complete commissioning process test procedures.
8. Assure compliance with the commissioning schedule by organizing and planning to have appropriate personnel, equipment and material available when required. Coordinate

vendor's personnel for all furnished and assigned owner's pre-purchased equipment. Provide as much advanced notice to vendors as possible.

9. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
10. Cooperate with the CxA for resolution of issues recorded in the Issues Log.

1.7 CxA'S RESPONSIBILITIES

A. Organize and lead the commissioning team.

B. Provide commissioning plan.

C. Convene commissioning team meetings.

D. Provide Project-specific construction checklists and commissioning process test procedures. Indicate on test procedures that start and stop times for each test shall be recorded. Approximately 4 weeks prior to activity to allow time to review and comment.

E. Verify the execution of commissioning process activities. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When an item does not meet the requirement, the CxA will report the failure in the Issues Log.

F. Prepare and maintain the Issues Log.

G. Prepare and maintain completed construction checklist log.

H. Witness systems, assemblies, equipment, and component startup.

I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

J. Define required test equipment and who shall supply.

1.8 RETESTING

A. Repeat, at no additional cost to the owner, the complete functional test procedure for each test in which acceptable results are not achieved. Repeat tests until acceptable results are achieved. Compensate the owner, design team, and CxA for direct costs incurred as the result of tests repeated to achieve acceptable results.

B. Correct test deficiencies promptly, during testing period if possible while all parties are available, and schedule retests so as to not delay building occupancy.

PART 2 - PRODUCTS AND TESTING FIRMS

2.1 SHOP DRAWINGS

A. Commissioning Authority (CxA) shall receive and review a copy of all shop drawings from the General Contractor, or from the Owner for pre-purchased equipment, related to equipment or systems to be commissioned.

2.2 EQUIPMENT

A. General Contractor shall provide two-way radios to facilitate all level 4 and 5 testing.

1. Provide 15 fully charged radios for use by all in attendance.

B. General Contractor shall provide four stop watches for use by all in attendance to time events.

C. Test equipment and additional stop watches, data recorders, temperature sensors, etc. required to complete the commissioning shall be provided by the Commissioning Agent and/ or a testing agency coordinated by the Commissioning Agent.

2.3 INSTRUMENTS AND BENCHMARK

A. During level 5 and Benchmark testing, the General Contractor shall provide the services of independent testing firms and personal qualified and certified by national organizations for the testing they are to perform. Personnel shall be certified and experienced in the testing they are to perform and with the instruments they will be using.

B. All instrumentation shall be calibrated within 12 months of the beginning of level 5 testing. Instrumentation shall bear a certification sticker that was placed by a certified testing and calibration company.

C. Provide a DLR approved thermo-graphic infrared scanning firm associated with TEGG, with certified personnel to perform the following testing per NETA standards:

1. Scan and document all the power terminations under load from the utility service and generator to the PDU level.
2. Scan all temporary power cables and terminations for hot spots.
3. Provide a report of thermographic testing that documents all terminations under load. At a minimum provide testing per NETA standards. For database purposes record all relevant information including equipment and termination identification, color photograph and thermographic photograph of each item, and electrical load at the time of test.
4. Identify any observed abnormalities and any concerns. Report abnormal issues immediately if warranted, otherwise issue a summary report daily.
5. Provide colored hard copy and electronic copy of pictures and report within 7 days of completion of testing.

D. Provide a NETA certified firm and personnel to provide and connect test instruments to record normal and abnormal operations during level 4 and 5 testing. Provide metering as follows:

1. Synchronize time stamps with BMS system.
2. Provide required voltage and current probes.
3. Include software required to download data.
4. Record times of all testing stages, switching, transfers, etc. for comparison to meter readings.
5. Record meter locations on a one line drawing. Submit for review at same time as level 5 script review.
6. TM2 – Fluke 1735 Datalogger meter shall record electronically and on an external LCD screen all power system parameters for all phases including voltage, amperage, power factor, kVA, kW, kVAR, and kWH. Meter shall capture trends and waveforms.
7. TM2 – Wave form capture meter shall record electronically and on a printer all power system parameters, surges, sags, spikes and dips. Unit shall record continuously during testing. Set up unit for event recording. Record and timestamp any event that is outside the ITIC CBEMA curve values.
8. During Level 5 testing provide TM1 trending meters in the following locations:
   a. Each main service (utility) at loadside of switchboard CB to record total load.
   b. Each generator service at loadside of switchboard CB to record total load
   c. As required to determine all loads minus UPS loads so a ratio of IT loads to total loads can be calculated. (switchboard meters can be used if they exist and one commissioned).
9. Provide TM2 event capture meters as follows:
   a. Output switchboard of UPS after wrap around maintenance feeder CB.
   b. Output of a PDU or panel on UPS at 120/208V. Cross check switchboard and UPS meters with TM1 and TM2 meters. Record all meters (equipment TM1 and TM2

meters) at each step for voltage, amperage, kW, kVA, Pf and THD for each phase and system.

10. Provide TM1 meter for generator acceptance testing and UPS battery discharge testing.
11. Synchronize times on all equipment and meters. Record when all transfers and switching occurs and verify proper operation and response of the power system and equipment.

E. Measurements During Testing

1. Place a data logger and a fast reacting digital thermometer in the center of each cold aisle. Mount six feet above raised floor over the perforated tiles. Locate every 30 feet per ASHRAE TC9.9 recommendations. Stand shall not block air flow from perforated tile. Stagger locations along length of cold aisles to get a representative room layout. Provide more than one location per aisle if required. Indicate proposed location on a floor plan for owner and design team review during review phase of Level 5 testing script.
2. Place data logger and a fast reacting digital thermometer outdoors near heat rejection equipment to sense ambient air conditions
3. Synchronize times on all equipment and meters. Record when all transfers and switching occurs and verify proper operation and response of the cooling system and equipment.
4. Monitor and record water flow, pressure, chiller capacity, pump speed, etc on supply and return during testing.
5. Record at the start of testing (zero load) and at each load step 25%, 50%, 75%, 100% and during all transfer and equipment failure testing and during cooling system failure tests.
6. Review temperatures and humidity levels as compared to ASHRAE Thermal Guidelines (TC9.9) recommendations.
7. Review meter graphs during testing and transfers to visually verify no power abnormalities. Record times of each step to correlate with electronic data. Redo testing if abnormalities are observed.
8. During level 5 testing record the following values at zero load, 25%, 50%, 75%, and 100% at each meter:
   a. Voltages, PH-PH and PH-N
   b. kW, kVA
   c. kWH
   d. Power factor (leading or lagging)

PART 3 - EXECUTION

3.1 SCHEDULE

A. The typical time frame for level 4 and 5 commissioning and benchmarking is two weeks for a 1.125 MW UPS data center pod. Level 5 testing typically takes three 12 hour days.

END OF SECTION

SECTION 02 41 19
SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. General: The work described in this Section consists of selective demolition, cleaning, removal and legal disposal of all structures, equipment and materials indicated for demolition, or careful removal and temporary storage of materials and equipment indicated for salvage and re-use, or salvage and delivery to Owner.

B. Permits: Obtain and pay for all demolition and construction permits required by local authorities having jurisdiction and other regulatory agencies and utility companies.

C. Selective demolition and removal work includes, but is not limited to:

1. Saw cut and remove existing concrete slab and trench for electrical work.
2. Remove from site all abandoned, disconnected and dismantled electrical fixtures and equipment, including conduits, wiring, meters and other devices.
3. In addition to demolition specifically shown, cut, move or remove existing construction to remain as necessary to provide access or to allow alterations and new work to proceed. Coordinate such relocation's and removal to accommodate the demands and requirements of other trades.
4. Removal of unsuitable or extraneous materials not marked for salvage, such as abandoned furnishings and equipment, and debris such as rotted wood, rusted metals and deteriorated concrete.

D. Selective demolition and removal work by individual utility, mechanical and electrical trade subcontractors includes, but is not limited to the following:

1. Each trade subcontractor shall Disconnect cut, cap and make safe all utilities, equipment and fixtures which are not indicated for salvage or re-use, or otherwise indicated to be abandoned in place as well as any abandoned materials of any kind.
   a. Disconnect cut, cap and make safe, all utility services indicated to be demolished at their primary source. Obtain the approval from authorities having jurisdiction, or applicable service provider prior to the execution of the work.
   b. Cut, cap and make safe all existing utility services indicated to be abandoned in place, where so indicated on the Drawings.
2. The Electrical subcontractor shall disconnect, detach, dismantle all existing abandoned electrical systems and equipment including, but not limited to, panelboards, light fixtures, fire alarm, intercom, speakers, wiring devices, and all related conduit and appurtenances.
   a. Suspended wiring, conduit, hangers, fixtures, equipment, and appurtenances scheduled for demolition, shall be disconnected and lowered to floor by the Electrical subcontractor.
3. Remove, salvage and furnish to the General Contractor designated equipment, fixtures or other items so identified. Refer to notes on Drawings.

4. Identify locations of utilities for work of other sections.

E. Remove, salvage and provide storage for removed materials, equipment and furnishings indicated for re-use, including but not limited to:

1. Wall protection.
2. Temporary doors, frames, and assorted hardware.

F. Remove, salvage, and furnish to Owner for maintenance stock, or other future use, the following products. Carefully package and clearly identify prior to delivery to Owner.

1. Roll-up door and hardware.

G. Protect adjacent existing workstations during demolition.

1.2 RELATED REQUIREMENTS

A. Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS: Procedural and administrative requirements for temporary facilities and controls.

B. Section 01 73 29 - CUTTING AND PATCHING: Procedural and administrative requirements for cutting and patching.

C. Individual specification sections: Cutting and patching incidental to work of individual specification sections shall be performed by respective trades, except as specified in Section 01 73 29.

1.3 REFERENCES

A. Reference Standards: Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ANSI A10.6 – Safety Requirements for Demolition Operations.
2. NFPA 241 – Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.4 OWNERSHIP OF REMOVED MATERIALS

A. Ownership of materials, equipment and furnishings designated for salvage for re-use in this Project or designated for Owner's use is retained by the Owner.

B. Ownership of materials, equipment and furnishings to be removed from the Project which are not defined by the above two paragraphs is retained by the Contractor; if any of these are considered of salvageable value to the Contractor, they may be removed from the Project as work progresses.

1. On-site storage or sale of removed items is prohibited.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Comply with all requirements of this contract relative to protection, scheduling and coordination with the Owner.
2. Hazardous materials: When hazardous materials are encountered, they shall be handled, removed, and disposed of in accordance with all regulatory

agency requirements.

3. Coordinate and arrange with utility, mechanical and electrical trades for their disconnecting, rerouting and maintenance of existing services leading to adjacent occupied buildings, as part of the work of this Contract.
4. Coordinate Work of this Section with related utilities work identified in the Contract Documents.

B. Sequencing:

1. Coordinate and arrange with mechanical and electrical trades for their disconnecting, rerouting and maintenance of existing services in the buildings as required, as part of the work of this Contract.

C. Scheduling:

1. Comply with all requirements of this contract relative to protection, scheduling, phasing, and coordination with the Owner.

1.6 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Schedule: Prior to commencement of work, prepare a schedule indicating proposed methods and sequence of operations for demolition work.
   a. Include coordination for shut-off, capping, and continuation of utility services as required, together with details for dust and noise control protection.
   b. Provide detailed sequence of demolition and removal work to ensure uninterrupted progress of Owner's on-site operations. Receive acceptance from Engineer / Architect prior to commencing work.
2. Permits: Submit copy of permits required by regulatory agencies for demolition.
3. Special Procedure Submittals: Submit copies of written agreements from private landowners, landfill operators, or other agencies accepting disposal of demolished materials at least two weeks prior to commencement of demolition work.

1.7 REGULATORY REQUIREMENTS

A. Conform to applicable codes for demolition work, safety of structure, dust control, and disposal of debris. Conform to procedures applicable when discovering hazardous materials or contaminated substances.

1. The Contractor is directed not to disturb or attempt removal of any discovered hazardous materials or contaminated substances. Immediately notify both the Owner and the Engineer / Architect upon discovery of such conditions.

B. Obtain and pay for required permits and licenses required from authorities prior to commencing demolition work. Arrange and pay for legal disposal of removed materials and equipment, obtain proper disposal receipts for verification.

C. Notify affected utility companies and Owner before starting work and comply with utility company requirements.

D. Do not close or obstruct egress width to exits. Do not disable or disrupt building fire or life safety systems without 3 days prior written notification to the Owner.

1.8 QUALITY ASSURANCE

A. General: Conduct the work in a manner giving prime consideration to protection of the public; protection from the weather, control of noise, shocks and vibration; control of dirt and dust; orderly access for and storage of materials; protection of existing buildings; protection of adjacent surfaces and property; coordination and cooperation with the Owner at all times.

1. Comply with all requirements of this contract relative to protection, scheduling and coordination with the Owner.

B. Qualifications:

1. Demolition subcontractor: Company specializing in performing work of this section with minimum 3 years documented experience.
2. Shoring and bracing design: Design shoring, and bracing, under direct supervision of Professional Engineer experienced in design of this Work and licensed at Project location.

1.9 SITE CONDITIONS

A. Comply with wind and weather conditions established at pre-demolition meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Condition of Structures: Owner assumes no responsibility nor makes any claim as to the actual condition or structural adequacy of any existing construction to be demolished. The Contractor shall investigate and assure himself of the condition of the work to be demolished and shall take all precautions to ensure safety of persons and property.

1. Notify both Owner and Engineer / Architect, if any type of hazardous chemicals, gases, explosives, flammable material, unmarked containers, or similar dangerous substances are discovered. Cease work in affected areas until directed by Engineer / Architect. Continue work in other areas.

B. The Contractor shall have examined the existing conditions per requirements of the Conditions of the Contract and Division 1 - General Requirements, and reviewed Contract Documents prior to commencement of demolition. Coordinate and verify scope of selective demolition with other portions of work specified in other sections, and under separate Contract. Change orders will not be issued for the removal of any exposed to view materials or equipment, which are either indicated on the Drawings for removal, or not indicated, but necessary to remove for the Work of this Project.

3.2 PREPARATION

A. General: Provide necessary protection of non-work areas during demolition operations. Provide, erect and maintain temporary barriers as required to protect non-construction related pedestrian and vehicular traffic using the adjacent portions of the site and building.

1. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued Owner occupancy of adjacent spaces.

B. Protect existing structures which are not to be demolished. Protect designated materials and equipment to be removed and retained by Owner.

1. Cover or otherwise protect as necessary existing equipment, furniture and furnishing located beyond the immediate demolition work.
2. Protect existing landscaping materials, structures, and appurtenances which are not to be demolished.

C. Prevent movement of structure; provide required bracing and shoring.

1. Protect existing active utility services and structures from damage during selective demolition work including during installation of bracing and removal of same. Repair or replace damages to satisfaction of Owner.

D. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations.

3.3 GENERAL REQUIREMENTS FOR SELECTIVE DEMOLITION

A. Conduct demolition to minimize interference with adjacent and occupied building areas, in compliance with governing laws and buildings, with prime consideration given to the safety, protection and convenience of the public and Owner's personnel.

1. Maintain protected egress and access to the Work at all times.

B. Perform selective demolition in an orderly and careful manner. Carefully cut materials to be removed to eliminate damage to portions to remain. Protect existing structure designated to remain.

1. Do not demolish building elements beyond what is indicated on Drawings without Engineer / Architect's approval.
2. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
3. Pull nails and fasteners which remain after removal of attached material. Remove lath, strapping and other substructures associated with finishes to be removed.
4. Where existing finishes are indicated to be removed, remove down to bare subsurface without causing damage to the subsurface.

   a. After removal of non-asbestos finish flooring materials. Remove underlying mastic and prepare substrate to receive new flooring materials by shot blasting method. Create a uniform 20 mil profile. Mechanically scarify areas which cannot be profiled by shot blast method. Thoroughly wash all flooring substrate and leave clean and dry ready for application of new flooring materials.

C. Cutting openings and holes: Neatly cut openings and holes plumb, square, and true to dimensions required. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces.

1. All penetrations in floors and roof shall be framed with miscellaneous metal work prior to cutting and demolition of deck and concrete.
2. Repair damage done to existing elements of building to remain, except repairs specified to be provided under other Sections. Repairs shall be done in such manner as to closely match construction, appearance and quality of original work.

D. Disconnect existing equipment and fixtures to be removed, or services abandoned, and piping, wiring, and conduit which would otherwise be exposed in the finished work.

Remove from site disconnected equipment and fixtures and piping not to be reused.

1. Contractor to remove and dispose of all equipment not tagged or scheduled for reuse.

3.4 GENERAL DUST CONTROL AND PROTECTION

A. Compliance with requirements for dust protection and air quality control is required for work areas which abut Owner occupied areas. Dust removal and periodic cleaning requirements apply to all work. Contractor shall employ dust and pollution prevention procedures so that a healthy Owner's environment is fully maintained at all times. Compliance with requirements of with requirements of Section 01 50 00 - TEMPORARY FACILITIES is mandatory and may not be compromised at any point during construction.

1. Clean up loose debris daily, or more frequently as required, to prevent the wind spreading debris. Keep dumpsters covered when not in use.
2. Cover handcarts carrying debris being transported through Owner occupied areas.
3. Wet down debris (as appropriate) to prevent air pollution by dust rising from demolition work. Wet down dumpsters to prevent fires caused by vandals.
4. Employ tarpaulins on all trucks carrying debris.

B. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer / Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION REQUIREMENTS FOR MATERIALS AND SURFACES.

A. Walls, General:

1. Remove interior walls and partitions as indicated and as needed to accommodate new work.
2. Where existing walls-to-remain are indicated to receive new finishes, completely remove trim and fasteners.
3. Patching: The Contractor is responsible for patching of substrates and back-up systems. Finishes work shall be provided under individual product specification sections.

B. Ceilings, General:

1. Patching: The Contractor shall provide patching of substrates and back-up systems. Ceiling work is specified under individual product specification sections.
   a. Ceilings which must be temporarily removed for mechanical, plumbing or fire protection work shall be carefully removed and stored for reinstallation when work has been completed under Section 09 51 00 - Acoustical Ceilings.

C. Doors and Frames: Where doors and frames are indicated to be removed from walls or partitions which are to remain, remove doors and frames carefully so as to minimize damage to wall. Repair and patch wall as necessary to accommodate new door frame or other new work.

D. Electrical Equipment and Lighting Fixtures:

1. Electrical subcontractor(s) shall disconnect, cap and lower to floor items required

to be removed, including but not limited to, panelboards, light fixtures, and overhead devices including, fire alarm, intercom, bus ducts. Contractor is responsible for removal from site.

3.6 REPAIRS

A. Repair all damage done to elements of buildings and structures to remain, except repairs specified to be provided under other Sections, or as indicated for removal in subsequent project phase(s). Repairs shall be done in such manner as to closely match construction, appearance and quality of original work.

3.7 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated or specified to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. As work progresses, regularly remove demolished materials from site. Do not allow demolished materials to accumulate on-site, except as required for materials determined to be reused, salvaged, or as required for waste segregation and diversion for recycling.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Do not burn or bury demolished materials on site, arrange for legal disposal of the same.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.8 CLEANING

A. Daily cleaning: Sweep all street and roads affected by demolition operations.

B. Upon completion of the work of this Section; remove unused tools and equipment, surplus materials, rubbish, debris, and dust. Leave area in raked or broom-clean condition, as appropriate.

C. Upon completion of the work of this Section; clean adjacent structures and facilities of dust, dirt and debris caused by demolition work to the satisfaction of Owner, owner(s) of adjacent properties, and authorities having jurisdiction.

END OF SECTION

SECTION 03 01 36
RESURFACING AND PATCHING OF CONCRETE SLABS

PART 1 - GENERAL

1.1 SUMMARY

A. Grind down high spots in existing concrete surfaces to specified tolerances.

B. Shot blast clean existing concrete slabs free of dirt, laitance, corrosion, or other contamination ready to receive finish flooring.

C. Prepare substrates, level and patch existing concrete surfaces, and concrete surfaces disturbed by the Work of this Contract, including:

1. Restore concrete surfaces after conclusion of demolition.
2. Fill openings in suspended slabs where indicated.
3. Patch concrete at slabs-on-grade where trenching has occurred.

1.2 RELATED REQUIREMENTS

A. Section 03 05 13 - CONCRETE SEALERS: Concrete sealers/coatings on exposed-to-view concrete floors.

B. Section 03 30 00 - CAST-IN-PLACE CONCRETE:

1. Placing and finishing concrete slabs.
2. Dustproofing concrete slabs exposed to view and substrate for carpet.

1.3 REFERENCES

A. Reference Standards: Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ACI 302 - Guide for Concrete Floor and Slab Construction.
2. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete.
3. ASTM C 33 - Concrete Aggregates.
4. ASTM C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-inch Cube Specimens).
5. ASTM C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
6. ASTM C 150 - Portland Cement.
7. ASTM C 348 - Standard Test Method for Flexural Strength of Hydraulic-Cement Mortars.

8. ASTM C 928 - Standard Specification for Packaged, Dry, Rapid-Hardening Cementitious Materials for Concrete Repairs.
9. ASTM C 1708 – Self-leveling Mortars Containing Hydraulic Cements.

1.4 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties for proposed patching underlayment.
2. Concrete Mix Test Reports: Submit Preliminary Design Mix Reports (ACI 301).
3. Manufacturer's instructions: Manufacturer's preparation, mixing, priming, and application instructions.
4. Shop drawings:
   a. Patching and resurfacing scope drawings: 1/4-inch scale elevations and plans of areas covered by the Work of this Section.
   b. Reinforcement shop drawings: Plans and details showing bar sizes, spacing, locations, depth of doweling, and quantities of reinforcing steel Include schedules and diagrams to indicate beds, sizes and lengths of reinforcing members.

1.5 QUALIFICATIONS

A. Materials manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years' experience.

B. Mixing and application equipment as approved by the manufacturer.

1.6 QUALITY ASSURANCE

A. General: Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.

B. Sole Source: Obtain products required for the Work of this Section from a single manufacturer, or from manufacturers recommended by the prime manufacturer of materials.

C. Qualifications:

1. Installer/Applicator: Minimum of 3 years documented experience demonstrating previously successful work of the type specified herein, and approved by product manufacturer.

D. Perform work to provide homogeneous concrete with required strength, durability, and without planes of weakness, and other structural defects, and free of air pockets, voids, projections, off sets of plane, and other defacements on exposed surfaces.

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:

1. Do not deliver items to the site, until all specified submittals have been submitted to, and approved by, the Architect.

B. Deliver materials in manufacturer's original undamaged packages or acceptable

bulk containers.

C. Storage and Handling Requirements:

1. Store and handle materials following manufacturer's recommended procedures, and in accordance with material safety data sheets.
2. Protect materials from damage due to moisture, direct sunlight, excessive temperatures, surface contamination, corrosion and damage from construction operations and other causes.

D. Damaged material: Remove any damaged or contaminated materials from job site immediately, including materials in broken packages, packages containing water marks, or show other evidence of damage, unless Architect specifically authorizes correction thereof and usage on project.

1.8 ENVIRONMENTAL CONDITIONS

A. Do not place cementitious underlayment when ambient temperature is below freezing.

B. When air temperature has fallen or is expected to fall below 40 degrees. F (4 degrees. C), heat water and aggregates before mixing to attain concrete at point of placement with temperature of 50 degrees F, 80 degrees F maximum.

C. Do not place concrete underlayment on surfaces that are covered with standing water, snow, or ice.

PART 2 – PRODUCTS

2.1 DESCRIPTION

A. General Description: Interior Work consisting of:

1. Cement and polymer-based, trowel applied underlayment and patching mortar, for conditions:
   a. Feather to 1/2 inch thick.
   b. 1/2 to 3 inches thick.
2. Portland cement concrete fill.

B. Sustainability Requirements:

1. Provide materials with maximum possible recycled content.

2.2 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or approved equal:

1. Ardex Engineered Cements, Aliquippa PA.
2. Bonsal American (Pro Spec), Charlotte NC.
3. Silpro Corporation, Ayer MA.

2.3 UNDERLAYMENT AND PATCHING MORTAR

A. General: Provide products that are compatible with flooring adhesives.

B. Concrete resurfacing and underlayment for applications up to 1/2 inch thick: Factory blended portland cement-based product mixed with latex admixture, having the following performance characteristics:

1. Thickness Range: From feather edge to 1/2" maximum thickness.

2. Working Time: At least 30 minutes at 70°F.
3. Compressive Strength: ASTM C109, minimum 4,700 psi after 28 days.
4. Tensile Strength: ASTM C190, minimum 1,040 psi after 28 days.
5. Flexural Strength: ASTM C348, 1,560 psi after 28 days.
6. Bond Strength to Concrete: ASTM C321, Crossed brick method, failure in concrete.
7. Acceptable products:
   a. Ardex: “SD-F Feather Finish”.
   b. Bonsal (Pro Spec): “Feather Edge”.
   c. Silpro: “Masco Underlayment and Repair Mortar with Silpro C21”.

C. Concrete resurfacing and underlayment for applications over 1/2 inch thick and up to 3 inches thick: Factory blended portland cement-based product with latex admixture, having the following performance characteristics:
1. Thickness Range: From 1/2 inch to 3 inch maximum thickness. Provide without added aggregate, unless recommended by manufacturer for thickness required.
   a. Silpro: 1/2 to 3/4 inch without aggregate; use 3/8 inch pea stone for 3/4 to 3 inch thickness.
   b. Ardex: 1/2 inch to 2 inches without aggregate; Use 3/8 pea stone for 2 to 3 inch thickness.
   c. Bonsal (Pro Spec): 1/2 inch to 2 inches without aggregate; Use 3/8 pea stone for 2 to 3 inch thickness.
2. Working Time: At least 30 minutes at 70°F.
3. Compressive Strength: ASTM C109, minimum 6,000 psi after 28 days.
4. Tensile Strength: ASTM C190, minimum 710 psi after 28 days.
5. Flexural Strength: ASTM C348, minimum 1,200 psi after 28 days.
6. Shear Bond Strength: ASTM C1042, minimum 1,540 psi after 28 days.
7. Acceptable products:
   a. Ardex: “SD-T”.
   b. Bonsal (Pro Spec): “Premium Patch 100”.
   c. Silpro: “Mascrete Topping and Structural Repair Mortar with Silpro C21”.

D. Water: Clean and potable.

E. Primers: Unless otherwise recommended by underlayment and patching mortar manufacturer for substrate material, condition, and porosity encountered:
1. Ardex: “P-51”.
2. Bonsal (Pro Spec): “118 Primer”.
3. Silpro: “C 21 All Acrylic”.

2.4 CONCRETE FILL MATERIALS

A. Minimum compressive strength of slabs on grade, and topping slabs on metal deck: 3000 psi at 28 days, unless otherwise indicated on the structural Drawings.

B. Maximum water to cement ratio: 0.45.

C. Concrete Materials:
1. Cement conforming to ASTM C 150, Type II - Normal.

2. Fine aggregates conforming to ASTM C 33; natural sand.
3. Course aggregates conforming to ASTM C 33; crushed stone or gravel.
4. Water: Clean and potable.

D. Concrete bonding agent: Two component epoxy bonding agent conforming with ASTM C881, Type 2.

2.5 ACCESSORIES:

A. Cleaning Agent: Commercial Muriatic acid.

B. Perimeter Joint Filler: Glass fiber strips, compressible to 50 percent original thickness under load of 25 pounds per square inch with full recovery. Conforming to ASTM C612, Class 2.

2.6 SOURCE QUALITY CONTROL

A. Manufacturer Services: Make arrangements to have Manufacturer's representative (employed by manufacturer) on-site during Work of this Section to periodically review installation procedures. A minimum of 3 site visits are required.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces and verify that they are in proper condition to receive the work of this Section. Beginning of installation means acceptance of existing conditions.

B. The Contractor shall inspect and sound the areas involved to determine the full extent of the work involved and shall outline the limits of work involved using a marking crayon, paint or other suitable method for review by Architect.

3.2 PREPARATION - GENERAL

A. Clean concrete surfaces of dirt, laitance, corrosion, or other contamination; wire brush using acid; rinse surface with clean water and allow to dry.

B. Remove loose and friable materials from depressions and edges so new material bonds to sound existing construction.

C. Flush out cracks and voids with Muriatic acid to remove laitance and dirt. Chemically neutralize by rinsing with water.

D. Apply recommended number of coats of specified primer, at strength recommended for the substrate, by the primer manufacturer.

E. Preparation for patching holes and depressions:

1. Edges: Confirm edges are saw cut. Broken and fractured edges are not acceptable.
2. Shape for slabs-on-grade: Confirm excavated shape has a greater surface area at the bottom than at the top to create a "dovetail slot" where the new concrete fill is mechanically locked.
3. Shape for supported slabs: Confirm sound support and formwork at limits of placement.

F. Where concrete patching, filling, or topping is required to "feather edge", saw cut a minimum 3/4 inch wide by 3/8 inch deep bonding channel in the concrete substrate at the point of feather edging.

3.3 RESURFACING WORK - GENERAL

A. For spalling slab areas: Saw-cut around spalled areas to a depth of 1/2 to 3/4 inch. Angle bottom of saw cut away from spalled areas to provide keying. Chip out spalled area to saw cuts, chip area flat and level. Fill voids flush with surface with underlayment patching material.

B. In locations where concrete is loose, chipped or missing to a depth of more than 3 inches; dowel stainless steel reinforcing into existing concrete. Drill holes in existing concrete equal to depth of repair; insert 1/4-inch diameter stainless steel dowels and pack solid with high- strength non-shrink grout.

3.4 FILLING WITH CONCRETE

A. Install all framing, formwork and dowels required for the placing of concrete and for bonding new concrete to existing.

B. Shortly before placing concrete, saturate the perimeter edges of the openings with water. After the free or glistening water disappears, the edges shall be given a thorough coating of neat cement slurry mixed to the consistency of thick paste and scrubbed in with a stiff bristle brush.

C. Place mix and strike level with adjacent surfaces.

D. Texture of finished concrete shall match that of existing abutting concrete.

3.5 APPLICATION - CONCRETE UNDERLAYMENT AND PATCHING MORTAR

A. Surface Preparation:

1. Clean substrate free of grease, wax, curing compounds and all other foreign materials.
   Substrates shall be solid and sound; remove all soft or crumbly materials.
2. Make adhesion tests as recommended by manufacturer to ensure good bond to substrate. Acid etch polished floors. Completely strip sealed floors of existing sealer compounds.
3. Prime subfloors as recommended by underlayment manufacturer, using the correct primer for porous and non-porous subfloors.

B. Strictly comply with manufacturer's instructions and recommendations, except where more restrictive requirements are specified in this Section.

C. Mix product directly from sealed package with water in proportions recommended by manufacturer. Where recommended by product manufacturer, add crushed stone aggregate and blend to dry mix prior to adding latex admixture. Avoid over watering.

D. Apply underlayment and patching mortar while primer is still tacky. Place and trowel underlayment to the desired thickness. Do not use a power trowel. Steel trowel finish where underlayment will be a substrate for a finished flooring surface.

E. If two or more layers of underlayment are applied, place second layer after first layer has set to walkable hardness.

F. Where depressions occur, fill depressed area level with abutting surfaces.

G. Install expansion joint filler at:

1. Perimeter of placements.

2. Around penetrations through decks.

3.6 TOLERANCES

A. Installation Tolerances: The following allowable installed tolerances are allowable variations from locations and dimensions indicated by the Contract Document and shall not be added to allowable tolerances indicated for other work.

1. Allowable Variation from True Level: 1/8" in 10'-0" when measured with a 10 foot long straight edge in all directions.

3.7 DEFECTIVE UNDERLAYMENT

A. Defective underlayment and patching mortar: Defined as material not conforming to required lines, details, dimensions, tolerances or specified requirements.

B. Refinish or remove and replace underlayment and patching mortar surfaces that are too rough to receive finish flooring or where physical properties do not meet specified requirements.

C. Repair or replacement of defective underlayment will be determined by the Architect.

END OF SECTION

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SECTION 03 05 13
CONCRETE SEALERS

PART 1 – GENERAL

1.1 SUMMARY

A. Furnish and install concrete sealers/coatings on exposed--to--view concrete floors where shown and as scheduled on the Drawings.

1.2 RELATED REQUIREMENTS

A. Section 03 30 00 – CAST-IN-PLACE CONCRETE:
   1. Placing and finishing concrete slabs.
   2. Dustproofing concrete slabs exposed to view and substrate for carpet.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 -- REFERENCES.
   1. ASTM C156 – Water Retention by Liquid Membrane--Forming Curing Compounds for Concrete.
   2. ASTM C309 – Liquid Membrane-Forming Compounds for Curing Concrete.
   3. ASTM C1315 – Liquid Membrane-Forming Compounds, having Special Properties for Curing and Sealing Concrete

1.4 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 -- SUBMITTAL PROCEDURES:
   1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties, material compositions, and application instructions for all finishing products to be applied hereunder.
      a. Include certification of data indicating Volatile Organic Compound (VOC) content of all coatings.
   2. Samples of each level of slip resistance, aggregate, and pattern available in the specified products from the proposed manufacturer.
   3. Provide manufacturer’s documentation indicating that the concrete sealer is compatible with the raised access floor pedestal adhesive.

1.5 QUALITY ASSURANCE

A. Use an applicator approved by the manufacturer, experienced in the approved materials, and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.6 ENVIRONMENTAL CONDITIONS

A. Work shall be done only under optimum conditions as recommended by manufacturer. Surfaces over which sealer is to be applied shall be completely dry (minimum 30 days

since concrete placement) and thoroughly clean. Maximum moisture content is 8 percent. Substrate and ambient temperature shall be between 60 and 90 degrees Fahrenheit (15 to 32 degrees Celsius).

1.7 PRODUCT HANDLING

A. Deliver materials to the job site and store in their original unopened containers with all labels intact and legible at time of use. Store in strict accordance with the manufacturer's recommendations.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Transparent non--yellowing water--based acrylic sealer having a minimum of 25 percent solids, with a maximum VOC limit of 100 g/L. Subject to compliance with ASTM C309, Type 1, Class A and B, ASTM C1315 Type 1, Class B, and requirements specified herein.

1. Manufacturers offering products which may be incorporated in the work include the following, or approved equal:
   a. Euclid Chemical Company, Cleveland, Ohio, product “Ultra Guard”.
   b. L&M Construction Chemicals Inc., Omaha NE, product “Dress & Seal WB25”. (30% solids)
   c. Symons Corporation, Des Plaines, IL, product “Cure & Seal HS WB”.

PART 3 – EXECUTION

3.1 SURFACE PREPARATION

A. Upon acceptance of completed substrate surfaces, thoroughly remove all dust and debris by sweeping or vacuum cleaning.

B. Remove laitance, curing sealers, and other foreign matter from concrete surfaces with necessary techniques such as shot blasting, Muriatic acid etching, surface freezing and power scarification.

C. Surface preparation required if a curing compound has been applied to substrate surfaces.

1. Thoroughly etch concrete surfaces using well mixed solution consisting of two parts by volume water diluted with one part by volume 30 percent commercial grade hydrochloric acid at a rate of one quart per ten square feet. Apply evenly to thoroughly saturated areas and scrub into surfaces using stiff--bristled broom. Allow solution to activate undisturbed for not less than five minutes or for duration of boiling effect.
2. Thoroughly remove etching solution by washing down surfaces with clean water; flooded at least three separate times at a rate of two gallons per ten square feet; thoroughly remove all contaminates that may be engrained or latent in surfaces.
3. Perform a test application of a square foot in three locations, such as beneath casework. Allow to set for 72 hours, and test adhesion as recommended by the manufacturer.

3.2 APPLICATION

A. Apply sealer with manufacturer's recommended sprayer, at recommended rate of 400 square feet per gallon. Apply second coat when sealer is dry to touch. Allow sealer to cure undisturbed for a minimum period of 6 hours. Maintain temperature at 60 degrees Fahrenheit minimum until floor surfacing has completely dry.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

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

1. Equipment Foundations.
2. Slabs on Grade

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

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

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Product Data for Credit IEQ 4.3: For curing and sealing compounds, documentation including printed statement of VOC content.
3. Design Mixtures for Credit ID 1.1: For each concrete mixture containing fly ash as a replacement for portland cement or other portland cement replacements, and for equivalent concrete mixtures that do not contain portland cement replacements.

C. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

D. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar

diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

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

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

1.5 INFORMATIONAL SUBMITTALS

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

1. Cementitious materials.
2. Admixtures.
3. Form materials and form-release agents.
4. Steel reinforcement and accessories.
5. Curing compounds.
6. Bonding agents.
7. Adhesives.
8. Semirigid joint filler.
9. Joint-filler strips.
10. Repair materials.

B. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:

1. Aggregates.

C. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

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

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

G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

1. Plywood, metal, or other approved panel materials.
2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

   a. High-density overlay, Class 1 or better.
   b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
   c. Structural 1, B-B or better; mill oiled and edge sealed.
   d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

E. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.

2.2 STEEL REINFORCEMENT

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

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

2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

2.4 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:

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

2. Blended Hydraulic Cement: ASTM C 595, Type IS, portland blast-furnace slag Type IP, portland-pozzolan Type I (PM), pozzolan-modified portland Type I (SM), slag-modified portland cement.

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

C. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

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

2.5 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
   b. BASF Construction Chemicals - Building Systems; Confilm.
   c. ChemMasters; SprayFilm.
   d. Conspec by Dayton Superior; Aquafilm.
   e. Dayton Superior Corporation; Sure Film (J-74).
   f. Edoco by Dayton Superior; BurkeFilm.
   g. Euclid Chemical Company (The), an RPM company; Eucobar.
   h. Kaufman Products, Inc.; Vapor-Aid.
   i. Lambert Corporation; LAMBCO Skin.
   j. L&M Construction Chemicals, Inc.; E-CON.
   k. Meadows, W. R., Inc.; EVAPRE.
   l. Metalcrete Industries; Waterhold.
   m. Nox-Crete Products Group; MONOFILM.
   n. Sika Corporation; SikaFilm.
   o. SpecChem, LLC; Spec Film.
   p. Symons by Dayton Superior; Finishing Aid.
   q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
   r. Unitex; PRO-FILM.
   s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Anti-Hydro International, Inc.; AH Curing Compound #2 DR WB.
    b. BASF Construction Chemicals - Building Systems; Kure 200.
    c. ChemMasters; Safe-Cure Clear.
    d. Conspec by Dayton Superior; W.B. Resin Cure.
    e. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
    f. Edoco by Dayton Superior; Res X Cure WB.
    g. Euclid Chemical Company (The), an RPM company; Kurez W VOX; TAMMSCURE WB 30C.
    h. Kaufman Products, Inc.; Thinfilm 420.
    i. Lambert Corporation; AQUA KURE - CLEAR.
    j. L&M Construction Chemicals, Inc.; L&M Cure R.
    k. Meadows, W. R., Inc.; 1100-CLEAR.
    l. Nox-Crete Products Group; Resin Cure E.
    m. Right Pointe; Clear Water Resin.
    n. SpecChem, LLC; Spec Rez Clear.
    o. Symons by Dayton Superior; Resi-Chem Clear.
    p. TK Products, Division of Sierra Corporation; TK-2519 DC WB.
    q. Vexcon Chemicals, Inc.; Certi-Vex Enviocure 100.

2.7 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

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

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

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

2.8 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

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

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Equipment Foundations: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

2.10 FABRICATING REINFORCEMENT

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

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
1. Class B, 1/4 inch for rough-formed finished surfaces.

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

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

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

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

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

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

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
3. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of

weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

G. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view,.

C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING EQUIPMENT FOUNDATIONS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

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

C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces equipment foundations.

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

D. Broom Finish: Apply a broom finish to exterior concrete sidewalks, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.9 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

3.10 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer.

3.11 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.

    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231, pressure method, for normal-weight concrete;one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
    b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

    a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
    b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other

requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

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

END OF SECTION 03 30 00

SECTION 04 20 00
UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install:

1. Concrete masonry unit construction for infill of existing tilt-up panels where indicated on the Drawings.
2. Reinforcing, ties, anchors, and other metal accessories, for anchoring unit masonry together and to other materials.

B. Place, install and build-in, as work progresses, the following products and materials furnished under the indicated Sections:

1. Anchor bolts, wood blocking, and anchorage items furnished or set by other trades as specified in individual Sections.
2. Access door frames furnished by Section 08 31 00 - ACCESS DOORS AND PANELS or by section requiring the same.

1.2 RELATED REQUIREMENTS

A. Section 01 45 00 - QUALITY CONTROL: Perform testing of masonry, mortar and grout specified herein.

B. Section 01 45 29 - TESTING LABORATORY SERVICES: Perform testing of masonry, mortar and grout specified herein.

C. Section 07 84 00 - FIRESTOPPING.

D. Section 07 92 00 - JOINT SEALANTS: Sealant, caulking materials, and compressible joint bead back-up, in conjunction with masonry work.

1.3 REFERENCES

A. Referenced Standards: Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. The standards referenced herein are included to establish recognized minimum quality only. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern. Equivalent quality and testing standards will be acceptable, subject to their timely submission, review and acceptance by the Architect.

1. Masonry Standards Joint Committee (MSJC) [The Masonry Society (TMS)/American Concrete Institute (ACI)/American Society of Civil Engineers (ASCE)]: TMS 602/ACI 530.1/ASCE 6 - “Specifications for Masonry Structures”
2. ASTM A 82 - Steel Web, Plain, for Concrete Reinforcement.
3. ASTM A 123 - Zinc (Hot-Dip Galvanized) Coating on Iron and Steel Products.
4. ASTM A 153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
5. ASTM A 497 - Welded Wire Fabric; Deformed, for Concrete Reinforcement.
6. ASTM A 615 - Deformed and Plain Billet-Steel Bar for Concrete Reinforcement.

7. ASTM A 641 - Zinc-Coated (Galvanized) Carbon Steel Wire.
8. ASTM B 117 - Salt Spray (Fog) Testing.
9. ASTM B 633 - Electrodeposited Coatings of Zinc on Iron and Steel.
10. ASTM C 5 - Quicklime for Structural Purposes.
11. ASTM C 90 - Load-Bearing Concrete Masonry Units.
12. ASTM C129 - Non-Load Bearing Concrete Masonry Units.
13. ASTM C 140 - Method of Sampling and Testing Concrete Masonry Units.
14. ASTM C 144 - Aggregate for Masonry Mortar.
15. ASTM C 150 - Portland Cement.
16. ASTM C 207 - Hydrated Lime for Masonry Purposes.
17. ASTM C 270 - Mortar for Unit Masonry.
18. ASTM C 387 - Packaged, Dry, Combined Materials, for Mortar and Concrete.
19. ASTM C 404 - Aggregates for Masonry Grout.
20. ASTM C 476 - Grout for Masonry
21. ASTM C 514 - Water Penetration and Leakage Test to Assess Performance of Integral Water Repellent Admixtures.
22. ASTM C 595 - Blended Hydraulic Cement.
23. ASTM C 778 – Specification for Standard Sand.
24. ASTM C 780 - Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
25. ASTM C 1019 - Method of Sampling and Testing Grout.
26. ASTM C 1072 - Method for Measurement of Masonry Flexural Bond Strength.
27. ASTM C 1093 - Standard Practice for Accreditation of Testing Agencies for Masonry.
28. ASTM C 1329 – Standard Specification for Mortar Cement.
29. ASTM C 1357 – Test Methods for Evaluating Masonry Bond Strength.
30. ASTM D 1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
31. ASTM D 2000 - Classification System for Rubber Products.
32. ASTM D 2287 - Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds.
33. ASTM E 119 - Fire Tests of Building Construction and Materials.
34. ASTM E 447 - Compressive Strength of Masonry Prisms.
35. ASTM E 488 - Strength of Anchors in Concrete and Masonry Elements.
36. ASTM E 518 - Test Method for Flexural Bond Strength of Masonry.
37. American National Standards Institute Building Code requirements.
38. MCAA – Hot and Cold Weather Masonry Construction.

B. The following reference materials are hereby made a part of this Section by reference thereto:

1. UL Fire Resistance Directory.
2. IMI: Masonry Construction Guide Manual.
3. PCA, “Concrete Masonry Handbook”.
4. NCMA applicable TEK Bulletins.
5. NCMA TEK Bulletin Nº. 45 - Removal of Stains from Concrete Masonry Walls.

1.4 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Literature: Manufacturer's product data sheets, performance data, physical properties for each item furnished hereunder.
2. Material certificates: Provide for the following, signed by manufacturer and Contractor certifying that each material complies with requirements.
   a. Each material and grade indicated for reinforcing bars.
3. Material test reports from a qualified independent laboratory employed and paid by Contractor indicating and interpreting test results relative to compliance of the following proposed masonry materials with requirements indicated:
   a. Mortar complying with the property requirements of, and tested in accordance with ASTM C 270.
   b. Grout mixes: Include description of type and proportions of grout ingredients.
   c. Masonry units; report for tests performed within the previous six months.

1.5 QUALIFICATIONS

A. Installer: Company specializing in performing the masonry work of this Section with minimum of 10 years documented experience. Work shall be done by skilled workmen, fully instructed as to the requirements of these Specifications and adequately supervised during the work.

1.6 QUALITY ASSURANCE

A. Single-source responsibility for concrete masonry units: Obtain concrete masonry units for the project from a single manufacturer.

B. Single-source responsibility for mortar materials: Obtain mortar ingredients of uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source and producer for each aggregate.

1.7 REGULATORY REQUIREMENTS

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

1.8 DELIVERY, STORAGE, AND HANDLING

A. General: Do not deliver cement, lime, and similar perishable materials to the site until suitable storage is available. Store such materials in weatherproof structures, and ensure that materials are in perfectly fresh condition when brought for use. Protect masonry units and manufactured products of all types from wetting by rain or snow, and keep covered when not in use.

B. Masonry Face Units: Handle all masonry units carefully in transit and on the site, so as to keep units whole, with edges sharp, and faces clean and undamaged. Deliver all masonry units on pallets; or handle units individually, and properly stack same.

C. Aggregates: Deliver, store and handle aggregate materials so as to prevent contamination with earth or other foreign materials.

1. Store cement, lime and similar products under cover and from direct contact with earth or floor slabs.

D. Manufactured items: Deliver manufactured products in original containers plainly marked with product identification and manufacturer's name.

1. Store metal accessories and the like under cover and from direct contact with ground, and in manner to prevent rust.

E. Damaged material: Remove any damaged or contaminated materials from job site immediately, including materials in broken packages, packages containing water marks, or which show other evidence of damage, unless Architect specifically authorizes correction thereof and usage on project.

1.9 ENVIRONMENTAL CONDITIONS

A. Hot and cold weather requirements shall be in accordance with the recommendations of the Masonry Industry Council as contained in the document "*HOT AND COLD WEATHER MASONRY CONSTRUCTION*" published by the MCAA (Masonry Contractor's Association of America). Enforcement for these requirements shall take place under the following conditions which modify those in the referenced document.

1. The recommended hot weather requirements for 100 degrees Fahrenheit (37.8 degrees Celsius) shall be enforced for this project when ambient temperatures are above 90 degrees Fahrenheit (32.2 degrees Celsius) under all wind conditions including zero velocity.
2. Cold weather requirements shall be enforced when ambient temperatures fall below 40 degrees Fahrenheit (4.4 degrees Celsius).

1.10 COORDINATION

A. Coordinate work with that of other trades which require placement and building-in of, as work progresses, anchor bolts, wood blocking, and anchorage items.

B. Examine all Drawings as to requirements for the accommodation of work of other trades. Provide all required recesses, chases, slots, and cutouts. Place anchors, bolts, sleeves and other items occurring in the masonry work. Take every precaution to minimize future cutting and patching. Closely coordinate the location and placement of such items.

PART 2 - PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. Load bearing hollow and solid, normal weight concrete masonry units: Conform to ASTM C90, Type 1, Class 1, normal weight.

1. Plain-faced units of nominal thickness indicated on the Drawings, nominal 8 by 16 inch face dimension with light gray color and uniform medium-fine texture, sound, true to plane and line, and free from chips, cracks, and other defects.
   a. Types required, wythe (depth) and fire resistant construction rating as indicated on Drawings.
2. Aggregate: sand and gravel: conform to ASTM C 33.
3. Minimum allowable compressive strength for an individual unit of not less than 1700 psi (net area); and not less than 1,900 psi. (net area) for average of 3 units; when tested in accordance with ASTM C 140.

4. Oven dry density: 125 pounds per cubic foot.
5. Moisture content for average of 3 units, when delivered, not exceeding 35 percent of the total absorption, when tested in accordance with ASTM C 140.

B. Concrete masonry grout blocks: Open end high strength concrete masonry units and slot type strength concrete masonry units for use at reinforced concrete masonry construction where indicated on the Drawings. Conform to all requirements specified above for standard concrete masonry units, and the following additional requirements:

1. Plain-faced units of nominal thickness indicated on the Drawings, nominal 8 by 16 inch face dimension with light gray color and uniform medium-fine texture, sound, true to plane and line, and free from chips, cracks, and other defects.

2.2 MORTAR

A. Prepackaged mortar (ready mix) complying with ASTM C 1142, or site-mixed portland cement mortar complying with ASTM C 270 may be used.

1. Admixtures are not permitted except where expressly specified herein or as otherwise approved by Architect for specific field conditions.
2. Color and texture: As selected by the Architect to match approved samples

B. Mortar materials for site mixed mortar:

1. Portland cement for masonry conforming to ASTM C 150, Type I, non-staining, without air entrainment. Use Type III as necessary for laying masonry in cold weather.
   a. For concrete masonry, use white color portland cement
2. Aggregates for grout: Conforming to ASTM C 144 for fine aggregate and ASTM C 404, Size 8 or 89.
3. Aggregate for concrete masonry mortar: Clean, washed uniformly well graded sand conforming to ASTM C 144, with the following gradation, and having a fineness modulus between 2.15 and 2.35:

Sieve Size	Percentage Passing
#4	100%
#8	95 to 100%
#16	70 to 100%
#30	40 to 75%
#50	10 to 35%
#100	2 to 15%
#200	0 to 5%

4. Mortar pigments: Commercial alkali-resistant, non-fading mortar pigments, oxides of iron where feasible, synthetic type, equal to products of
   a. Davis Colors, Beltsville MD.
   b. Solomon Grind-Chem Service, Inc., Springfield IL.
   c. Landers Segal Color, Inc., Passaic New Jersey.
5. Lime: Approved brand of plastic hydrated lime, conforming to ASTM C 207, Type “S”.
6. Water: Clean and fresh without contaminants.

C. Prepackaged mortar (ready mix)

1. General: complying with ASTM C 1142, factory blended consisting of:
   a. Portland cement: Comply with ASTM C 150, Type I.
   b. Hydrated lime: Type S, complying with ASTM C 207.
   c. Aggregate: Provide clean, sharp, well graded aggregate free from injurious amounts of dust, lumps, shale, alkali, surface coatings, and organic matter, and complying with ASTM C144.
   d. Admixtures: Prepackaged mortar mixes contain manufacturer's own proprietary admixtures; additional field admixtures are strictly prohibited.
   e. Water: Provide water free from deleterious amounts of acids, alkalis, and organic materials. Water shall be potable.
   f. Pigments: Chemically inert synthetic iron oxide pigments, lightfast, weather resistant, complying with ASTM C-979.
      1) Mortar Color: As selected by Architect from manufacturer's full range of standard colors.

D. Mortar types: ASTM C 270 Type M or S using the property specification.

2.3 GROUT MIXES

A. Prepackaged grout (ready mix) complying with ASTM C 1107, or site-mixed Portland cement grout complying with ASTM C 476 may be used.

B. Grout: Ready mixed, non-metallic high-strength controlled expansion grout of flowable consistency, conforming to ASTM C 1107 with minimum compressive strength of 8,000 pounds per square inch (55.2 MPa) at 28 days.
   1. Products which may be considered as equal include the following:
      a. Five Star Products, Inc., Fairfield CT, product "Five Star Grout."
      b. L&M Construction Chemicals, Omaha NE, Product: "Crystex."
      c. BASF Construction Chemicals, Cleveland, OH, product "Masterflow 713".
      d. Sika Corporation, Lyndhurst, NJ, product "SikaGrout 212".
      e. ChemMasters, Madison, OH, product "Conset".

C. Grout for engineered masonry (core fill): Course grout having a compressive strength of 2,000 to 2,250 pounds per square inch (13.8 to 15.5 MPa) at 28 days; slump 8 to 10 inches.

D. Grout for bond beams and lintels: Fine grout having a compressive strength of 2,500 to 3,000 pounds per square inch (17.2 to 20.6 MPa) at 28 days; slump 8 to 10 inches.

2.4 REINFORCEMENT AND ANCHORAGE MATERIALS

A. Reinforcing steel, additional to rods which are embedded in concrete: Solid steel reinforcing bars, conforming to ASTM A 615, Grade 60, of sizes indicated on the Drawings.
   1. Recycled content of Steel: Use maximum available percentage of recycled steel. Reinforcing steel incorporated into the work shall contain not less than 60 percent of recycled scrap steel.

2.5 ACCESSORIES

A. Cleaning solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.6 MIXING MORTARS AND GROUT

A. General: Mix mortar and grout in accordance with the requirements of ASTM C270, and ASTM C476 as applicable.

1. Control batching procedure to ensure proper proportions by measuring materials by volume. Amount of mixing water and mortar consistency shall be controlled by mason.
2. Control batch sizes to allow for use within manufacturer's recommended pot life.
3. Retempering will be permitted only within the first two hours of initial mix or shorter times as directed by manufacturers.
4. Discard all mortar and grout which exceeds the time limits allowed by the manufacturer. Discard mortar that has partially set.

B. Maintain sand uniformly damp immediately before mixing process.

C. Add mortar color and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and coloration.

D. Do not use anti-freeze compounds to lower the freezing point of mortar or grout.

E. Pouring grout shall be fluid consistency (as fluid as possible for pouring without separation of constituent parts).

2.7 SOURCE QUALITY CONTROL

A. Preconstruction testing: Except for testing by the Contractor, required as part of this Section, or Section 01 45 29 – TESTING LABORATORY SERVICES, the Owner will employ and pay a qualified independent testing laboratory to perform the following preconstruction testing indicated as well as other inspecting and testing services required by referenced unit masonry standard or indicated herein for source quality control:

1. Concrete Masonry Unit Tests: For each different concrete masonry unit indicated, units will be tested for strength, absorption, and moisture content per ASTM C 140.
2. Mortar composition and properties will be field evaluated per ASTM C 780 for compressive strength, consistency, mortar aggregate ratio, water content, air content, and splitting tensil strength.
3. Grout compressive strength will be tested per ASTM C 1019 for compressive strength and slump.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive the work of this Section.

B. Verify built-in and other items provided by separate Sections of the work are properly sized and located.

C. Verify foundation walls supporting masonry is constructed within tolerances required by code

D. Beginning of installation means acceptance of site conditions.

3.2 PREPARATION

A. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

B. Protect surfaces of windows, door frames, louvers and vents as well as similar finish products with painted and integral finishes from mortar droppings and stains.

3.3 INSTALLATION - GENERAL

A. Leave openings for equipment to be installed before completion of masonry. After installation of equipment, complete masonry to match construction immediately adjacent to the opening.

B. Establish lines, levels and coursing indicated. Protect from displacement.

C. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

3.4 COURSING, BONDS AND JOINTS

A. Coursing, joints and bond pattern: Running bond except as otherwise indicated on the Drawings.

B. Joints:

1. Concealed from view masonry, including masonry which will be concealed by flashings and similar materials: Fill joints with mortar and strike joints flush. Concave tool exterior joints below grade.

3.5 LAYING MASONRY - GENERAL

A. Build the masonry walls and partitions in the various combinations and thickness as indicated on the Drawings.

B. Erect all masonry work in compliance with the line and level tolerances specified herein. Hold uniform joint sizes. Correct, or replace, as directed by the Architect, non-conforming masonry work at no additional cost to the Contract.

C. Lay out coursing before setting to minimize cutting closures or jumping bond, Avoid the use of less-than-half-size units.

D. Laying masonry units:

1. Lay solid masonry units in full bed of mortar, with full head joints; uniformly joint with other work.
2. Lay hollow masonry units with face shell bedding on head and bed joints.
3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
4. Interlock intersections and external corners.
5. Cut all exposed masonry with a motor-driven carborundum blade saw to ensure straight and clean, unchipped edges.
   a. Lay no unit having chipped edges or face defects where such unit would be exposed to view. Remove any such unit, if installed, and replace with

an undamaged unit, and bear all costs therefore.

6. Do not spread any more mortar than can be covered before surface of mortar has begun to dry.
7. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove entirely, clean off mortar, and reset with fresh mortar.
8. Except for cleaning down and repointing, finish all masonry as the walls and partitions are carried up.

E. Build-in reinforcement and anchorage items as the work progresses, grouting for secure anchorage.

F. Provide complete protection against breakage and weather damage to all masonry work, including substantial wood boxing around door jambs, over the tops of walls and wherever necessary to protect work at all stages of completion. Protect masonry when not roofed over, at all times when masons are not working on the walls. Apply tarpaulins or waterproof paper, properly weighted, or nailed, to assure their remaining in place to protect masonry from all possible hazards.

G. Point and fill all holes and cracks in new mortar joints with additional fresh mortar; do not merely spread adjacent mortar over defect or use dead mortar droppings. Do all pointing while mortar is still soft and plastic. If hardened, chisel defect out and refill solidly with fresh additional mortar, and tool or rake joints as specified herein.

H. Protect all masonry from rain prior to, and during the installation thereof. If the temperature is in excess of 80 degrees Fahrenheit at time of installation, lightly moisten contact surfaces of masonry units by brushing with water.

I. Cold/Hot Weather Procedures: No masonry work shall be laid in temperatures below 40 degrees Fahrenheit without the submittal to and review by the Architect of cold weather procedures.

1. In ambient temperatures below 40 degrees Fahrenheit make provisions to adequately protect the masonry materials and the finished work from frost by heating of masonry materials, enclosing the work or heating the enclosed spaces.
2. No frozen work shall be built upon nor shall anti-freeze admixtures be permitted in the mortar mix.
3. Any completed work found to be affected by frost shall be taken down and rebuilt at no additional expense to the Owner.

3.6 ENGINEERED MASONRY

A. Lay masonry units with core cells vertically aligned and clear of mortar and unobstructed.

B. Place mortar in masonry unit bed joints back 1/4 inch from edge of unit grout spaces, bevel back and upward. Permit mortar to cure 7 calendar days before placing grout.

C. Refer to the Drawings for locations where vertical steel reinforcing rods will be required in masonry walls. Reinforce masonry unit cores with reinforcement bars and grout.

D. Retain vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 192 bar diameters. Splice reinforcement as indicated on the Drawings.

E. Wet masonry unit surfaces in contact with grout just prior to grout placement.

F. Grout spaces less than 2 inches in width with fine grout using low lift grouting techniques. Grout spaces 2 inches or greater in width with course grout using high or low grouting techniques.

G. When grouting is stopped for more than one hour, terminate grout 1-1/2 inch below top of upper masonry unit to form a positive key for subsequent grout placement.

H. Low lift grouting: Place first lift of grout to a height of three concrete masonry unit courses, and rod for grout consolidation. Place subsequent lifts in 8 inch increments and rod for grout consolidation.

3.7 BUILDING-IN WORK

A. As work progresses install built-in metal frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates and other items to be built-in the work.

B. Install built-in items plumb and level; take care not to distort alignment of such items.

C. Bed anchors of metal frames in adjacent mortar joints. Fill frame voids solid with grout except where joints are indicated to receive caulking and sealant. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

1. Rake joints to receive sealant to a uniform depth of 3/4 inch for installation of caulking and sealant.

D. Do not build-in organic materials subject to deterioration.

3.8 REINFORCEMENT AND ANCHORAGE

A. Lap reinforcement as indicated on the Drawings.

B. Anchor ends of walls to structure as indicated on the Drawings.

C. Embed anchors in concrete as indicated on the Drawings.

D. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

3.9 FIELD QUALITY CONTROL

A. Field inspection will be performed under the provisions of Division 1 – GENERAL REQUIREMENTS (Section 01 45 00 - QUALITY CONTROL, or Section 01 45 29 – TESTING
LABORATORY SERVICES, as applicable).

B. Testing frequency: Tests and evaluations listed in this article shall be performed during construction for each 5000 square feet of wall area or portion thereof.

C. Evaluation of Quality Control tests: In absence of other indications of noncompliance with requirements, masonry will be considered satisfactory if results from source quality control tests comply with minimum requirements indicated.

3.10 PROTECTION OF WORK

A. Protection of Masonry: During erection, cover tops of walls, projections, and sills with

waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

B. Stain prevention: Provide protection and prevent grout, mortar, and soil from staining the face of exposed masonry and building finishes. Protect base of walls from rain-splashed mud and mortar splatter.

1. Remove immediately all grout, mortar, and, soil that come in contact with such masonry.

3.11 TOLERANCES

A. Maximum variation from true surface level for exposed to view walls and partitions:

1. Unit-to-unit tolerance: 1/16 inch.
2. Surface, overall tolerance: 1/4 inch in 10 feet in any direction and 1/2 inch in 20 feet or more.
   a. Where both faces of single wythe wall or partition will be exposed to view, request and obtain decision from the Architect as to which face will be required to conform to the specified surface level tolerance.

B. Maximum variation from plumb: For lines and surfaces of walls do not exceed 1/4 inch in 10 feet, 3/8 inch in any story up to 20 feet maximum. At expansion joints and other conspicuous lines, do not exceed 1/4 inch in 20 feet.

C. Maximum variation from level: For lines of sills, tops of walls and other conspicuous lines, do not exceed 1/8 inch in 3 feet, or 1/4 inch in 10 feet and 1/2 inch in 30 feet.

D. Maximum variation of linear building line: For position shown in plan relating to columns, walls, and partitions, do not exceed 1/2 inch in 20 feet or 3/4 inch in 40 feet.

E. Maximum variation in specified height: 1/2 inch per story.

F. Maximum variation of joint thickness: 1/8 inch in 3 feet.

G. Maximum horizontally projected unsupported masonry unit: 1-1/8 inches

3.12 CLEANING

A. Comply with requirements of Section 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL for handling and disposition of all construction waste.

B. Progress Cleaning:

1. General: Maintain site free of waste materials, debris, and rubbish resulting from the work of this Section.
   a. Remove from work areas surplus and waste materials resulting from the work of this Section. Remove on a continual on-going basis through-out the term of construction.
2. During the progress of the work, keep the exposed surfaces of masonry clean at all times, and protected against damage. As each segment of the masonry is erected, dry-brush the surfaces free from mortar spots and droppings.

C. Prior to performing the final cleaning work, examine all face joints in exposed masonry to locate cracks, holes or other defects in the mortar; and point up all such defects and fill with mortar as specified herein. Where necessary, in the opinion of the Architect, cut out defective joints in masonry and replace with new materials, exercising extreme care to match original work.

D. At a time approved by the Architect, perform final cleaning operations on all masonry as specified herein.

1. Perform the final cleaning work only when the ambient temperature is above 40 degrees Fahrenheit, and rising.
2. Do not use wire brushes or other abrasive tools in the cleaning operations.
3. Perform final cleaning operations from the top down. If masonry cleaning work is performed after windows, doors, frames, and other work has been installed, provide complete protection for said items; be fully responsible for any damage due to the cleaning operations.
4. Remove large mortar particles by hand with wooden paddles and non-metallic scrape hoes or chisels.
5. Perform final cleaning of masonry units by scrubbing with stiff bristle fiber brushes and clear water, changing the water frequently.

E. Provide suitable protective coverings for all other surfaces and materials during the final cleaning procedures, and bear full responsibility for correcting any damage caused by these operations, to the satisfaction of the Architect.

END OF SECTION

SECTION 05 12 00

STRUCTURAL STEEL 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. Structural steel.

B. Related Sections:

1. Section 014000 "Quality Requirements" for independent testing agency procedures and administrative requirements.
2. Section 055000 "Metal Fabrications" for other metal items not defined as structural steel.
3. Section 055100 "Metal Stairs."

1.3 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Heavy Sections: Rolled and built-up sections as follows:

1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
2. Welded built-up members with plates thicker than 2 inches.
3. Column base plates thicker than 2 inches.

C. Demand Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the Seismic-Load-Resisting System and which are indicated as "Demand Critical" or "Seismic Critical" on Drawings.

1.4 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use ASD; data are given at service-load level.

1.5 ACTION SUBMITTALS

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

B. LEED Submittals:

1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.
2. Laboratory Test Reports for Credit IEQ 4: For primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. Identify members and connections of the seismic-load-resisting system.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.
8. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified fabricator and installer.

B. Welding certificates.

C. Mill test reports for structural steel, including chemical and physical properties.

D. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength bolt-nut-washer assemblies.

E. Source quality-control reports.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. Preinstallation Conference: Conduct conference at Project site.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.9 COORDINATION

A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 - PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than the following:

1. W-Shapes: 60 percent.
2. Channels, Angles-Shapes: 60 percent.
3. Plate and Bar: 25 percent.
4. Cold-Formed Hollow Structural Sections: 25 percent.
5. Steel Pipe: 25 percent.
6. All Other Steel Materials: 25 percent.

B. W-Shapes: ASTM A 992/A 992M.

C. Channels, Angles-Shapes: ASTM A 36/A 36M.

D. Plate and Bar: ASTM A 36/A 36M.

E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

F. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
1. Finish: Galvanized.

G. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.

B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.
2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.

2.3 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.

3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning and SSPC-SP 3, "Power Tool Cleaning."

F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.4 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.5 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.

2.6 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. Ultrasonic Inspection: ASTM E 164.
4. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

C. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

D. Splice members only where indicated.

E. Do not use thermal cutting during erection.

F. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.

B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.

1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E 165.

b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
c. Ultrasonic Inspection: ASTM E 164.
d. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 12 00

SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install:
   1. Soffit support framing.
   2. Universal grid system.
   3. Steel mesh infill.

B. Perform all drilling and cutting in miscellaneous metal items required for the attachment of other items.

C. Perform all shop painting for all surfaces of exposed to view galvanized and non-galvanized metals, and post-erection touch-up of shop prime coat, using the same material as shop- prime coating.

D. Perform application of liquid zinc touch-up to all welds of galvanized steel items furnished hereunder.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - ROUGH CARPENTRY: Wood blocking.

B. Section 09 22 16 - NON-STRUCTURAL METAL FRAMING: Non-loadbearing metal framing systems for interior partitions and ceilings.

C. Section 09 91 00 - PAINTING: Applied finish coatings other than those specified herein.

1.3 REFERENCES

A. Referenced Standards: Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
   1. ASTM A 36 - Structural Steel.
   2. ASTM A 53 – Pipe, Steel, Black and Hot-Dipped, Zinc-coated, Welded and Seamless Steel Pipe.
   3. ASTM A 108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.
   4. ASTM A 123 - Zinc Coatings on Products Fabricated From Rolled, Pressed and Forged Steel Shapes, Plates, Bars, and Strip.
   5. ASTM A 153 - Zinc-Coating on Iron and Steel Hardware.
   6. ASTM A 283 - Carbon Steel Plates, Shapes, and Bars.
   7. ASTM A 307 - Carbon Steel Externally Threaded Standard Fasteners.
   8. ASTM A 325 - Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
   9. ASTM A 361 - Zinc Coated (Galvanized) Iron or Steel Roofing sheets.

10. ASTM A 385 – Providing High Quality Zinc Coatings.
11. ASTM A 386 - Zinc Coating on Assembled Steel Products.
12. ASTM A 446 - Zinc Coated (Galvanized) Steel Sheets of Structural Quality, Coils and Cut Lengths.
13. ASTM A 501 - Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
14. ASTM A 525 - Specification for Sheet Steel, Zinc Coated (Galvanized).
15. ASTM A 780 – Repair of Hot-Dip Galvanizing.
16. ASTM A1011/A1011M - Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High- Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra- High Strength.
17. ASTM B117 Standard Practice for Operating Salt Spray (Fog) Apparatus.
18. ASTM B 209 - Specification for Aluminum Alloy, Sheet and Plate.
19. ASTM B 221 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Shapes, and Tubes.
20. ASTM A 575 Standard Specification for Steel Bars, Carbon, Merchant Quality, M- Grades.
21. ASTM A576 Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
22. ASTM A 653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
23. AGAI - Inspection Manual for Hot-Dipped Galvanized Products.
24. AISC - Code of Standard Practice for Steel Buildings and Bridges.
25. AISC - Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings.
26. AISI referenced standards.
27. AWS - Standard Code for Arc and Gas Welding in Building Construction.
28. FS QQ-A-250d - Aluminum and Aluminum Alloy, Plate and Sheet.
29. MIL-P-21035B - Paint High Zinc Dust Content, Galvanizing Repair (Metric) (superseding DOD-P-21035A)
30. NAAMM, applicable publications.
31. SSPC referenced standards.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Be responsible for establishing locations and levels for all work of this Section, except such parts as may be delivered to others and set by them. In such cases assist them in properly locating said parts.

B. Pre-Installation Meetings: At least two weeks prior to commencing fabrication work of this Section, conduct a pre-installation conference at the Project site. Comply with requirements of Section 01 31 00 - PROJECT MANAGEMENT AND COORDINATION. Coordinate time of meeting to occur prior to installation of work under the related sections named below.

1. Required attendees: Architect, Contractor, Installer's Project Superintendent, and representatives of other related trades as directed by the Architect or

Contractor.

2. Agenda:
   a. Scheduling of metal fabrications operations.
   b. Finish and installation requirements for AESS fabricated components.
   c. Review of staging and material storage locations.
   d. Coordination of work by other trades.
   e. Installation procedures for ancillary equipment.
   f. Protection of completed Work.

C. Sequencing:
   1. Field Measurements:
      a. Take field measurements before preparation of shop drawings and fabrication, where possible, to ensure proper fitting of Work.
      b. Allow for adjustments within specified tolerances wherever taking of field measurements before fabrication might delay Work.

D. Scheduling:
   1. Coordinate the work of this Section with the respective trades responsible for installing inserts and anchorages furnished by this Section; make arrangements for delivery, receipt and installation of inserts and anchorages to prevent delay of the Work.

1.5 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:
   1. Product Data: Manufacturer's complete product data and specifications for all prefabricated items, shop primer paints, liquid zinc coating, and hydraulic cements, to be furnished hereunder.
      a. For epoxy anchoring systems: Furnish ICC-ES Code approvals and performance data that includes recommended loading for each application.
   1. Shop Drawings, bearing registration stamp of a Professional Structural Engineer registered in Commonwealth of Virginia:
      a. Include large scale details of items of all metal fabrications to be furnished hereunder, showing proposed methods of anchorage to surrounding structure and conditions.
      b. Include large scale details of railings.
      c. Include large scale details of metal fabrications supporting work of other trades.
      d. Indicate on the shop drawings all erection marks for various places of miscellaneous metals, and ensure that the actual field pieces bear corresponding marks.
   2. Selection Samples:
      a. Sample card indicating Manufacturer's full range of colors of shop applied finishes available for selection by Architect.
   3. Verification Samples:
      a. Factory/shop finishes: 3 inch by 6 inch samples of factory-applied coatings and colors proposed for use for approval prior to coating application.

b. Provide minimum 24 by 24 inch (or equivalent for shapes) of fabricated and finished ornamental metal components, demonstrating the quality of fabrication work, and finish.

4. Certificates:

a. Certificate of Compliance from Galvanizer: Submit notarized Certificate of Compliance with application for payment for galvanizing, signed by galvanizer, indicating compliance with requirements of specifications. Include scope of services provided, and quantity and itemized description of items processed.

b. Welders certificates as specified under Article entitled “QUALITY ASSURANCE”.

5. Delegated Design Submittals:

a. Provide calculations for loading and stresses for metal railings bearing the Professional Structural Engineer’s seal. Show how design load requirements and other performance requirements as required by the Virginia State Building Code have been satisfied.

B. Closeout Submittals: Submit the following under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS.

1. Special Inspections: Submit prior to request for Certificate of Occupancy, to both Architect and local Building Official having jurisdiction, the following:

a. All certifications, reports and programs required by the Virginia State Building code for work engineered by Contractor’s Professional Engineer under the requirements of this Section.

1.6 QUALITY ASSURANCE

A. General: Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.

1. Galvanizer’s tagging: The galvanizer shall mark all lots of material with a clearly visible stamp or tag indicating the name of the galvanizer, the weight of the zinc coating, and the applicable ASTM Specification Numbers.

B. Qualifications:

1. Fabricator/Installer: Minimum of 5 years documented experience demonstrating previously successful work of the type specified herein, and approved by product manufacturer.

2. Welders: Utilize only qualified welders employed on the Work. Submit verification that Welder’s are AWS D1.1 and D1.4 qualified within the previous 12 months.

3. Licensed Professionals: Provide the services of a Professional Structural Engineer, registered in the Commonwealth of Virginia to design and certify that the work of this section meets or exceeds the performance requirements specified in this section and as required by the Virginia State Building Code.

a. Prepare Shop Drawings for railings under direct supervision of a same Engineer experienced in design of this work.

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:

1. Do not order or deliver any materials until all submittals, required in the listed

Specification Sections included as part of this Subcontract, have been received and approved by the Architect.

B. Storage and Handling Requirements:

1. Handle and store materials under cover in a manner to prevent defacement, deformation, or other damage to the materials and to shop finishes, and to prevent the accumulation of foreign matter on the metal work. All such work shall be repaired and cleaned prior to erection.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: All materials shall be new stock, free from defects impairing strength, durability, or appearance, and of best commercial quality for each intended purpose. Unless specifically called for otherwise, work shall be fabricated from the following:

1. Aluminum: Provide alloy and temper recommended by aluminum producer or finisher for the type of use and finish indicated
   a. Extruded bar and shapes: ASTM B 221, alloy 6063--T6 or alloy 6463--T52.
   b. Extruded pipe and tube: ASTM B 429, alloy 6063-T6.
   c. Drawn Seamless tube: ASTM B 483, alloy 6063-T832.
   d. Plate and sheet: ASTM B209, alloy 6063--T6 or Alloy 3003-H14
2. Steel shapes, plates and bars: ASTM Designation A 36.
3. Steel pipe: ASTM A53, grade A, seamless pipe, black finish unless otherwise noted.
4. Structural steel tubing, square and rectangular shapes: ASTM A500, Grade B.
5. Steel tubular shapes: ASTM A 501.
6. Steel plates to be bent or cold-formed: ASTM A283, grade C.
7. Steel bars and bar-size shapes: ASTM A36.
8. Cold-finished steel bars: ASTM A108.
9. Galvanized carbon steel sheets: ASTM A526, with G90 zinc coating in accordance with ASTM A525.

B. Steel materials: to be hot dip-galvanized: Provide steel chemically suitable for metal coatings complying with the following requirements: Carbon below 0.25 percent, silicon below 0.24 percent, phosphorous below 0.05 percent, and manganese below 1.35 percent. Notify galvanizer if steel does not comply with these requirements to determine suitability for processing.

C. Metal surfaces, general: For metal fabrications exposed to view upon completion of the Work, provide materials selected for their surface flatness, smoothness and freedom from surface blemishes. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.

D. Welding rods: AWS E70XX grade, or select in accordance with AWS specifications for the metal alloy to be welded and in accordance with the recommendation of the welding rod manufacturer.

1. Where stainless steel is welded to mild steel, select rods to minimize dilution effects on the stainless steel component.

2.2 UNIVERSAL GRID SYSTEM

A. Specified Manufacturer: To establish a standard of quality, design and function desired, Drawings and specifications have been based on Unistrut Corporation, Itasca IL.

1. Acceptable Manufacturers and products: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following.
   a. Unistrut Corporation, Itasca IL., product “Unistrut”
   b. Thomas & Betts Corporation, Memphis TN, product “Kindorf Superstrut”.
2. There are no other manufacturers of this product type available in the United States, fabricators may choose to fabricate grid system components using structural steel shapes, with submittal and approval of complete engineering Drawings and calculations as a substitution.
3. Finish:
   a. Rust inhibiting acrylic enamel paint applied by electro-deposition after cleaning and phosphating, and thoroughly baked shall be used at exposed to view grid components. Color is per Federal Standard 595a color number 14109 (dark limit V-). Finish to withstand minimum 400 hours salt spray when tested in accordance with ASTM B 117.
   b. Zinc coated after all manufacturing operations are complete. Coating shall conform ASTM A 123 or A 153.

B. All channel members shall be fabricated from structural grade steel confirming to the following ASTM specifications:

1. ASTM A 653 Grade A

C. All fittings shall be fabricated from steel conforming to one of the following ASTM specifications:

1. ASTM A 36, A 575, or A 576.

D. All materials shall be stamped and identifiable by manufacturer and part number (where appropriate). Materials that appear damaged, distressed, unidentifiable or rusted shall not be used and will not be accepted.

2.3 STEEL MESH INFILL

A. Specified Manufacturer: To establish a standard of quality, design and function desired, Drawings and specifications have been based on McNichols Company, model 3621200048, consisting of the following characteristics:

1. Product type: Plain steel, cold-rolled rectangular mesh.
2. Weight: 0.7 #/SF.
3. Construction type: Welded trimmed.
4. Mesh size 1: 2 inches.
5. Mesh size 2: 1 inch.
6. Opening size 1: 1.8800.
7. Opening size 2: 0.8800.
8. Wire diameter parallel width: 0.1200.

9. LWO parallel to: Width.
10. Percent of open area: 84.
11. Width: 48 inches.
12. Length, (span for grating): 96 inches.
13. SKU type: Sheet.
14. Wire diameter parallel length: 0.1200.
15. Acceptable Manufacturers and products: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following.
    a. McNichols Company, North Billerica, MA.
    b. WireCrafters LLC, Louisville, KY.

2.4 FASTENERS

A. General: Provide all fasteners and attachments as required for work specified herein and as indicated on the Drawings.
   1. In general,
      a. Provide all fasteners and attachments of the same material and finish as the metal to which it is applied unless otherwise noted.
         1) Provide Type 304 stainless-steel fasteners for exterior use.
         2) Provide Type 304 stainless-steel fasteners for fastening aluminum.

B. Steel Bolts, Nuts and Washers: ASTM A307, galvanized to ASTM A153 for galvanized components.

C. Fasteners at blind structural tubes or other blind conditions: Lindaptor North America, Ann Arbor MI, product: “Type HB Hollo-Bolt”, or approved equal.
   1. Acceptable Manufacturers, or approved equal.
      a. Lindaptor North America, Ann Arbor MI.
      b. Simplified Building Components, Rochester NY.
      c. Avdel USA LLC, Stanfield NC.
   2. Head type: Button head.
   3. Material: Stainless steel.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel type 304 bolts, nuts and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.

E. Anchor Bolts: ASTM F 1554, Grade 36.
   1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

F. Eyebolts: ASTM A 489.

G. Machine Screws: ASME B18.6.3.

H. Lag Bolts: ASME B18.2.1.

I. Wood Screws: Flat head, ASME B18.6.1.

J. Plain Washers: Round, ASME B18.22.1.

K. Lock Washers: Helical, spring type, ASME B18.21.1

2.5 ACCESSORIES

A. Adhesive for attaching anchors and for direct pinning: high-modulus, high strength, moisture tolerant, epoxy adhesive. Two-component 100 percent solids, epoxy resin complying with ASTM C 881.

1. Minimum performance properties (as cured at 70 degrees F. and 50 percent relative humidity):
   a. Minimum Compressive Strength, tested per ASTM D-695: 1) at 3 days: 11300 psi (31.0 MPa).
      2) at 7 days: 11800 psi (44.8 MPa).
      3) at 28 days: 12200 psi (58.6 MPa).
   b. Shear Strength, tested per ASTM D-732 at 14 days: 6200 psi (43 MPa)
   c. Minimum Flexural Strength tested per ASTM D-790 at 14 days: 10700 psi (74 MPa).
   d. Minimum Bond Strength tested per ASTM C-882 at 14 days:
      1) Plastic Concrete to Hardened Concrete 2200 psi (13.8 Mpa).
      2) Plastic Concrete to Steel 2000 psi (13.8Mpa).
   e. Maximum Water Absorption, tested per ASTM D-570: 24 hour 0.27%
   f. Minimum Tensile properties tested per ASTM D-638: Tensile Strength 6900 psi (48 Mpa).
2. Products which may be considered as equal include the following:
   a. Sika Corporation, Lyndhurst NJ., product: “Sikadur 32 Hi-Mod Gel.
   b. Simpson Strong Tie, Pleasanton, CA, product “SET High Strength Epoxy”.
   c. Symons Corporation, Des Plaines, IL, product “Rescon Gel anchor 304”.

B. Grout: Ready mixed, non-metallic high-strength controlled expansion grout of flowable consistency, conforming to ASTM C 1107 with minimum compressive strength of 8,000 pounds per square inch (55.2 MPa) at 28 days.

1. Products which may be considered as equal include the following:
   a. Five Star Products, Inc., Fairfield CT, product “Five Star Grout.”
   b. L&M Construction Chemicals, Omaha NE, Product: “Crystex.”
   c. BASF Construction Chemicals, Cleveland, OH, product “Masterflow 713”.
   d. Sika Corporation, Lyndhurst, NJ, product “SikaGrout 212”.
   e. ChemMasters, Madison, OH, product “Conset”.

C. Metal paste filler: 2 component epoxy, high strength, structural adhesive putty:

1. Products which may be considered as equal include the following:
   a. Abatron, Inc. Gilberts IL, product: “Ferrobond-P”.
   b. Dynatron/Bondo Corp., Atlanta, GA, product: “Bondo Plastic Filler”.
   c. U.S. Chemical & Plastics Company., Massillon OH, product “Metal filled epoxy”.

D. Liquid zinc coating, for touch-up of welds, scratches, and abrasions in galvanized steel: Low VOC organic zinc-rich coating containing 92% metallic zinc, by weight in the dried

film (ASTM D520, Type III) and conforming to SSPC Paint 20, Type II, Level 1. Liquid zinc coating shall be recognized under the Component Program of Underwriter's Laboratories, Inc. as an equivalent to hot-dip galvanizing; conforming to MIL-P-21035B and SSPC Paint 29, Type II, Level I, for repair of hot-dip galvanizing and meeting the requirements for Zinc- Rich Paints.

1. VOC limit: not more than 250 g/L.
2. Specified manufacturer and product: ZRC Worldwide, Marshfield MA, product “ZRC- 221”.

E. Primer for non-galvanized steel surfaces, modified alkyd rust-inhibitive, high solids primer:

1. Products which may be considered as equal include the following:
   a. International (Courtaulds Coatings): Interlac 260HS.
   b. Rust-Oleum: 1069 Heavy Duty Rust Inhibitive Red Primer.
   c. Sherwin Williams: Kem Flash Primer HS, Red Oxide E61R702.
   d. Tnemec: 10-99 Red Primer.
   e. Wibur & Williams (California Products Corporation): 1703 Universal Metal Primer.

2.6 FABRICATION - GENERAL

A. Metal surfaces shall be clean and free from mill scale, flake, rust and rust pitting; well-formed and finished to shape and size, true to details with straight, sharp lines, and angles and smooth surfaces. Curved work shall be to true radii. Exposed sheared edges shall be eased.

B. Shop fabricate items wherever practicable, accurately fitting all parts and making all joints tight. Do not fabricate materials until all specified submittals have been submitted to, and approved by, the Architect.

C. Do all cutting, punching, drilling, and tapping required for attachment of anchor bolts and other hardware and for attachment of work by other trades. All such work shall be done prior to hot-dip galvanizing of the various components.

D. Grind all edges of bars and plates completely free from nicks and machine marks, prior to galvanizing and/or shop priming.

E. Grind all exposed-to-view welds completely smooth and flush to the surface plane of the base metals. Perform welding work prior to galvanizing in all cases, except where field welding is necessary, in which case, completely coat all such welds with two coats of specified liquid zinc coating, after performing grinding operations.

F. Use screws and bolts only where welding cannot be performed, of sufficient size to ensure against loosening from normal usage of miscellaneous metal items furnished hereunder.

1. Countersink all screw heads and bolt heads as far as practicable. Use not less than two screw, bolts, or other anchorage items, at each connection point.
2. Draw up all threaded connections tightly, after buttering same with pipe joint compound, to exclude water.

G. Carefully coordinate the installation of metal fabrications with the work of trades responsible for the installation of interfacing work, and for the installation of work into the various assemblies furnished hereunder, and permit the installation of the related

materials to be made at the appropriate times.

H. Fit and assemble metal fabrications in largest practical sections for delivery to site, ready for installation.

1. Galvanized assemblies: Where size of assembly is too large for galvanizing kettle, galvanize components prior to fabrication and assemble after galvanizing.

2.7 FABRICATION - RAILINGS

A. Refer to the Drawings for location and details of steel railings to be furnished and installed hereunder.

1. Verify heights shown in Drawings comply with referenced codes and regulations.

B. Railing performance requirements; conform to all requirements of those codes and regulations referenced under Section 01 41 00 - REGULATORY REQUIREMENTS.

1. Design, fabricate and install all railings in a manner which will ensure the railings will be capable of withstanding loads as follows, required by the International Building Code, Section 1607.

a. Resist a load of 50 pounds per linear foot (0.73 kN/m) applied in any direction at the top and to transfer load through railing supports to structure.

b. Resist a single concentrated load of 200 pounds (0.89kN) applied in any direction at any point along the top, and to transfer load through railing supports to structure.

c. Intermediate rails, balusters and panel fillers shall resist a horizontally applied load of 200 pounds (0.89kN) on an area equal to 1 square foot (.093m2), including openings and space between rails.

C. Fabrication, Railings: Fabricate to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of tube, post spacings, and anchorage, but not less than that needed to withstand indicated loads and deflection criteria. Indicate on shop drawings sizes of all members, gages and configurations of handrails, and guardrails.

1. Fabricate railings with 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.

a. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.

2. Form changes in direction of railings as indicated on drawings, with radius bends of radius indicated. Form simple and compound curves by bending members in 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.

3. Close exposed ends of railing members with prefabricated end fittings.

4. 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 (6 mm) or less.

5. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and

for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

a. Connect posts to stair framing by direct welding unless otherwise indicated.

2.8 FABRICATION - SUPPORTS

A. Design, engineer and fabricate structural overhead support for equipment, furnishings, and products furnished under Sections, which includes, but is not limited to:

1. Equipment furnished under individual specification sections.
2. Owner's furnished equipment.

B. Fabricate support system to carry the entire load of supported products to building structure above without transferring any horizontal or vertical load to ceiling system(s). Provide frequently spaced holes for multiple adjustments. Provide diagonal bracing. Use of a "Universal Grid" system members is acceptable.

C. Fabricate supports for medical equipment and surgical lights utilizing a "Universal Grid" system with rails extending wall-to-wall, perpendicular to the path of travel of the equipment.

1. Design, engineer and fabricate supporting framework to support a concentrated load at any single point along the exposed rails, as exerted by the equipment to be purchased by the Owner.
   a. Installed framework shall have a minimum loading safety factor of 2.5, based upon ultimate strength under static loading conditions.
   b. The concentrated load shall be the maximum that will be encountered by positioning the equipment at the extremities of its travel (maximal load configurations).
   c. Base loads on the most severe conditions as may be encountered by any of the manufacturers producing equipment for the type of services of the rooms indicated.
2. Rail shall be on centers as required by equipment manufacturer and allow continuous attachment along any point on the rail.
3. System shall be true, plumb and level to the tolerances indicated, with no more than 1/720th of the span maximum deflection in either plane, when maximum loading
   Conditions are applied due to equipment operations.

2.9 FINISHES - HOT-DIP GALVANIZING

A. Surface preparation prior to galvanizing: Pickle steel prior to galvanizing in conformance with SSPC-SP8. Remove all rust, dirt, weld flux, weld spatter, and other foreign matter.

B. Hot-Dip Galvanizing: For steel exposed to the elements, weather or corrosive environments and other steel indicated to be galvanized, provide coating for iron and steel fabrications applied by the hot-dip process.

1. Basis-of-Design: "Duncan Galvanizing, Everett, MA, product "Duragalv."
2. Comply with ASTM A 123 for fabricated products and ASTM A 153 for bolts, nuts, washers, and other rough hardware. Provide thickness of galvanizing specified in referenced standards.
3. Wherever possible, perform galvanizing after assembly of items.

4. Galvanized items shall be straightened to remove all warpage and distortion caused by the galvanization process.
5. Fill vent holes after galvanizing (if applicable), and grind smooth.
6. Touch-up all breaks on hot-dip surfaces caused by cutting, welding, drilling or undue abrasion with liquid zinc coating as specified herein above. Apply liquid zinc by brush or spray on all damaged areas in two coats to a total dry film thickness of not less than 3 mils. Apply first coat within two hours after damage to hot-dip film to prevent undue oxidation of exposed surface. On all welds remove weld spatter by power wire brushing or equivalent before applying liquid zinc coating. Repair material should extend at least 3 inches beyond all edges of the damaged galvanized area as possible to assure continuity of galvanic protection.
7. Touch-up of galvanized surfaces with aerosol spray, silver paint, bright paint, brite paint, or aluminum paints is not acceptable.

2.10 FINISHES - SHOP APPLIED COATINGS

A. Schedule: Shop applied coatings as scheduled at end of Section and as indicated on Drawings.

B. For non-galvanized steel surfaces:
   1. Surface preparation prior to priming: Thoroughly clean all steel of all loose mill scale by power wire brushing or sandblasting. Remove all rust, dirt, weld flux, weld spatter, and other foreign matter by wire-brushing or scraping (power wire-brushing, if necessary). Grind smooth any sharp projections.
   2. Shop apply specified primers thoroughly and evenly on the surfaces and worked into the joints and other open areas on the surfaces. Surfaces inaccessible after assembly shall be given two coats. Dry film thickness of primer shall be not less than 2.4 mils per coat.

C. For hot-dipped galvanized steel items scheduled for field applied painted finish:
   1. Touch-up all breaks on hot-dip surfaces caused by cutting, welding, drilling or undue abrasion with liquid zinc coating as specified above under the Article entitle “Hot Dip Galvanizing”.
   2. Factory-Applied Primer over Galvanized Steel: Provide factory-applied prime coat, certified OTC/VOC compliant less than 2.8 lbs/gal. and conforming to EPA and local requirements. Apply primer within 12 hours after galvanizing at the same galvanizer’s plant in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer. Primer coat shall exhibit a rugosity (smoothness) not greater than 4 rug (16-20 microns of variation) when measured by a profilometer over a 1 inch straight line on the surface of architectural and structural elements that are less than 24 pounds per running foot. Profilometer shall be capable of operating in 1 micron increments. Blast cleaning of the surface is unacceptable for surface preparation. Primer shall have a minimum two year re-coat window for application of finish coat. Coatings must meet or exceed the following performance criteria as stipulated by the coatings manufacturer:
      a. Basis-of-Design: Primergalv by Duncan Galvanizing, Everett, MA.
      b. Abrasion Resistance: ASTM D 4060 (CS17 Wheel, 1,000 grams load).1kg load, 200 mg loss.
      c. Adhesion: ASTM D4541, 1050 psi.
      d. Corrosion Weathering: ASTM D5894, 13 cycles, 4,368 hours; rating 10

per ASTM D714 for blistering and rating 7 per ASTM D610 for rusting.

e. Direct Impact Resistance: ASTM D2794, 160 in. lbs.

f. Flexibility: Method: ASTM D522, 180 degree bend, 1 inch mandrel, passes.

g. Pencil Hardness: ASTM D3363, 3B.

h. Moisture Condensation Resistance: ASTM D4585, 100 degrees F, 2000 hours; passes, no cracking or delamination.

i. Dry Heat Resistance: Method: ASTM D2485, 250 degrees F.

3. Touch-up finish in conformance with manufacturer's recommendations. Provide touch- up such that repair is not visible from a distance of 6 feet.

D. For hot-dipped galvanized steel items scheduled for shop applied coating:

1. Touch-up all breaks on hot-dip surfaces caused by cutting, welding, drilling or undue abrasion with liquid zinc coating as specified above under the Article entitled “Hot Dip Galvanizing”, herein above.

2. Finish: Provide factory-applied architectural coating over hot-dip galvanized steel matching approved samples.

a. Basis-of-Design: Duncan Galvanizing, Everett, MA, product “Colorgalv 10”.

b. Primer coat shall be factory-applied. Apply primer within 12 hours after galvanizing and within 3 hours of surface preparation at the same facility where the galvanizing is done in a controlled environment meeting applicable environmental regulations and as recommended by the primer coating manufacturer. Primer must meet or exceed the criteria for the following categories as stipulated by the coatings manufacturer:

1) Abrasion Resistance: ASTM D4060 (CS17 Wheel, 1,000 grams load) 1kg load, 200 mg loss.

2) Adhesion: ASTM D4541, 1050 psi.

3) Corrosion Weathering: ASTM D5894, 13 cycles, 4,368 hours; rating 10 per ASTM D714 for blistering and rating 7 per ASTM D610 for rusting.

4) Direct Impact Resistance: ASTM D2794, 160 in. lbs.

5) Flexibility: Method: ASTM D522, 180 degree bend, 1 inch mandrel, passes.

6) Pencil Hardness: ASTM D3363, 3B.

7) Moisture Condensation Resistance: ASTM D4585, 100 degrees F, 2000 hours; passes, no cracking or delamination.

8) Dry Heat Resistance: Method: ASTM D2485, 250 degrees F.

c. Finish coat shall be factory-applied high performance architectural finish. Apply finish coating at the galvanizer’s plant, in a controlled environment meeting applicable environmental regulations and as recommended by the finish coating manufacturer. Finish must meet or exceed the criteria for the following categories as stipulated by the coatings manufacturer:

1) Abrasion Resistance: ASTM D 4060, CS17 Wheel, 1,000 cycles 1kg load, 87.1 mg loss.

2) Adhesion: ASTM D4541, 1050 psi.

3) Direct Impact Resistance: ASTM D2794, greater than 28 in. pounds.

4) Indirect Impact Resistance: ASTM D2794, 12-14 in. pounds.

5) Dry Heat Resistance: ASTM D2485, 200 degrees F.

6) Salt Fog Resistance: ASTM B117 9,000 hours, rating 10 per ASTM D714 for blistering.

7) Flexibility: ASTM D522, 180 degree bend, 1/8 inch mandrel, passes.
8) Pencil Hardness: ASTM D3363, 2H.
9) Moisture Condensation Resistance: ASTM D4585, 100 degrees F, 1000 hours, no blistering or delamination.
10) Xenon Arc Test: ASTM D 4798, pass 300 hours.

d. Coatings shall be certified VOC compliant and conform to applicable regulations and EPA standards. Apply the galvanizing, primer and coating within the same facility and provide single-source responsibility for galvanizing, priming and finish coating. Blast cleaning of the galvanized surface is not acceptable.

3. Engage the services of a galvanizing facility which will assume single-source responsibility for galvanizing and finish coating.
   a. Touch-up finish in conformance with manufacturer's recommendations. Provide touch-up such that repair is not visible from a distance of 6 feet.
4. Alternate finish: An acceptable alternate to specified “Colorgalv 10” finish; aliphatic acrylic polyurethane enamel shop applied coating system, within 12 hours of galvanizing as follows:
   a. Preparation: Mechanically abrade all surfaces.
   b. Acid etch coat, if recommended by paint manufacturer:
      1) Courtaulds/International Polyvinyl Butyral Primer “Interprime Etch Primer” at
         0.4 to 0.5 mils DFT.
   c. First Coat: (epoxy intermediate)
      1) Courtaulds/International “Intergard 475” at 4.0 to 6.0 mils DFT.
      2) Tnemec Series 27 “F.C. Typoxy” at 4.0 to 6.0 mils DFT.
   d. Second Coat: Aliphatic Acrylic Polyurethane, Gloss Finish
      1) Courtaulds/International “Interthane 870” at 4.0 to 5.0 mils DFT.
      2) Tnemec Series 74 “Endura Shield” at 4.0 to 5.0 mils DFT.

E. For aluminum fabrications: Shop-applied standard electrostatically applied baked enamel coating complying with AAMA 603. Coating shall be applied to 1.5 to 2 mills dry film thickness in color selected from manufacturer’s fully available range.

F. Field touch-up: Shall be the responsibility of the installing contractor and shall include the filling, and touch-up of exposed job made bolt or screw holes, refinishing of raw surfaces resulting from job fitting, repair of job inflicted scratches and marks, and final cleaning up of the finished surfaces.
   1. Touch-up finishes shall be fully compatible with, and exactly match shop applied finish, color, texture and sheen.

PART 3 - EXECUTION

3.1 ERECTION - GENERAL

A. General: Accurately set all work to established lines and elevations, and rigidly fasten in place with suitable attachments to the construction of the building. At the completion of the work, check all work, re-adjust as required, and leave in perfect condition. Grind all exposed to view welds smooth to the touch.

B. Setting bearing and leveling plates:

1. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
2. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
    a. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations, unless otherwise indicated.
    b. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

C. Miscellaneous framing and supports: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and additional requirements indicated on Shop Drawings.
1. Anchor supports for operable partitions, and similar products, securely to and rigidly braced to building structure.

3.2 FIELD WELDING

A. Field weld components indicated on approved shop drawings in accordance with AWS D1.1. Weld profile, quality, and finish shall be consistent with approved samples and mock- ups.
1. Welds ground smooth: . For groove welds, the weld shall be made flush to the surfaces of each side and be within + 1/16”, -0” of plate thickness.
2. Contouring and blending of welds: Where fillet welds are indicated to be ground contoured, or blended, oversize welds as required; grind to provide a smooth transition and to match profile on approved mock-up .
3. Continuous Welds: Where noted on the drawings, provide continuous welds of a uniform size and profile.
4. Minimize Weld Show Through: At locations where welding on the far side of an exposed connection occurs, grind distortion and marking of the steel to a smooth profile with adjacent material.

B. Immediately after welding, touch-up welds, burned areas and damaged surface coatings.
1. Thoroughly remove all spatter by power wire-brushing (or if inaccessible, wire brushing) per SSPC, surface preparation specification SP2 or SP3. Allow surface to cool to ambient temperature. Clean surface with solvent wipe to remove oils, grease and dirt in accordance with SSPC surface preparation specification SP1.
2. Apply one coat of liquid zinc to attain a minimum of 1.5 mils dry film thickness. Coating should extend at least two inches beyond either side of weldment to ensure complete coverage of welded area.

3.3 FIELD BOLTING

A. Accurately drive all bolts into holes, protecting the bolt heads so as not to damage the thread during the driving. Ensure that bolt heads and nuts rest squarely against the metal. Where structural members have sloping flange faces, provide approved beveled washers at the bolted connections to afford square seating for bolt heads or nuts. Nick bolt threads for unfinished bolts to prevent the nuts from backing off.

1. Bolt Head Orientation: All bolt heads shall be oriented as indicated on the contract documents. Where bolt-head alignment is specified, the orientation shall be noted for each connection on the erection drawings. Where not noted, the bolt heads in a given connection shall be oriented to one side.

B. Use an approved calibrated manual or power torque wrench to obtain the proper torque and tension as recommended by the bolt manufacturer for all ASTM A 325 bolts.

3.4 INSTALLATION OF RAILINGS

A. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated, or if not indicated, as required by design loading. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:

1. Anchor posts to steel with steel flanges, angle type or floor type as required by conditions, welded to posts and bolted to steel supporting members.
2. Anchor rail ends to steel with round flanges welded to rail ends and bolted to structural steel members, unless otherwise indicated.
3. Install removable railing sections where indicated in slip-fit metal sockets cast into concrete. Accurately locate sockets to match post spacing.

3.5 TOUCH-UP

A. Touch-up all welds, burned areas, scratches, abrasions, on galvanized metals, using specified liquid zinc coating.

B. Touch-up all welds, scratches, abrasions, and other surface damaged on shop-primed or painted metals, using the same coatings as specified under shop applied finishes, herein above.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install the following:

1. Fire retardant treated plywood backer panels for mounting of electrical panelboards, telephone/data backboards, HVAC and fire control equipment and other equipment.
2. Plywood wall sheathing beneath gypsum wallboard at interior walls and partitions as blocking for wall mounted equipment and products.
3. Various wood blockings, edgings, nailers, curbs, cants, grounds, furring, sheathing, framing members including wood preservative, as required for receipt of various finishes and surfacing materials, not described herein above.
4. Rough installation hardware, including bolts, screws, spikes, nails, clips, and connection assemblies, as needed for installation of the rough carpentry work.

B. Install the following furnished under the designated Sections:

1. Metal door frames furnished under Section 08 11 13 - HOLLOW METAL DOORS AND
FRAMES.
2. Concealed anchorage devices for handicap handrails in toilet rooms: Section 10 81 00 – TOILET ACESSORIES.

1.2 RELATED REQUIREMENTS

A. Section 06 20 00 - FINISH CARPENTRY: Wood trim.

B. Section 07 21 00 - THERMAL INSULATION: Thermal insulation between framing, and vapor barrier.

C. Section 08 11 13 - HOLLOW METAL DOORS AND FRAMES: Furnishing hollow metal framing.

D. Section 09 22 16 - NON-STRUCTURAL METAL FRAMING: Metal framing for drywall construction work.

E. Section 09 29 00 - GYPSUM BOARD: Wallboard construction work, having taped and compounded joint finish.

F. Section 09 91 00 - PAINTING: Applied primer and finish coatings to exposed to view rough carpentry work.

G. Division 26 - ELECTRICAL: Providing and mounting electrical panels and equipment.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive

requirements shall govern.

1. APA - applicable grades and specifications.
2. APA PRB-108 Performance Standards and Policies for Structural-Use Panels.
3. ANSI A250.11 (formerly SDI 105) - Recommended Erection Instructions for Steel Doors and Frames.
4. ASTM D 3201 - Test Method for Hygroscopic Properties of Fire-Retardant Wood.
5. AWPA Standards and references for preservative treated wood including Standards UC1, UC2, UC3A, UC3B, UC4A, and P5
6. AWPA Standard UCFA – Fire Protection as Required by Codes Above Ground Interior Construction.
7. AWPA Standard UCFB – Fire Protection as Required by Codes Above Ground Exterior Construction.
8. AWPA M4 – Care Of Preservative Treated Wood Products.
9. NER-643: ACQ Preserve® and ACQ Preserve Plus® Wood Preservative Treatment, ICBO Evaluation Service.
10. MIL L-1914OE - Lumber and Plywood, Fire Retardant Treated.
11. SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.
12. SPIB Grading Rules, current edition.
13. UL - Building Materials Directory
14. US. Department of Commerce Voluntary Product Standard PS1 for Construction and Industrial Plywood.
15. US. Department of Commerce Voluntary Product Standard PS2 for Wood-Based Structural-Use Panels.
16. US. Department of Commerce Voluntary Product Standard PS-20 - American Softwood Lumber Standard.
17. U.S. Department of Commerce Simplified Practice Recommendation R-16, for sizes and use classifications of lumber
18. American Lumber Standards Committee, National Lumber Grades Authority for Canadian Lumber, and applicable grading rules and standards of the various lumber associations whose species are being used for grades specified.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work of this Section with the respective trades responsible for locating anchorages installed into blocking which is provided under this Section.
2. Coordinate work of this Section with the work of the various trades responsible for applying finish materials and other items to rough carpentry work, and ensure that the work performed hereunder is acceptable to such trades for the installation of their work.

1.5 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Product Data: Manufacturer's product data sheets, specifications, performance data, physical properties and installation instructions for products specified

herein.

2. Certifications:
   a. Written certification from the respective treatment plants indicating types of wood preservative treatment and fire-retardant treatment used, treatments method, applications instructions, and conformance to the requirements specified herein.
      1) Provide certification that fire retardant treatment materials do not contain ammonium phosphate.
      2) Provide report from ICC Evaluation Service on fire retardant treated wood flame spreading, strength, corrosion and hygroscopic properties.
      3) Provide report from ICC Evaluation Service on pressure preservative treated wood strength, corrosion, anti-fungi, and anti-insect properties.

1.6 QUALITY ASSURANCE

A. General: Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.
   1. All lumber shall:
      a. Be new, dressed four sides (S4S), clear and free from warping and other defects.
      b. Have a moisture content not exceeding 19 percent when delivered to the project.
      c. Be in accordance with the grading rules of the lumber manufacturer's association under whose jurisdiction the lumber is produced and bear the mark of grade and mill identification.

B. Certifications:
   1. Plywood: Conform to the requirements of Product Standard PS-1, and bear applicable APA grade trademarks.
      a. Plywood for electrical boards treated for retardance, meet Class I or a flame spread rating of 25 or less and bear U.L. label "Classified FRS".

1.7 DELIVERY, STORAGE AND HANDLING

A. Storage and Handling Requirements:
   1. Protect wood materials from damage due to moisture, direct sunlight, excessive temperatures, surface contamination, corrosion and damage from construction operations and other causes.
   2. Store materials in an elevated dry location, protected by waterproof coverings.

PART 2 - PRODUCTS

2.1 BOARD AND SHEET MATERIALS

A. Lumber for blocking, nailers and curbs as indicated or required: Hem-Fir, Douglas Fir, Eastern Spruce, Eastern Hemlock, or Southern Pine, surfaced dried stud or utility grade. Wood members shall be of sizes indicated on the Drawings or of the

same size as the members being braced.

1. 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. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

B. Furring: Nominal 1 by 3 inches or 1 by 4 inches Douglas Fir, Eastern Spruce, Eastern Hemlock, or Southern Pine, surfaced dried construction grade.

C. Plywood and sheet products:

1. Marine grade plywood: EWA MARINE A-A EXT, fir veneer marine grade plywood, with plugged cores and sanded faces.
2. For substrate beneath gypsum board: Square edge APA graded C-D-X EXT, touch- sanded, 1/2 inch thick, except as otherwise indicated on the Drawings
3. For electric panel board mountings and similar uses: APA graded B-D INT, Group 2 species, touch-sanded, fire-retardant treated, 3/4 inch thick, except as otherwise indicated on the Drawings.
4. For unspecified interior concealed from view locations: APA graded C-D PLUGGED INT, Group 2 species, thickness as indicated on the Drawings.

2.2 WOOD TREATMENTS

A. Treated wood products shall be produced by a single treatment plant, fully licensed by the chemical manufacturers, and conforming to the requirements specified herein.

1. Toxicity and Environmental Quality:
   a. Products containing chromium will not be permitted.
   b. Products containing arsenic will not be permitted.
   c. Fire-retardant-treated wood products shall be free of halogens, sulfates, ammonium phosphate and formaldehyde.
2. Dye wood or otherwise color code all treated wood at treatment plant to clearly distinguish the different treatments in the field.
3. Kiln dry all treated lumber and plywood to the following maximum moisture content after treatment.
   a. Lumber: 19 percent.
   b. Plywood 15 percent.
   c. Discard pieces with defects which might impair quality of work.
4. Quality marks: Each piece of lumber and plywood shall be permanently affixed with a quality mark, containing the following information:
   a. Identification of the inspection agency.
   b. Standard to which material was treated.
   c. Identification of the treating plant.
   d. Fire retardant treated wood shall include: stamp signifying a FR-S rating
   e. Preservative treated wood shall include: Retention and end use for which product is suitable.

B. Fire retardant treated wood. Designated as “FRTW”

1. Chemical Manufacturer: Subject to compliance with the requirements specified herein, Products which may be incorporated in the work include:
   a. Hickson Corporation, product, “Dricon”.
   b. Osmose, Inc., Griffin GA., product “FirePro”.
   c. Hoover Treated Wood Products, Inc., product “PyroGuard”.
   d. Viance, LLC., Charlotte, NC, product: “D-Blaze FRT”.
2. Fire retardant treated wood shall comply with the following requirements:
   a. All fire-retardant lumber and plywood must have an Underwriters Laboratories stamp signifying a FR-S rating certifying a 25 or less flame spread and smoke developed value, when tested in accordance to ASTM E-84, or UBC Standard No. 42-1.
   b. Corrosion rates: Less than one mil per year for carbon steel, galvanized steel, aluminum, copper, and red brass in contact with the fire retardant treated wood when tested in accordance with Federal Specification MIL-L-19140E Paragraph 4.6.5.2.
   c. The fire retardant treated wood must have an equilibrium moisture content of not more than 25 percent when tested in accordance with ASTM D 3201 procedures at 95 percent relative humidity and 80 degrees Fahrenheit.
   d. Fire retardant chemical: Registered for use as a wood preservative by the U.S. Environmental Protection Agency.
   e. Testing: Fire performance and strength properties for both lumber and plywood, of the fire retardant treated wood shall be recognized by issuance of a ICC Evaluation Service Report. Fire retardant chemical must not damage the middle lammella of the wood structure when exposed to 170 degrees Fahrenheit and 90 percent relative humidity for 23 days.

C. Pressure preservative treated wood. Designated as “PT”
1. Chemical Manufacturer: Subject to compliance with the requirements specified herein, Products which may be incorporated in the work include:
   a. Osmose, Inc., Griffin GA., product “NatureWood”.
   b. Universal Forest Products, Inc., Grand Rapids MI., product “ProWood ACQ”.
   c. Viance, LLC., Charlotte, NC., product “Preserve”
2. Treatment: Ammoniacal Copper Quaternary Compound (ACQ), arsenic-free and chromium-free chemical “ACQ Preservative” in accordance with AWPA Standards. Apply the preservative in a closed cylinder by pressure process in accordance with AWPA Standard C15.
   a. Minimum preservative retention for floor plates, framing, lumber and plywood above ground use: 0.25 pounds per cubic foot (4.0 kg/m3) of ACQ chemical, in accordance with AWPA UC1, UC2, UC3A, and UC3B, or NER-643 as appropriate.
   b. Minimum preservative retention for framing, lumber and plywood in contact with water, ground, concrete and masonry: 0.40 pounds per cubic foot (6.4 kg/m3) of ACQ chemical, in accordance with AWPA UC4A, UC4B, UC4C, or NER-643 as appropriate.
   c. Minimum preservative retention for lumber and plywood in permanent wood foundations: 0.60 pounds per cubic foot (9.6 kg/m3) of ACQ chemical, in accordance with AWPA UC4B, or NER-643.

3. Fixation of Chemical: Treated wood shall not be shipped from treatment plant until fixation of the preservative has occurred in the wood.

2.3 ACCESSORIES

A. Adhesives:

1. General: Provide adhesives approved which are Low-VOC or non-VOC, non-flammable, water-proof after cured, odor free.
2. Adhesive for lamination and fabrication of wood and plywood items: Exterior adhesives containing no urea formaldehydes, having a VOC limit of 70 g/L.
3. Adhesive for subfloors and underlayment: High strength, waterproof and non-freezing adhesive complying with AFG-01 “Frozen Lumber Test” and ASTM 3498, and having a VOC limit of 50 g/L.

B. Nails (interior and exterior): Galvanized common nails, of size and type to suit application and as required by state and local building codes.

C. Screws:

1. Screws for interior applications: Flat head electroplated-galvanized wood screws of the appropriate sizes.
2. Screws for exterior applications:
   a. For pressure preservative treated wood: Flat head stainless steel, wood screws, of the appropriate sizes. Aluminum and coated metals are prohibited.
   b. For general application (non-pressure preservative treated wood): Flat head hard aluminum, or stainless steel, wood screws, of the appropriate sizes.

D. Anchor bolts, expansion bolts and lag screws: Hot-dipped galvanized steel, of the following types:

1. For lumber having actual thickness of 1-1/2 inches or greater to masonry and concrete: Anchor bolts or expansion bolts, as most applicable for the specific receiving surface material, 3/8-inch minimum diameter, spaced as shown on drawings, and staggered as far as practicable. Countersink all bolt heads, and provide head washers of matching material.
2. For lumber having actual thickness of greater than 7/8-inch but less than 1-1/2 inches to masonry and concrete: Anchor bolts or expansion bolts, as most applicable for the specific receiving surface material, at least 1/4-inch diameter of the most appropriate lengths for the specific application, spaced as shown, and staggered as far as practicable. Countersink all bolt heads, and provide head washers of matching material.
3. For lumber having actual thickness of 7/8-inch and less: Anchor bolts or expansion bolts, at least 1/4-inch in diameter; or screws, of the most appropriate sizes; in lengths most suitable for the specific application, countersunk, spaced, and staggered.

E. Protection paper: Canadian red-rosen paper or kraft paper.

PART 3 - EXECUTION

3.1 PREPARATION

A. All materials shall be inspected before use, with all checked, split and otherwise deficient stock rejected, or used only for miscellaneous blocking, furring or other incidental use. The Contractor shall be responsible for replacing all lumber which, due to warpage, twist, splitting, or checking, results in unsatisfactory work. Such replacement shall be required at any time, whether before or after application of finish material under other Sections.

B. Verify exact locations of toilet accessories, door stops and similar items with Architect prior to installation of blocking for accessories.

3.2 INSTALLATION - GENERAL

A. Closely coordinate the installation of the rough carpentry work with the work of other trades responsible for the installation of interfacing or overlaying materials, so as not to delay the work of the related trades.

B. Erect all rough carpentry work plumb, level, and true with tight, close fitting joints, securely attached and braced to surrounding construction, all in a first class workmanlike manner. Counterbore for bolt heads, nuts, and washers where required to avoid interference with other materials. Bear complete responsibility for structural integrity, connections, and anchorage of all rough carpentry work.

C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

D. Use as long lengths as practicable for wood nailers, blockings, and curbs, to minimize number of joints, and attach the members with the types, and spacing, of fasteners specified herein.

E. Install blocking, grounds and furring, as required for proper attachment of the work of other trades, in accordance with the requirements provided by the respective related trades.

1. Spacing for furring and strapping shall not exceed 16 inches on center.

F. Field cuts of fire retardant treated lumber: Do not rip or mill fire retardant treated lumber. Only end cuts, drilling holes and joining cuts are permitted.

G. Field cuts of ACQ pressure-treated lumber: Apply solution of copper naphthenate containing a minimum of 2 percent metallic copper in-solution, in accordance with AWPA standard M4. Brush liberally all cuts and holes.

H. Install concealed from view plywood with specified fasteners spaced not more than 10 inches on centers.

I. Install fire-treated plywood backer boards with counter-sunk galvanized fasteners, of specified sizes, spaced not more than 12 inches on centers.

3.3 INSTALLATION – EQUIPMENT BACKBOARDS

A. Provide panel mounting backboards for HVAC, Fire Prevention, Electrical, and telephone/data equipment. Fabricate panels using fire-retardant treated 3/4 inch thick panels mounted to fire-retardant treated 2 by 4's. Provide a nominal space of 3-1/2

inches behind panels to permit wiring.

3.4 TOLERANCES

A. Framing members: Maximum deviation more than 1/4 inch in 10 feet from true or plumb position.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. Furnish and install the following:
   1. Mineral wool blanket insulation.
   2. Spray Foam insulation.
   3. Loose fill mineral wool insulation.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - ROUGH CARPENTRY: Wood blocking, nailers.

B. Section 07 27 16 - SHEET MEMBRANE AIR BARRIERS: Self-adhesive elastomeric sheet membrane air barrier system.

C. Section 09 81 00 - ACOUSTICAL INSULATION: Acoustical batt insulation between framing members.

1.3 REFERENCES

A. Referenced Standards: Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
   1. ASTM C 203 - Breaking Load and Flexural Properties of Block Type Thermal Insulation.
   2. ASTM C 518 - Thermal Transmission Properties by Means of the Heat Flow Meter.
   3. ASTM C 553 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
   4. ASTM C 578 - Preformed Cellular Polystyrene Thermal Insulation.
   5. ASTM C-612 - Mineral Fiber Block and Board Thermal Insulation.
   6. ASTM C665-01e1 Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
   7. ASTM D 1621 - Compressive Properties of Rigid Cellular Plastics.
   8. ASTM E 136 - Behavior of Materials in a Vertical Tube Furnace at 750ºC.
   9. ASTM E 84 - Surface Burning Characteristics of Building Materials.
   10. ASTM E 96 - Water Vapor Transmission of Materials.
   11. All applicable federal, state and municipal codes, laws and regulations for thermal insulation.

B. Definitions:
   1. The term "R-Value" referred to herein refers to the thermal resistance of the insulation alone and does not allow consideration of air spaces or other factors.

1.4 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1.5 Product Data: Manufacturer's product data sheets, specifications, performance data, physical properties for each item furnished hereunder.

1.6 QUALITY ASSURANCE

A. General: Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:

1. Do not deliver items to the site, until all specified submittals have been submitted to, and approved by, the Architect.
2. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B. Storage and Handling Requirements:

1. Store and handle materials following manufacturer's recommended procedures, and in accordance with material safety data sheets.
2. Protect materials from damage due to moisture, direct sunlight, excessive temperatures, surface contamination, corrosion and damage from construction operations and other causes.

C. Damaged material: Remove any damaged or contaminated materials from job site immediately, including materials in packages containing water marks, or show evidence of mold.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or approved equal:

1. Fibrex Insulations Inc., Sarnia, Ontario
2. Thermafiber Inc., Wabash IN.
3. Roxul, Inc., Milton, Ontario. (Formerly Rock Wool Manufacturing Company)

2.2 MATERIAL

A. Mineral-Wool Blanket, Unfaced ASTM C 665, Type I (blankets without membrane facing); consisting of fibers; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

B. Foil-Faced, Mineral-Wool Board Insulation (Type D): ASTM C 612; faced on one side with foil-scrim or foil-scrim-polyethylene vapor-retarder; with maximum flame-spread and smoke-developed indexes of 25 and 5, respectively, per ASTM E 84.

C. Nominal density of 8 lb/cu. ft., Type III, thermal resistivity of 4.35 deg F x h x sq. ft./Btu x in. at 75 deg F

D. Mineral-Wool Loose fill, ASTM C 764, with maximum flame-spread and smoke-developed indexes of 0, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

E. Acoustical batt insulation: Mineral wool fiber insulation batts, conforming to ASTM C665, Type 1, ASTM C612, and ASTM C553 with a nominal density of 2.5 pounds per cubic foot, nominally 3-1/2 inches thick.

F. Spray Polyurethane Foam, Froth-Pak by Dow Chemical Company.

1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   - Flame-Spread Index: 25 or less.
   - Smoke-Developed Index: 350 or less.
2. Fire Propagation Characteristics: Passes NFPA 285 testing as part of an approved assembly.

2.3 ACCESSORIES

A. Staples, tape, adhesives and fasteners required for the proper and complete installation for work of this Section shall be as recommended by each respective manufacturers of each insulation type.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Inspect all surfaces and verify that they are in proper condition to receive the work of this Section.

1. Beginning of installation means acceptance of existing substrate and project conditions.

3.2 INSTALLATION

A. Mineral fiber insulation in exterior wall cavities:

1. Adhere to manufacturer's instructions for conditions of installation.
2. Install full thickness of insulation over the entire surface to be installed as indicated. Ensure tight fit around penetrating elements and abutting construction. All voids and or gaps should be filled, minimizing the potential for thermal bridging. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Install mechanical fastening as per the manufacturer's recommendations, and in conformance with building code.
4. At the completion of a day's work, all exposed edges should be temporary sealed and or lapped by a moisture retardant barrier.
5. Vapor-Retarder-Faced Blankets: Tape joints and ruptures in vapor-retarder facings, and seal each continuous area of insulation to ensure airtight installation.

3.3 CLEANING

A. Clean work under provisions of Section 01 70 00 – EXECUTION.

B. Daily clean work areas by sweeping and disposing of debris, and scraps.

END OF SECTION

SECTION 07 26 00
VAPOR RETARDERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

PRODUCT DATA SHEET 0 - A. Furnish and install the following:

1. Vapor barriers in wall assemblies.
2. Foamed-in-place insulation / air barrier sealant: applied to seal gaps, cracks, cavities and joints in the building envelope, at door frames, perimeter of window frames, and other similar penetrations in exterior walls.

1.2 RELATED SECTIONS

PRODUCT DATA SHEET 1 - Section 02 41 19 – Selective Structure Demolition: Removal of existing partitions, walls and related insulation.

PRODUCT DATA SHEET 2 - Section 06 10 00 – Rough Carpentry: Wood blocking, nailers.

PRODUCT DATA SHEET 3 - Section 07 21 00 – Thermal Insulation: Thermal insulation.

PRODUCT DATA SHEET 4 - Section 09 29 00 – Gypsum BOard: Foil backed gypsum board used as a vapor barrier in exterior walls.

1.3 REFERENCES

PRODUCT DATA SHEET 5 - Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ASTM C 203 – Standard Test Method for Breaking Load and Flexural Properties of Block Type Thermal Insulation.
2. ASTM C 578 - Preformed Cellular Polystyrene Thermal Insulation.
3. ASTM D 570 - Water Absorption of Plastics.
4. ASTM D 1004 - Initial Tear Resistance of Plastic Film and Sheeting.
5. ASTM D 1622 - Apparent Density of Rigid Cellular Plastics.
6. ASTM D 1938 - Tear Propagation Resistance of Plastic Film and Thin Sheeting by a SingleTear Method.
7. ASTM D 1970 - Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
8. ASTM D 2842 - Water Absorption of Rigid Cellular Plastics.
9. ASTM D 2582 - Puncture-Propagation Tear Resistance of Plastic Film and Thin Sheeting.
10. ASTM D 2856 - Open Cell Content of rigid Cellular Plastics by Air Pycnometer.
11. ASTM E 136 - Behavior of Materials in a Vertical Tube Furnace at 750ºC.
12. ASTM E 84 - Surface Burning Characteristics of Building Materials.
13. ASTM E 96 - Water Vapor Transmission of Materials.
14. ASTM E 1745 - Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs
15. ASTM E 154 - Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs
16. ASTM E 1643 - Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs
17. NFPA 701 - Fire Tests for Flame Resistant Textiles and Films
18. All applicable federal, state and municipal codes, laws and regulations for thermal insulation and vapor barriers.

1.4 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 – Submittal Procedures:

1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties for each item furnished hereunder.
2. Manufacturer's installation instructions for placement, seaming and pipe boot installation.

1.5 REGULATORY REQUIREMENTS

A. Obtain certificate of compliance from authority having jurisdiction indicating approval of specified products.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials under cover and in manner to keep them dry, protected from weather, direct sunlight and damage from construction traffic and other causes.

PART 2 - PRODUCTS

2.1 VAPOR BARRIERS WITHIN BUILDING ASSEMBLIES

A. Sheet plastic vapor barrier: Clear polyethylene film, 0.006 inches (6 mil) thick provided in full-wall length and width pieces, without joints, wherever possible.

2.2 FOAMED-IN-PLACE INSULATION

A. Foamed-in-place insulation for air barrier sealant: UL Class I, two component polyurethane self frothing foam insulation equal to Flexible Products Company, product "Froth-Pak" having the following characteristics:

1. Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:
   a. BASF Corp., Polymers Div., Styropar Group, Parsippany NJ.
   b. Flexible Products Company (Division of Dow Chemical)., Marietta GA.
   c. Universal Protective Coatings, San Rafael CA.
2. Product characteristics.
   a. Propellent: HCFC or HFC, No CFC's are permitted.
   b. Apparent Density (ASTM D1622): 1.7 pounds per cubic foot. (with 1.75 pcf HCFC)
   c. Water Absorption (ASTM D2842): less than 2.5 percent water absorbed.
   d. Open cell content (D2856): less than 2 percent.
   e. Apparent aged (18 months) R value: 4.9 per inch.
   f. Flexural Strength, parallel (ASTM C203): 17 to 23 pounds per square inch.
   g. Flexural Strength, perpendicular (ASTM C203): 26 to 42 pounds per square inch.
   h. Flame Spread (ASTM E84): 25 or less (Class 1 rated).
   i. Smoke Developed (ASTM E84): 350 (Class 1 rated), tested for 2 inch depth.

2.3 ACCESSORIES

PRODUCT DATA SHEET 6 - Staples, tape, adhesives and fasteners required for the proper and complete installation for work of this Section shall be as recommended by each respective manufacturers of each type of vapor barrier.

1. Double-stick tape for attachment of vapor barrier: Double coated acrylic closed-cell foam tape, as manufactured by 3M Industrial Specialties Division, 3M Center Building 220-7E,

St. Paul MN 55144, product “Scotch VHB - 4952” having a thickness of 0.045 inches and a width of 1 inch.

PRODUCT DATA SHEET 7 - Building felt: Nº. 15 asphalt impregnated felt.

PART 3 - EXECUTION

3.1 PREPARATION

PRODUCT DATA SHEET 8 - Ensure that subsoil is approved by Architect.

PRODUCT DATA SHEET 9 - Level and tamp or roll aggregate, sand or tamped earth base.

3.2 INSTALLATION - VAPOR BARRIERS WITHIN BUILDING ASSEMBLIES

PRODUCT DATA SHEET 10 - Place vapor and air barrier on warm side of all thermal insulation not scheduled or indicated to be covered by foil faced gypsum board. Attach using commercial grade double stick tape. Lap and seal all sheet joints.

PRODUCT DATA SHEET 11 - Extend vapor and air barrier tight to full perimeter of adjacent window and door frames and other items interrupting the plane of membrane. Tape seal in place.

3.3 INSTALLATION - FOAMED-IN-PLACE AIR BARRIER

PRODUCT DATA SHEET 12 - Foamed-in-place air barrier: Apply foam in froth method to a uniform monolithic density without voids, in accordance with manufacturer's instructions.

1. Apply application of foam for air barrier seal includes, but is not limited to:
   a. Door frames, window frames, and similar penetrations in exterior walls.
   b. Gaps, cracks, cavities and joints in the building envelope, not sealed with other forms of air boots, including electrical boxes and conduit, ducts, fans, and piping.
   c. Where additionally indicated on Drawings.

END OF SECTION

SECTION 07 59 00
CUTTING AND PATCHING MEMBRANE ROOFING

PART 1 - GENERAL

1.1 SUMMARY

A. Partial removal of existing roofing system as required for preparation of new construction.

B. Patch or replace existing roofing where abuts new construction, at flashing and other penetrations occurring through existing roof.

1. Tapered and flat insulation beneath the roofing work of this Section.

C. Repair existing roofing damaged by the work of this Contract.

D. Walkway rolls leading from roof access point to each rooftop mechanical unit and at work areas surrounding rooftop units, or as otherwise indicated on the Drawings.

E. Provide manufacturer's pre-construction and final inspection as required for maintenance of Owner's warranty. These inspections are to be included in the base bid; additional inspections, or work incurred as a result of the final inspection shall be without additional cost to the Owner.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - ROUGH CARPENTRY:

1. Removal and replacement of rotted or damaged existing roof sheathing.
2. Pressure treated blocking, curbing and nailers.

B. Section 07 72 00 - ROOF ACCESSORIES: New roof curbs and equipment supports.

C. Division 22 - PLUMBING: Mechanical system and plumbing penetrations through existing roof.

D. Division 26 - ELECTRICAL; Electrical system penetrations through existing roof.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES.

1. FM Roof Assembly Classifications and Loss Prevention requirements I-28 and I-29S.
2. UL Fire Resistance Directory.
3. All applicable federal, state and municipal codes, laws and regulations for fire- resistance roof ratings.

B. The following reference materials are hereby made a part of this Section by reference thereto:

1. NRCA Roofing and Waterproofing Manual, latest printing.

1.4 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties and installation instructions for all proposed items and schedule indicating locations of all roofing accessories.
2. Shop drawings:
   a. Submit shop drawings showing construction details with specific instructions for attachment and tie-ins.
   b. Indicate roof walkway locations.
3. Review statement: Written statement, signed by the roofing applicator, stating that the Contract Drawings have been reviewed by an agent of the roofing system manufacturer; accompanied by a pre-installation written statement from the manufacturer that the selected roof system is proper, compatible, and adequate for the application shown.
   a. The roofing applicator will notify the Architect and Owner in writing if the existing conditions when exposed are in conflict with the Contract Documents for the proper application of the selected roofing system or the warranty requirements.

B. Submit the following under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS:

1. Manufacturer’s field quality control reports of field inspections, including, revised “as- built” shop drawings and manufacturer’s final punch list.
2. Manufacturer’s warranties: Include coverage of materials and installation and resultant damage from failure of installation to resist penetration of moisture.

1.5 QUALITY ASSURANCE

A. The manufacturer’s authorized representative shall provide a final inspection at the completion of the project to insure, that the project has been completed in accordance with the manufacturer’s warranty requirements. Upon approval and acceptance of the project, an updated manufacturer's warranty certification shall be written, executed and furnished to the Owner.

B. Submit Manufacturer’s field quality control reports of field inspections, including, revised “as-built” shop drawings and manufacturer’s final punch list.

C. All roofing shall be as described in this Section and shall be provided and approved by the existing roof system manufacturer whose warranty is active. Any materials not manufactured or provided by this roofing manufacturer shall have written approval from the roofing manufacturer stating the materials are acceptable and are compatible with the other materials and systems required.

D. The roof system manufacturer’s Technical Specifications shall be considered a part of this specification and should be used as a reference for specific application procedures and recommendations. Where a conflict does exist between the manufacturer’s written specifications and those procedures specified in this Section, the more stringent requirements meeting the Manufacturer’s minimum requirements for the provided warranty shall apply.

1.6 QUALIFICATIONS

A. Roofing applicator, with a minimum of 3 years documented experience demonstrating previously successful work of the type specified herein, and shall be trained and certified by roofing manufacturer of the existing roof system.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver and store all materials in accordance with the manufacturer's recommendations. Protect materials from water and direct sunlight and damage.

B. Distribute any materials stored on roof levels for immediate use to prevent concentrated loads that would impose excessive strain on deck or structural members. Protect roof stored materials to prevent displacement by the wind and protect from exposure to inclement weather and sun.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Do not remove existing roofing when weather conditions threaten the integrity of the building contents or intended continued occupancy.

B. Apply roofing in dry weather; do not install roofing in inclement weather or when precipitation is predicted with greater than 20 percent possibility.

C. Do not apply roofing membrane to damp or frozen deck surface.

D. Apply roofing when ambient temperature is above 40 degrees Fahrenheit.

1.9 WARRANTY

A. Deliver to the Owner upon completion of the work of this Section, a new unconditional warranty on the work of this Section including repairs of existing roof to remain. Warranty shall include the prompt repair of in-place roofing as necessary to prevent penetration of water through it.

1. Warranty shall cover same terms as previous warranty, and include membrane, insulation, adhesives, sealant, fasteners, membrane flashings, and other materials furnished and installed under this Section.
2. Warranty shall cover product quality, performance, and workmanship for a extended period of 20 years from date of Project Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND MATERIALS IN GENERAL

A. Materials shall be provided by manufacturer of existing roofing system, in full compliance with existing valid roofing warranty. Where an existing roofing warranty has expired and is no longer in effect, manufacturers offering products which may be incorporated in the work are limited to, the following:

1. Firestone Building Products Co., LLC, Indianapolis, IN.

2.2 ROOFING MATERIALS

A. Roofing membrane: Fabric reinforced TPO sheet complying with ASTM D 6878, internally fabric- or scrim-reinforced, uniform, flexible TPO sheet, with a nominal thickness of 60 mils.

1. Exposed face color: White.

B. Flashing material: Manufacturer's standard system compatible with flexible sheet membrane.

C. Bonding adhesive shall be as recommended by manufacturer. Adhesive shall be compatible with all materials to which the elastomeric membrane is to be bonded.

D. Insulation materials:

1. Acceptable manufacturers: Subject to acceptance of roofing manufacturer and the following specification requirements:
   a. Pactiv Building Products, Atlanta, GA.
   b. DiversiFoam Products, Rockford, MN.
   c. The Dow Chemical Corp., Midland, MI.
   d. Owens-Corning Roofing Products LLC, Toledo, OH.
2. Extruded polystyrene roofing insulation: Thermal conductivity (K-factor) shall be 0.20 or better. Insulation shall meet or exceed requirements of and ASTM C 578.
   a. Thickness to provide R-value required by Commonwealth of Virginia State Building Code or as indicated on the Drawings.
   b. Compressive strength: 25 psi (ASTM D1621).
   c. Moisture vapor transmission: Less than 1 perm (ASTM E-96).
   d. Water absorption: Less than 0.1 percent per volume (ASTM C272).
   e. Provide tapered insulation system as required to meet elevations and slopes shown on drawings or as required by membrane manufacturer, whichever is more stringent. Provide cants and crickets at drains as necessary.
3. Overlayment (recovery) board: 1/2 inch thick complying with ASTM C 1177 and FM 4450, Class I, non-structural glass mat faced, noncombustable, water-resistant treated gypsum core panel.
   a. Acceptable manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or approved equal:
      1) Georgia-Pacific Building Products, Atlanta, GA, product: “DensDeck Roof Board”.
      2) United States Gypsum Company, Chicago, IL, product: “Securock Glass- Mat Roof Board”.

E. All accessories, including splicing cement, inseam sealant, lap sealant, cutoff mastic, night sealer, elastomeric accessories, nailing strips, cant strips, tapered edge strips, and flashing accessories shall be as recommended by roofing manufacturer.

F. Termination bars: Minimum 1/8 inch thick extruded aluminum, of channel profile with 1/4- inch legs and minimum overall width of 2 inches. Termination bar shall be factory punched to accept fasteners 6 inches on-center. Install with stainless steel screw fasteners.

G. Screws: Steel fastener with fluorocarbon coating. Minimum thread diameter 0.22 inches and minimum shank diameter of 0.172 inches.

H. Masonry fasteners: Round head stainless steel screw and neoprene washer with lead expansion anchor, equal to Rawlplug by the Rawlplug Company, Inc., New Rochelle NY. Other manufacturers offering similar products which may be considered equal, include the following:

1. Dur-O-Wal Inc., Dayton, OH.
2. Hilti Corporation, Tulsa OK.

I. Retro-fitted roof drains: Polycarbonate co-polymer drain body, clamping ring, strainer dome and seam compression ring. Equal to U-Flow Roof Drain Systems, Inc., Buffalo NY., Product: "PC/PET RetroDrain". Other manufacturers offering similar products which may be considered equal, include the following:

1. W.P. Hickman Company, Asheville, NC.
2. Johns Manville Roofing Systems, Denver, CO.

J. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway rolls, approximately 3/16 inch (5 mm) thick, and acceptable to membrane roofing system manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. During the operation of work of this Section, protect the work of other trades against undue soilage and damage by the exercise of reasonable care and precautions. Repair or replace any work so damaged and soiled.

B. Carefully broom clean substrate immediately prior to patching roofing.

C. Where surface joints at roof and wall substrates exceed 1/4-inch width, fill flush with surface with pourable sealer before proceeding with the installation.

3.2 EMERGENCY MATERIALS AND PROCEDURES

A. Maintain continuous temporary protection prior to and during installation of new roofing system. Do not leave unfinished roof areas uncovered over-night or during inclement weather.

3.3 CUTTING AND PATCHING EXISTING ROOFING ASSEMBLY

A. The existing roof is under valid warranty, Contractor shall obtain warranty information from Owner, notify roofing manufacturer of changes to existing roof and request bid list of applicators who are eligible for the work. All materials must be approved by manufacturer for use on this project.

1. Follow local, state and federal regulations, safety standards and codes. When a conflict exists, the more restrictive document shall govern.
2. Follow insurance underwriter's requirements acceptable for use with specified products or systems.

B. Review all special conditions, such as penetrations, projections, tie-ins with existing construction and connections with new construction. Review these conditions with the Roofing Manufacturer, submit the Roofing Manufacturer's recommendations and details to the Architect for approval.

C. Cut and patch existing roofing to accommodate new roof top equipment and penetrations in roofing. Perform cutting and patching of existing membrane roof as required by new construction in accordance with details and specifications of roofing manufacturer.

D. Where penetrations are made through membrane roofing system and existing

insulation is disturbed by new construction, install insulation to match existing roof assembly.

3.4 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Clean roofing membrane and heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.5 FLASHING INSTALLATION

A. Flash all penetrates (pipes, conduits.) passing through membrane. Flash pipe with molded pipe flashings where installation is possible. Where molded pipe flashings cannot be installed, use field fabricated pipe seals. Secure top edge of molded or prefabricated flashing with stainless steel clamping ring.

B. Flashing for ductwork penetrating roof shall be as detailed and shall consist of metal cover flashing over membrane base flashing, attaching directly to ductwork with screws or flashing of prefabricated curbing. Apply sealant in accordance with manufacturer's instructions.

C. Unusual Penetrations: Clusters of pipes and unusual shaped penetrations shall be sealed with Pourable Sealer, 2 inches deep minimum, in a pitch pocket type seal.

D. Molded flashings, prefabricated flashings and membrane base flashings shall be products of the specified manufacturers.

E. Elastomeric Flashings. Provide elastomeric sheet flashings at elastomeric sheet roofing work, as indicated.

1. Use longest practical lengths and widths of elastomeric sheet flashing material to eliminate or minimize joints. Complete splices between flashings and main-roof sheet before bonding flashings to vertical surfaces. Splices shall be sealed 3 inches beyond fasteners that attach membrane to horizontal nailer in same manner as splices within roofing membrane. Flashings shall be bonded 100 percent to subsurfaces except at coves where movement is anticipated.
   a. Install flexible tube at coves where movement is anticipated.
2. Apply bonding adhesive to flashing and surface to which it is being bonded. When bonding adhesive has dried to the point where it does not string or stick to a dry finger touch, roll flashing into adhesive. Do not bridge flashing at changes of direction.
3. Nail top of flashing 12 inches on center under sheet metal copings, counter flashing, and other sheet metal work.

3.6 INSTALLATION - RETRO-FITTED DRAINS

A. Remove any components of the existing drains which prevent the retro-fitted drains from sitting flush with roofing membrane. Ream-out existing roof drain leaders to ensure proper drainage flow.

B. Verify insulation is sloped around drain to permit water drain off.

C. Insert and install drains in accordance with manufacturer’s instructions.

3.7 CLEANING

A. Remove elastomeric adhesive markings from finished surfaces.

B. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their instructions.

C. Repair or replace defaced or disfigured finishes caused by the work of this Section.

3.8 PROTECTION

A. Provide special protection or avoid traffic on completed work. Restore to original condition, or replace, work and roofing materials damaged.

END OF SECTION

SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Formed Products:
   a. sheet metal flashing fabrications.

1.3 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

1. Design Wind Loads: As indicated on structural drawings or as otherwise determined using design wind loads applicable to Project from basic wind speed indicated in miles per hour, according to ASCE 7, Section 6.5, "Method 2-Analytical Procedure."

B. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.

B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:

1. Identification of material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
4. Details of termination points and assemblies, including fixed points.
5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
6. Details of edge conditions, including eaves, ridges, valleys, rakes, crickets, and counterflashings as applicable.
7. Details of special conditions.
8. Details of connections to adjoining work.

9. Detail formed flashing and trim at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of sheet metal flashing, trim, and accessory indicated with factory-applied color finishes involving color selection.

D. Qualification Data: For qualified fabricator.

E. Warranty: Sample of special warranty.

1.5 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.

C. Skilled Workmen - All sheet metal work shall be fabricated and installed by fully trained, qualified sheet metal mechanics properly skilled to perform the Work in accordance with the standards set forth in these specifications. Substandard Work will be rejected.

D. Accepted Flashing Details - In the event field conditions make installation of a flashing detail in accordance with SMACNA or NRCA Details impractical, the Contractor shall submit a shop drawing design to the Owner for approval to fit the particular conditions present.

E. Reference Standards: Except as modified by the Drawings and Specifications, the following documents, or applicable portions thereof, govern the work:

1. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) "Architectural Sheet Metal Manual -Sixth Edition."
2. American Society for Testing and Materials (ASTM).
3. National Roofing Contractors Association (NRCA), “Roofing and Waterproofing Manual”, 5th edition,
4. Sheet Metal Welding Code.
5. ANSI SPRI ES1

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.

B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

1.7 WARRANTY

A. Special Warranty on Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D

4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

B. Prefinished Aluminum Sheet Metal - Conforming to ASTM B209 (UNS Alloy Designation A93003-H14 or A933004-H34), .050" minimum thickness. Exposed aluminum sheet metal shall have a high-performance organic finish, thermo-cured and containing not less than 70 percent polyvinylidene fluoride resin by weight, complying with AAMA 2604. Color: As selected by Architect from manufacturer's full range.

C. Stainless Steel Sheet Metal: ASTM A 240/A 240M, Type 304; No. 2B finish; 24 gage.

D. Galvanized Sheet Metal shall be 24-gauge (unless otherwise noted in the drawings) and shall be hot-dipped galvanized, meeting ASTM A 653.

2.2 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F.
2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F.
3. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
   a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
   b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.
   c. Henry Company; Blueskin PE200 HT.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
   a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
   b. Blind Fasteners: 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 prefinished Aluminum Sheet: Series 300 stainless steel.

3. Fasteners for stainless steel sheet: Series 300 stainless steel.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, non-sag, non-toxic, non-staining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.

F. Epoxy Seam Sealer: Two-part, non-corrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.

1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
2. Obtain field measurements for accurate fit before shop fabrication.
3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.

B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

C. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

D. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant.

E. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

F. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, non-corrosive metal.

G. Fabricate cleats and attachment devices of sizes as recommended by SMACNA's

"Architectural Sheet Metal Manual" and by FMG Loss Prevention Data Sheet 1-49 for application, but not less than thickness of metal being secured.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

I. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

J. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

K. No Dissimilar Metals - In no case, shall dissimilar metals come into contact with each other, nor shall a flashing be constructed in such a way as to permit water from running off one type metal onto another where chemical reaction or corrosion may occur.

L. Do not use graphite pencils to mark metal surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. General: Install underlayment as indicated on Drawings.

B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle-free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight

performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

3. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
5. Install sealant tape where indicated.
6. Torch cutting of sheet metal flashing and trim is not permitted.
7. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.

1. Underlayment: Where installing metal flashing 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. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.

D. Fastener Sizes: Use fasteners of sizes that will penetrate wood sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Seal joints as shown and as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

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 as indicated and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

B. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerances specified in MCA's "Guide Specification for Residential Metal Roofing."

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished

surfaces. Maintain in a clean condition during construction.

E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 72 00
ROOF ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install the following:
   1. Insulation for piping, ductwork and equipment.
   2. Protection membrane.
   3. Pre-manufactured pipe chase housing (doghouse).

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - ROUGH CARPENTRY: Wood curbing, nailers, and blocking.

B. Section 07 59 00 - CUTTING AND PATCHING MEMBRANE ROOFING:
   1. Partial removal of existing roofing system as required for preparation of new construction.
   2. Walkway pads leading from roof access point to each rooftop mechanical unit and at work areas surrounding rooftop units, or as otherwise indicated on the Drawings.

C. Section 09 91 00 - PAINTING: Field painting of roof accessories.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES.
   1. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated by the Hot Dip Process
   2. ASTM B 209 - Aluminum and Aluminum-Alloy Sheet and Plate.
   3. ASTM D 2822 - Asphalt Roof Cement.
   4. ASTM E 85 - Test Method for Surface Burning Characteristics of Building Materials.
   5. UL - Fire Hazard Classifications
   6. FM - Roof Assembly Classifications.
   7. All applicable federal, state and municipal codes, laws and regulations for ratings of roof assemblies

B. The following reference materials are hereby made a part of this Section by reference thereto:
   1. NRCA - Roofing and Waterproofing Manual.
   2. SMACNA - Architectural Sheet Metal Manual.

1.4 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:
   1. Literature: Manufacturer's product data sheets, specifications, performance data,

physical properties for each roof specialty item and related accessories furnished hereunder, include data on shape of components, materials and finishes, anchor types and locations.

2. Manufacturer's installation instructions: Indicate interface with adjacent components, and perimeter conditions.
3. Shop drawings: Indicate configuration and dimension of components, adjacent construction, required clearances and tolerances, and other affected work. Provide details bearing dimensions of actual measurements taken at the project

1.5 QUALITY ASSURANCE

A. Perform work in accordance with NRCA details.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver products in unopened, factory labeled packages. Store and handle in strict compliance with manufacturer's instructions and recommendations. Store under cover and protect from weather damage.

B. Sequence deliveries to avoid delays, but minimize on-site storage time.

C. Store all materials in an elevated dry location, protected by waterproof coverings.

1.7 **PROJECT** CONDITIONS

A. Perform work of this Section when existing or forecasted weather conditions are within the limits established by manufacturers of the materials and products used.

B. Field Measurements: Do not delay job progress, allow for field tolerances.

1.8 WARRANTY

A. Provide 5 year warranty under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS. Warranty shall include repair or replacement of roof accessories which exhibit defects in materials or workmanship. "Defects" is defined as uncontrolled leakage or water and abnormal aging or deterioration.

PART 2 - PRODUCTS

2.1 INSULATION FOR PIPING, DUCTWORK AND EQUIPMENT

A. Description: Flexible, closed-cell elastomeric insulation, form meeting the requirements as defined in ASTM C 534 – "Specification for preformed elastomeric cellular thermal insulation in sheet and tubular form".

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. Armacell Engineered Foams, LLC, Mebane, NC, product: "Armatuff Laminated Insulation, (with the UV protective white laminate)" or approved equal.

2.2 PIPE SUPPORTS

A. Fixed-Height Cradle-Type Pipe Supports: Polycarbonate pipe stand accommodating up to [1-1/2-inch- (38-mm-) diameter pipe or conduit; with provision for pipe retainer and with manufacturer's support pad or deck plate as recommended for penetration-free installation over roof membrane type; as required for quantity of pipe runs and sizes.

B. Miscellaneous individual pipes and conduits not supported on equipment rails

2.3 PROTECTION MEMBRANE

A. Membrane for ice-dam and wind-blown rain protection: Sheet barrier of rubberized membrane bonded to sheet polyethylene, minimum 40 mil (1.13 mm), one total thickness, with strippable treated release paper; having the following minimal characteristics:

1. Minimum tensile strength (tested in accordance with ASTM D 412, Die C modified) of 250 pounds per square inch,
2. Minimum elongation to ultimate failure of 250 percent, and unaffected pliability when tested per ASTM D 146 over 180 degree bend at minus 25 degrees Fahrenheit (- 32ºC.).
3. Minimum adhesion of 3 pounds per inch width (528 N/m), tested per ASTM D903 to plywood.
4. Maximum permeance when tested in accordance with ASTM D96, 0.05 perms (2.9ng/m2sPa).
5. Subject to conformance with the above requirements, acceptable products include the following, or approved equal:
   a. W.R. Grace Company, Cambridge MA., product "Grace Ice & Water Shield".
   b. Nicolon/Mirafi Group, Norcross GA., product “Miridri WIP”.

2.4 PREFORMED FLASHING SLEEVES

A. Pre-molded round boot flashing: 45-mil reinforced UltraPly TPO pipe boot

1. Size: custom size to accommodate structural steel tube
2. Fabrication: Factory welded seams with flange for attaching to existing roofing membrane
3. Color: match existing roof;
4. Location: at steel tubes supporting DSE units

2.5 PRE-MANUFACTURED PIPE CHASE HOUSING

B. Products: Provide the following pre-manufactured pipe chase housing, or approved equal:
   1. Pipe Chase Housing, distributed by Alta Products, LLC. Seattle Washington, John Applegate. (206) 409-1237.

C. Construction: .125” Welded aluminum housing and curb with stainless steel hardware, insulation, integral curb and removable top as indicated on drawings.

D. Size: As indicated on drawings

E. Finish: Powder coated, standard color.

F. Exit Seals: PVC injection molded to schedule-80 performance standards with EDPM gaskets.

2.6 FLEXIBLE WALKWAY PADS

A. Products: provide the following:
   1. UltraPly TPO walkway Pad, W56TPO3024
   2. Size: 30 inches wide x 50 feet long
   3. Thickness: .156 inches

2.7 METAL MATERIALS

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), manufacturer's standard alloy for finish required, with temper to suit forming operations and performance required.
   1. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

B. Aluminum Extrusions and Tubes: ASTM B 221 (ASTM B 221M), manufacturer's standard alloy and temper for type of use, finished to match assembly where used; otherwise mill finished.

C. Stainless-Steel Sheet and Shapes: ASTM A 240/A 240M or ASTM A 666, Type 304.

D. Steel Shapes: ASTM A 36/A 36M, hot-dip galvanized according to ASTM A 123/A 123M unless otherwise indicated.

E. Steel Tube: ASTM A 500/A 500M, round tube.

F. Galvanized-Steel Tube: ASTM A 500/A 500M, round tube, hot-dip galvanized according to ASTM A 123/A 123M.

G. Steel Pipe: ASTM A 53/A 53M, galvanized.

2.8 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. Polyisocyanurate Board Insulation: ASTM C 1289, thickness and thermal resistivity as indicated.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches (38 mm) thick.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

F. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces and verify that they are in proper condition to receive the work of this Section.

B. Beginning of installation means acceptance of existing site conditions.

3.2 INSTALLATION

A. General: Install roof accessories according to manufacturer's written instructions.
   1. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.
   2. Anchor roof accessories 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 accessories 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 accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.
   3. Bed flanges in adhesive compatible with roofing membrane, as required by manufacturers of roof accessories for waterproof performance.

C. Roof Curb Installation: Install each roof curb so top surface is level.

D. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

E. Pipe Support Installation: Comply with MSS SP-58 and MSS SP-89. Install supports and attachments as required to properly support piping. Arrange for grouping of parallel runs of horizontal piping, and support together.

1. Pipes of Various Sizes: Space supports for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

F. Preformed Flashing-Sleeve and Flashing Pipe Portal Installation: Secure flashing sleeve to roof membrane according to flashing-sleeve manufacturer's written instructions; flash sleeve flange to surrounding roof membrane according to roof membrane manufacturer's instructions.

G. Seal joints with elastomeric sealant as required by roof accessory manufacturer.
   1. Flexible walkway pad installation: comply with manufacturers written instructions for adhered installation. Drawings are diagrammatic. Final locations shall be coordinated with rooftop mechanical equipment, roofing seams, drains, and other roof accessories.
   2. Provide additional width at turning points.

3.3 ADJUSTING

A. Test operation of vents and hatches upon completion of the installation. Make any and all adjustments necessary to ensure proper operation.

B. Touch up damaged coatings and finishes.

3.4 CLEANING

A. Remove all labels and packing materials from roof accessories, and thoroughly clean all metal surfaces free from dirt, handling marks, and other foreign matter.
   1. Do not remove UL labels and “Risk of Fall” or other similar warning labels.

B. Upon completion of the work of this Section in any given area, remove tools, equipment and all rubbish and debris from the work area; leave area in broom-clean condition.

END OF SECTION

SECTION 07 84 00
FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install fireproof firestopping, firesafing materials, smoke seals and related accessories required for this Project for all penetrations through fire resistance rated construction, including, but not limited to, penetrations for plumbing, fire suppression, heating, ventilating and air conditioning, electrical systems, and specialized equipment.

1. Fire resistance rated construction requiring firestopping includes, but is not limited to: floors, rated partitions, smoke barriers, smoke partitions, partitions in rated corridors, passageways and stairs, shaft partitions, shaft wall (vertical and horizontal), area separation fire walls, party wall systems, and temporary fire resistant rated partitions and barriers.
2. Provide removable temporary firestopping (pillows) as required to maintain fire integrity prior to Owner's final acceptance, to permit installation of electrical, telephone, data and sound system wiring. Replace temporary firestopping with permanent, after wiring systems are completed.

B. Furnish and install firestopping/smoke seals at construction joints occurring at tops of fire resistance rated partitions, smoke partitions, and temporary partitions between top of partition and underside of deck above.

C. Furnish and install all firestopping, firesafing, and smoke seals at perimeter of floor/roof construction and exterior wall systems, as indicated and where required by applicable codes.

D. Furnish and install all firestopping, firesafing, and smoke seals at expansion joints in chase walls where expansion joints are not exposed to view.

E. Furnish and install all firestopping, firesafing, and smoke seals where required by applicable codes and as additionally required by authorities having jurisdiction at no additional cost to the Owner.

1.2 RELATED REQUIREMENTS

A. Section 01 73 29 - CUTTING AND PATCHING: Procedural and administrative requirements for cutting and patching.

B. Section 09 29 00 - GYPSUM BOARD: Gypsum wallboard fireproofing.

C. Division 21 - FIRE SUPPRESSION: Fire protection system penetrations through fire resistance rated construction.

D. Division 22 - PLUMBING: Plumbing system penetrations through fire resistance rated construction.

E. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING: Heating, ventilating and air conditioning system penetrations through fire resistance rated construction.

F. Division 26 - ELECTRICAL: Electrical penetrations through fire resistance rated construction.

1.3 REFERENCES

A. Referenced Standards: Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ASTM E-84 - Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E-119 - Method for Fire Tests of Building Construction and Materials.
3. ASTM E-814 - Test Method of Fire Tests of Through-Penetration Firestops.
4. NFPA 70 - National Electrical Code.
5. UL - Fire Resistance Directory.
6. UL 1479 - Fire Tests of Through Penetration Firestops.

1.4 PERFORMANCE REQUIREMENTS

A. Provide materials and work to conform to Building Code Requirements in fire resistant wall and floor assemblies.

B. Manufacturer’s certified product test requirements:

1. All firestop/smokeseal material shall be tested by a recognized, independent testing agency and shall conform to both Flame (F-rating) and Temperature (T-rating) requirements of ASTM E-814.
2. All firestop/smokeseal material shall be tested by a recognized, independent testing agency and shall conform to and be listed as compliant with Factory Mutual requirements with an FM Leakage Rating (L-rating) of not more than 7 cu.ft./min./sq.ft.
3. Conform to UL Fire Hazard Classification Requirements.
4. Tested and classified non-combustible per ASTM E-84.

C. Firestops in place shall be of sufficient thickness, width, and density to provide a fire resistance rating at least equal to the floor, wall, or partition construction into which it is installed.

D. Non-combustible dams shall be constructed:

1. As necessary to achieve fire rating as tested and rated.
2. In conformance with installation requirements for type of floor, wall, and partition construction.
3. As recommended by firestop/smokeseal manufacturer.

E. Combustible damming materials, if used, must be removed after proper curing.

1.5 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Product Data: Manufacturer's product data sheets, specifications, performance data, and physical properties.
   a. Indicate requirements for manufacturer’s descriptive data for products and

related materials with FM, UL or Warnock-Hersey illustrations showing systems and approval of materials in systems.

2. Certificates: Manufacturer's written certification stating that firestopping materials, meet or exceed the requirements specified under this Section and that all fire-resistive

requirements for the indicated combustibility, Flame (F-rating) and Temperature (T- rating) Ratings have been met.

3. Manufacturer's installation instructions.
4. Test reports: Submit fire test reports from recognized, independent testing agent(s) indicating the following:
   a. Fire test report of firestop material applied to substrate and penetration materials similar to project conditions. Tests to indicate both Flame (F-rating) and Temperature (T-rating) Ratings.
   b. Test reports of products to be used shall indicate conformance to ASTM E-814.
5. On-site sample installation to be included in Work: Minimum thirty days prior to application in any area, provide samples of firestop and smokeseal materials and installation in accordance with the following requirements.
   a. Apply one sample of appropriate firestop and smokeseal material for each different penetration and fire rating required for the work.
   b. Sample areas will comply with thickness, fire resistance ratings, and finished appearance of the project and applicable fire code.
   c. Acceptance samples will constitute standard of acceptance for method of application, thickness, and finished appearance for firestop and smokeseal application. The sample(s) shall remain visible during completion of the work and shall remain as part of the completed work.
6. Shop drawings indicating requirements for penetrations in wall/deck intersections, change of planes, control joints, expansion joints and blank openings.

1.6 QUALITY ASSURANCE

A. General: Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.

B. Sole Source: Obtain firestop and smokeseal products from a single manufacturer, except as otherwise approved by Architect.

C. Environmental Requirements for Volatile Chemicals: Use firestopping caulks that comply with the following limits for VOC content:
   1. Firestopping caulks: VOC not more than 250 g/L.

D. Special Inspections: Allow for 3 percent of each type of firestopping system to be removed and inspected for conformance with approved submittals.
   1. All firestopping shall be inspected prior to installation of suspended ceilings or concealed by other materials.

E. Qualifications:
   1. Installer: a specialized subcontractor having not less than 3 years documented experience demonstrating previously successful work of the type specified herein.
      a. The manufacturer of the firestop material shall submit written certification that the firm to be used for the firestop products has been trained in the

application of the products by the manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver and store firestopping materials in original, sealed, packages showing manufacturer's identification and date of packaging.

B. Store and handle materials following manufacturer's recommended procedures, and in accordance with material safety data sheets.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering similar products include the following:

1. Bio Fireshield (A Division of Rectroseal), Houston TX.
2. Dow Corning Corporation, Midland MI.
3. Hilti, Inc. Tulsa OK.
4. 3M Company, Saint Paul MN.
5. Specified Technologies, Inc., Somerville NJ.
6. Metacaulk, (A Division of Rectroseal), Houston TX.
7. Tremco, Inc., Beachwood OH.

2.2 REGULATORY REQUIREMENTS

A. Conform to applicable code for fire resistance ratings and surface burning characteristics.

B. Obtain certificate of compliance from authority having jurisdiction indicating approval of combustibility.

C. All firestoppping products shall be listed as FM Approved and where applicable comply with an FM Leakage Rating (L-rating) of not more than 7 cu.ft./min./sq.ft.

2.3 MATERIALS

A. Firestop mortar: asbestos free, cementitious mortar, U.L. classified as a "fill, void, or cavity material" for through penetration firestop system when tested in accordance with ASTM/UL1479.

1. Acceptable products, or approved equal:
   a. Bio Fireshield, product “Bio K-10+ Fire Rated Mortar”.
   b. Specified Technologies, Inc., product “Spec Seal Mortar”.
   c. Tremco Inc., product “Tremstop M”.

B. Silicone Firestop sealant: Single component, non-combustible silicone elastomer firestop sealant, U.L. classified as a "fill, void, or cavity material" for through penetration firestop system when tested in accordance with ASTM E-814/UL1479.

1. Acceptable products, or approved equal:
   a. Bio Fireshield, product product “Biotherm 100" (Gun Grade) or “Biotherm 200" (Self Leveling).
   b. Specified Technologies, Inc., product “Spec Seal Pensil 300 Sealant (gun grade)” or “Spec Seal Pensil 300SL" (Self Leveling).

c. 3M Company, product “Fire Barrier Silicone Sealants”.

d. Tremco Inc., product product “Tremsil" (Gun Grade) or “Tremsil S/L" (Self Leveling).

2. Sealants will not dissolve in water.

C. Intumescent firestop sealant and caulks: Acrylic based, water resistant sealant, which will not re-emulsify after drying.

1. Acceptable products, or approved equal:

a. Bio Fireshield, product “Biostop 500".

b. Specified Technologies, Inc., product “Spec Seal Triple-S Sealant".

c. 3M Company, product “Fire Barrier Caulk CP25WB+".

d. Tremco Inc., product “Tremstop 1A".

D. Firestop putty: sticks or pads.

1. Acceptable products, or approved equal:

a. Bio Fireshield, product “Moldable Putty”.

b. Specified Technologies, Inc., product “Spec Seal Putty Bars and Pads”.

c. 3M Company, product “Fire Barrier Moldable Putty”.

d. Tremco Inc., product “Flowable Putty”.

E. Firestop collars: Pre-manufactured fire protective pipe sleeve, UL classified as "fill, void, or cavity material" for through penetration firestop system when tested in accordance with ASTM E-814/UL1479.

1. Provide separated (two piece) firestop collar for application when plastic pipe system is already in place. Provide non-separated firestop collar for application prior to installation of plastic pipe system.

2. Acceptable products, or approved equal:

a. 3M Company, Inc., product “Fireshield Firestop Sleeve”.

b. Specified Technologies, Inc., product “Spec Seal Collars”.

c. 3M Company, product “Fire Barrier PPD’s”.

d. Tremco Inc., product “Fyrecan sleeve”.

F. Firestop pillows: UL Classified as "fill, void, or cavity material" for through penetration firestop system when tested in accordance with ASTM E-814/UL1479.

1. Acceptable products, or approved equal:

a. Bio Fireshield, product “Fireshield Firestop Pillows”.

b. Specified Technologies, Inc., product “Spec Seal Pillows”.

c. Tremco Inc., product “Tremstop P.S”.

G. Wrap strips:

1. Acceptable products, or approved equal:

a. Bio Fireshield, product “FS-195”.

b. Specified Technologies, Inc., product “Spec Seal Wrap Strip”.

c. 3M Company, product “Fire Barrier FS195 Wrap Strip”.

d. Tremco Inc., product “Tremco W.S”.

H. Mineral wool fiber / ceramic wool non-combustible insulation (fire safing): Conforming to ASTM C665, Type 1, ASTM C612, and ASTM C553 with a minimum density of 4 pounds per cubic foot.

1. Flame Spread Classification: Material shall be classified non-combustible per ASTM E-814.
2. Recycled content of slag: Use maximum available percentage of material (slag). Mineral wool insulation products incorporated into the work shall contain not less than 75 percent of recycled material (slag) by weight.
3. Acceptable products include:
   a. Fibrex Insulations Inc. Sarnia Ontario, Canada, product: “Fibrex FBX” Industrial board.
   b. Rock Wool Manufacturing Company, Leeds, AL, product: “Delta Safing Mineral Wool”.
   c. Roxul, Inc., product “Roxul Safe”.
   d. Thermafiber, Inc. product “Safing 4.0 pcf”.
4. Accessories: Provide galvanized steel safing clips as required for installation of insulation.

I. Elastomeric Firestopping: Non halogenated latex based elastomeric coating applied by airless spray.

1. Acceptable products, or approved equal:
   a. Specified Technologies, Inc., product “Spec Seal Elastomeric Firestop Spray”.
   b. Bio Fireshield (A Division of Rectroseal), product “Flamesafe FS900+”
   c. Hilti, Inc., product “CP 601S.”

2.4 ACCESSORIES

A. Forming and damming materials: Mineral fiberboard or other type as recommended by firestopping manufacturer.

B. Primer, sealant and solvents: As recommended by manufacturer.

C. Woven wire mesh: Galvanized 20 gage woven wire mesh “chicken wire” or “poultry fencing”, 1 inch spacing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Inspect areas and conditions where firestops are to be installed and notify the Architect of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.

1. Beginning of installation means acceptance of existing substrate and project conditions.

3.2 PREPARATION

A. Surface to receive firestops shall be free of dirt, dust, grease, oil, form release agents, or other matter that would impair the bond of the firestop material to the substrate or penetrating item(s).

B. Voids and cracks in substrate shall be filled and unnecessary projection removed prior to installation of firestops.

C. All penetrating items shall be permanently installed prior to firestop installation.

D. Substrate shall be frost, free and, when applicable, dry.

3.3 INSTALLATION

A. General

1. Installation of firestops shall be performed by applicators/installers qualified and trained by the manufacturer. Installation shall be performed in strict accordance with manufacturer's detailed installation procedures.
2. Apply firestops in accordance with fire test reports, fire resistance requirements, acceptable sample installations, and manufacturer's recommendations. Meet building code requirements.
3. Coordinate with plumbing, mechanical, electrical, and other trades to assure that all pipe, conduit, cable, and other items which penetrate fire rated construction have been permanently installed prior to installation of firestops. Schedule and sequence the work to assure that partitions and other construction which would conceal penetrations are not erected prior to the installation of firestops.
   a. Ensure that all firestopping is inspected prior to installation of suspended ceilings or concealed by other finished materials.

B. Dam construction

1. Install dams when required to properly contain firestopping materials within openings and as required to achieve required fire resistance rating. Combustible damming material must be removed after appropriate curing. Incombustible damming material may be left as a permanent component of the firestop system.
2. Placement of dams shall not interfere with function or adversely affect the appearance of adjacent construction.

C. Installation of single component silicone firestop

1. Apply with manual or powered caulking gun.
2. Apply minimum 1/2 inch thickness for 2 hour rating. Apply 1/2 inch to both sides of wall penetrations; one side only in floor penetrations.
3. Use incombustible insulation as required to achieve fire resistance rating.
4. Surface of gun grade silicone firestop may be tooled using clean, potable water.
5. Clean excess material off of adjacent surfaces and tools within 10 minutes using either water or Xylol where the use of such would not be hazardous.

D. Installation of cementitious firestop mortar.

1. Add dry powder to water and mix with mechanical mixer or hand mixing tools as recommended by firestop mortar manufacturer. Allow a average mixing time is 3 minutes and provide a average wet density of 70 pounds per cubic foot, plus or minus 5 PCF.
2. Do not apply if ambient or substrate temperature is less than 35 degrees Fahrenheit during 24 hours after application.
3. Wet all surfaces prior to application of firestop mortar.
4. Mortar may be hand applied or pumped into the opening.
5. Exposed surfaces shall be finished using conventional plastering tools prior to

curing.

6. When installation around layered cables, it is recommended to increase the fluidity of the firestop mortar to provide a better fill around the cables. Vibrate or move the cables slightly to prevent voids from forming between the cables.
7. Allow 48 hours for initial cure prior to form removal. For full cure allow 27 days.
8. Wet material may be cleaned with water. Dry material may require scraping or chipping.

E. Installation of firestop collars (plastic pipe only)

1. Firestop collars may be surface mounted to a slab or wall or imbedded in Firestop Mortar to a maximum depth of 2 inches.
2. For wall penetrations with ABS pipe firestop collars must be installed on both sides of the penetration to provide a 2 hour F and T Rating. All other applications required installation on one side only to provide a 2 hour F and T Rating.

F. Firesafing insulation: Install firestopping safing insulation on safing clips spaced as needed between each stud and floor slab, leaving no voids. Secure safing clips to slab using fasteners recommended by insulation manufacturer. Install sealant over mineral wool in accordance with test requirements.

3.4 LABELING

A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems.

1. Include the following information on labels:

WARNING: THROUGH-PENETRATION FIRESTOP SYSTEM-DO NOT DISTURB. NOTIFY FACILITY MANAGER OF ANY DAMAGE.

- *Contractor's name, address, and phone number.*
- *Through-penetration firestop systems designation of applicable testing and inspecting agency.*
- *Date of installation.*
- *Through-penetration firestop systems manufacturer's name.*
- *Installer's name.*

3.5 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.

1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.

B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.

C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

3.6 SCHEDULE

A. General: Typical penetrations are indicated below with list of standard firestopping/smokeseal approaches. Actual firestopping materials and combination of materials will vary with size of penetration and with individual firestopping manufacturer's approved UL Design System Requirements. Use only UL Design System materials for each penetration that best matches the wall and floor construction.

1. Where penetrations occur for which no listed UL or WH Design System test exists, obtain from the firestop system manufacturer an engineered system acceptable to the authorities having jurisdiction for firestopping such penetrations. Engineered system

   from manufacturer shall include a detail drawing showing the engineered system and shall contain no disclaimers.

B. Single metal pipe (non-insulated) and conduit penetrations through floors:

1. Firestop mortar.
2. Silicone Firestop sealant.
3. Intumescent firestop sealant.
4. Firestop putty, sticks or pads.
5. Mineral fiber / ceramic wool non-combustible insulation (fire safing) in conjunction with a firestop sealant.

C. Single metal pipe (non-insulated) and conduit penetrations through walls:

1. (masonry and concrete walls only) Firestop mortar and putty.
2. Intumescent firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing).
3. Intumescent firestop sealant with wrap strips.

D. Multiple metal pipe and conduit penetrations through floors:

1. Firestop mortar and wrap strips.
2. Intumescent firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing).

E. Multiple metal pipe and conduit penetrations through walls:

1. Firestop mortar and putty.
2. (through masonry walls only) Firestop pillows with woven wire mesh.
3. Silicone Firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing).

F. Insulated metal pipe penetrations through floors:

1. Firestop mortar and wrap strips.
2. Silicone Firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing).
3. Intumescent firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing).
4. Silicone Firestop sealant over wrap strip.
5. Mineral fiber / ceramic wool non-combustible insulation (fire safing) in conjunction with a firestop sealant.

G. Insulated metal pipe penetrations (single and multiple) through walls:

1. Firestop mortar with wrap strips.
2. Intumescent firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing).
3. Intumescent firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing) and Wrap strips.
4. (multiple penetrations through masonry walls only) Firestop pillows with woven wire mesh.

H. Duct penetrations through floors or walls:

1. Rectangular and square ducts: Intumescent firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing), and steel flanges provided under Division 15.
2. Round ducts: Intumescent firestop sealant over mineral fiber / ceramic wool non- combustible insulation (fire safing).

I. Combustible plastic pipe and conduit penetrations through floors:

1. Firestop mortar with wrap strips.
2. Firestop mortar with firestop putty and firestop collars.
3. Silicone firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing).
4. Silicone firestop sealant and firestop collars.
5. Intumescent firestop sealant and firestop collars.
6. Intumescent firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing) with firestop collars.
7. (maximum pipe size 2 inches) Intumescent firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing) with wrap strips.

J. Combustible plastic pipe and conduit penetrations through walls:

1. Intumescent firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing).
2. Intumescent firestop sealant with firestop collars.

K. Cable penetrations through floors:

1. Silicone Firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing).
2. Intumescent firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing).

L. Cable penetrations through walls:

1. Silicone Firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing).
2. Intumescent firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing).
3. (single penetrations only) Firestop putty.
4. (electrical boxes) Firestop pads.
5. Firestop putty over mineral fiber / ceramic wool non-combustible insulation (fire safing).

M. Cable tray penetrations:
   1. (floors only) Firestop mortar.
   2. Firestop pillows with woven wire mesh containment, and Firestop putty, sticks or pads for filling voids.
   3. Firestop pillows with woven wire mesh containment, and Firestop mortar at perimeter and firestop putty, sticks or pads for filling voids.

N. Bus ducts through floors:
   1. Firestop mortar and wrap strips.
   2. Intumescent firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing) and 28 gage (minimum) steel cover plate.

O. Blank openings:
   1. Firestop mortar.
   2. Silicone Firestop sealant over mineral fiber / ceramic wool non-combustible insulation (fire safing).

P. Fire rated joints:
   1. Silicone Firestop sealant over backer rod or bond breaker.

Q. Construction joints at head of wall/floor assemblies:
   1. Silicone Firestop sealant/mastic over mineral fiber / ceramic wool non-combustible insulation (fire safing).
   2. Elastomeric spray over mineral fiber / ceramic wool non-combustible insulation (fire safing).

R. Smoke barrier sealant for dampers, fire door frames:
   1. Silicone Firestop sealant.

S. Temporary sealing of openings and penetrations:
   1. Firestop putty, sticks or pads.
   2. Firestop pillows.

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. General:

1. This Section specifies general requirements, definition of joint sealer types, and application requirements for sealant work specified within other individual specification sections.

B. Prepare sealant substrate surfaces.

C. Furnish and install sealant and backing materials.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - ROUGH CARPENTRY.

B. Section 07 84 00 - FIRESTOPPING: Firestopping sealants and related backing materials.

C. Section 08 80 00 - GLAZING: Sealant used in conjunction with setting glass.

D. Section 09 29 00 - GYPSUM BOARD: Application of concealed acoustical sealant used in conjunction with gypsum board work at abutting surfaces (perimeter of partitions and walls).

E. Section 09 91 00 - PAINTING: Caulks used in preparation of applied finish coatings.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ASTM C 717 - Standard Terminology of Building Seals and Sealants.
2. ASTM C 790 – Guide for Use of Latex Sealants
3. ASTM C 804 - Use of Solvent-Release Type Sealants.
4. ASTM C 834 - Latex Sealing Compounds.
5. ASTM C 919 - Use of Sealants in Acoustical Applications.
6. ASTM C 920 - Elastomeric Joint Sealants.
7. ASTM C 962 - Use of Elastomeric Joint Sealants.
8. ASTM C 1193 - Guide for Use of Joint Sealants.
9. ASTM C 1247 - Standard Test Method for Durability of Sealants Exposed to Continuous Immersion in Liquids.
10. ASTM D 1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
11. ASTM D 3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings
12. FS TT-S-00227E - Sealing Compound: Elastomeric Type, Multi-Component.

13. FS TT-S-00230C - Sealing Compound: Elastomeric Type, Single-Component.
14. FS TT-S-001543A - Sealing Compound, Silicone Rubber Base.

B. The following reference materials are hereby made a part of this Section by reference thereto:

1. SWRI – Sealant and Caulking Guide Specification.

1.4 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Product Data: Manufacturer's product data sheets, specifications, performance data, chemical and physical properties and installation instructions for each item furnished hereunder.
2. Selection Samples: Sample card indicating Manufacturer's full range of colors available for selection by Architect.
3. Verification Samples: 12 inch long samples of sealant for verification of color, installed where directed by Architect.
4. Certificates: Manufacturer's certification that the Products supplied meet or exceed specified requirements.
5. Test and Evaluation Reports:
   a. Compatibility and adhesion test reports: Test reports from sealant manufacturer indicating that sealant proposed for use have been tested for compatibility and adhesion with actual samples of substrates to be used on this project. Include sealant manufacturer’s interpretation of test results, and recommendations for primers and substrate preparation specific to this Project.

B. Closeout Submittals: Submit the following under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS.

1. Bonds and Warranty Documentation: Manufacturer’s standard Warranties and Guarantees.

1.5 QUALITY ASSURANCE

A. General: Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.

B. Sole Source: Provide sealants from a single manufacturer for all work of this Section to the greatest extent possible. Each individual type of sealant installed in the Work shall be from a single manufacturer.

C. Qualifications:

1. Installer/Applicator: Minimum of 3 years documented experience demonstrating previously successful work of the type specified herein.

1.6 DELIVERY, STORAGE AND HANDLING

A. Each container and package must bear an unbroken seal, test number and label of the manufacturer upon delivery to the site. Failure to comply with these requirements shall be sufficient cause for rejection of the material in question, by the Architect and his requiring its removal from the site. New material conforming to said requirements shall be promptly furnished at no additional cost to the Contract.

1.7 SITE CONDITIONS

A. Do not install single component solvent curing sealant in enclosed building spaces.

B. Environmental Requirements: Maintain temperature and humidity recommended by the sealant manufacturer during and 24 hours after installation. Do not proceed with installation of joint sealers under the following conditions:

1. When ambient and substrate temperature conditions are below 40 degrees F.
2. When joint substrates are wet due to rain, frost, condensation, or other causes.

C. Do not proceed with installation of joint sealers until contaminates capable of interfering with their adhesion are removed from substrates.

1.8 WARRANTY

A. Provide 5 year warranty under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS. Warranty shall include coverage of installed sealant and accessories which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Specified Manufacturers and Products: To establish a standard of quality, design and function desired, Drawings and specifications have been based on the products specified under this section for each individual sealant type, for the applications scheduled at the end of Section, and as may be additionally identified on the Drawings.

B. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or approved equal:

1. BASF Construction Chemicals (Sonneborn), Shakopee MN.
2. Chem Link Inc., Schoolcraft, MI.
3. Dow Corning Corporation, Midland MI.
4. Momentive Performance Materials (GE Silicones), Waterford NY.
5. Pecora Corporation, Harleysville PA.
6. Sika Corp, Lyndhurst NJ.
7. STS Coatings, Inc., Comfort TX.
8. Tremco, Inc., Beachwood OH.
9. United States Gypsum Company (USG), Chicago IL.
10. York Manufacturing, Inc., Sanford ME.

2.2 SEALANT MATERIALS

A. Sealant Materials, General Requirements:

1. Only use sealant and primers that comply with the following limits for VOC content:
   a. Architectural Sealants: 250 g/L.
   b. Roofing Sealants: 450 g/L.

c. Roadway Sealants: 250 g/L.

d. Sealant primer: 250 g/L.

2. Sealants containing aromatic solvents, fibrous talc, formaldehyde, halogenated solvents, mercury, lead, cadmium, chromium and their compounds, are not permitted.

B. Joint Sealer Type AA (Acrylic acoustical): One component acrylic latex, permanently elastic, non-staining, non-shrinking, non-migrating and paintable.

1. Tremco, product “Tremco Acoustical Sealant”.
2. USG, product “USG Acoustical Sealant”.
3. Pecora, product “AC-20 FTR”.

C. Joint Sealer Type AP (Acrylic painters caulk): One component acrylic latex caulking compound, conforming to FS 19-TP-21M and ASTM C 834 Type P, Grade NF, paintable within 24 hours after application, with a minimum movement capability of ±12.5 percent, equal to one of the following:

1. BASF (Sonneborn), product, “Sonolac”.
2. Tremco, product, “Tremflex 834”.
3. Bostik, product, “Chem-Calk 600”.
4. Pecora, product “AC-20+”.

D. Joint Sealer Type HL2 (Horizontal-self-Leveling, 2-component): Pouring grade self-leveling multi-component urethane sealant, conforming to FS TT-S-000227E, Type I, Class A, and ASTM C 920, with a minimum movement capability of ±25 percent, equal to the following:

1. BASF (Sonneborn), product, “SL2”.
2. Sika, product, “Sikaflex 2CSL”.
3. Tremco, product, “THC-900 / THC-901”.

E. Joint Sealer Type HT (Horizontal-Trowel): Trowel grade multi-component modified-urethane or neutral-cure silicone paste sealant, conforming to FS TT-S-000227E, Type I, Class A, and ASTM C 920, with a minimum movement capability of ±25 percent, equal to the following:

1. BASF (Sonneborn), product “SL2 (slope grade)” (urethane).
2. GE silicones, product “Tosseal 811” (silicone).
3. Pecora, product “Dynatred” (urethane).
4. Sika, product “Sikaflex 2CTG” (urethane).
5. Tremco, product “THC-901” (urethane).

F. Joint Sealer Type P2 (Polyurethane, Multi-component): Low modulus type, Multi-component non-sagging gun-grade polyurethane sealant, conforming to FS TT-S-000227E, Type II, Class A, and ASTM C 920, Type M, Class 25, Grade NS, use NT,M, A and O with a minimum movement capability of ±25 percent, equal to the following:

1. BASF (Sonneborn), product “Sonolastic NP2”.
2. Tremco, product “Dymeric 240 / Dymeric 240FC”.
3. Pecora, product “Dynatrol II”.
4. Sika, product “Sikaflex 2CNS”.

G. Joint Sealer Type SC (Silicone, general construction): One-part medium modulus, natural cure, synthetic sealant, having a useful life expectancy of at least 20 years, conforming to ASTM C 920, Type S, NS, Class 25, use NT, G, A, M, O with a minimum movement capability of ±50 percent, equal to the following:

1. Dow Corning, product, “791”.
2. GE Silicones, product, “Silpruf”.
3. Pecora, product, “895”.
4. Sika, product, “Sika Sil-C 995”.
5. Tremco, product, “Spectrem 2”.

H. Joint Sealer Type SG (Silicone butt-joint Glazing): One-part low modulus, moisture curing, synthetic rubber sealant, having a useful life expectancy of at least 20 years, conforming to ASTM C 920, Type S, NS, Class 50, FS TT-S-001543A, Type Non-Sag, Class A, in black or clear color, as selected by Architect:

1. Dow Corning, product “999-A”.
2. GE Silicones, product “SilPruf SCS2000”.
3. Tremco, product “Spectrem 2”.

I. Joint Sealer Type SM (Silicone, Mildew-resistant): USDA approved one component acetoxy silicone rubber, mildew resistant, acceptable to local health officials, conforming to U.S. Food and Drug Administration regulation 21 CFR 177.2600, FS TT-S-001543A, Type Non- Sag, Class A, and FS TT-S-00230C, Type II, Class A and ASTM C 920, Type S, Class 25, Grade NS, use NT,G and A with a minimum movement capability of ±25 percent, and a Shore A hardness of 20, equal to the following:

1. BASF (Sonneborn), product "Sonolastic - OmniPlus".
2. Dow Corning, product "786".
3. GE Silicones, product "Sanitary 1700".
4. Tremco, product "Tremsil 200".
5. Pecora, product "898".

2.3 ACCESSORIES

A. Compressible joint bead back-up: Compressible closed cell polyethylene, extruded polyolefin or polyurethane foam rod complying with ASTM C 1330, Type C, 1/3 greater in diameter than width of joint. Shape and size of compressible back-up shall be as recommended by manufacturer for the specific condition used. Provide one of the following, or equal.

1. Nomaco, Inc., Zebulon, NC, product “Green Rod”.
2. Industrial Thermo Polymers Ltd., Brampton, Ontario CN, product “ITP Standard Backer Rod”.
3. BASF Construction Chemicals (Sonneborn), Shakopee MNtrem, product "Sonolastic Closed Cell Backer Rod".
4. W.R. Meadows Inc., Hampshire, IL, product “Sealtight Kool-Rod”.

B. Primers: Furnish and install joint primers of the types, and to the extent, recommended by the respective sealant manufacturers for the specific joint materials and joint function.

C. Bond-breaker tape, and temporary masking tape: Of types as recommended by the manufacturer of the specific sealant and caulking material used at each application,

and completely free from contaminants which would adversely affect the sealant and caulking materials.

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. General:

1. Weather conditions must be dry and of the temperature, as recommended by sealant manufacturer, during application operations.
2. Surface receiving work of this section must be absolutely dry and dust free. All joints receiving sealant/caulking materials and primers shall be subject to the approval of the sealant manufacturer for proper use of specified materials.

B. Thoroughly clean all joints, removing all loose mortar, oil, grease, dust, frost, and other foreign materials that will prevent proper adhesion of primers and sealant materials.

1. Clean ferrous metals of all rust and coatings by wire brush, grinding or sandblasting. Remove oil, grease and protective coatings with cleaners recommended by sealant manufacturer.

C. Prime joint substrates**,** as recommended in writing by joint-sealant manufacturer**,** as based on preconstruction joint-sealant-substrate tests or as based upon 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.

D. Verify that joint backing and release tapes are compatible with sealant.

E. Perform preparation in accordance with ASTM C 804 and C 790 for solvent and latex base solvents, respectively.

3.3 INSTALLATION

A. General: Conform to SWRI requirements, and sealant manufacturer’s written requirements for installation.

B. Install joint bead back-up in all joints in excess of 5/8-inch depth, and joints that have no back-up therein, placing the joint bead in the joint in a manner that will assure a constant depth 1/8 inch greater than the sealant and caulking material depth tolerances.

1. Set beads into joints continuously, by slightly stretching during placement, to permit compression against sides of joint, without surface wrinkles or buckles.
2. Do not stretch back-up material into joints.

C. Install bond breaker in joints where shown in the Drawings and wherever recommended by the sealant manufacturer to prevent bond of the sealant to surfaces where such

bond might impair the Work.

D. Apply masking tape or other precautions to prevent migration or spillage of materials onto adjoining surfaces.

E. Apply urethane sealant and latex caulking materials into joints in accordance with manufacturer's instructions, using mechanical or power caulking gun equipped with nozzle of appropriate size, with sufficient pressure to completely fill the joints.

1. The depth of sealant and caulking materials shall be in accordance with manufacturer's recommendations for the specific joint function, but in no case exceed 1/2-inch in depth, nor less than 1/4-inch, regardless of the joint width.
2. Maintain the outer edge of the sealant and caulking materials, where side faces of joints are in the same plane, back 1/8-inch from the faces.
3. Apply sealant in continuous beads without open joints, voids or air pockets so as to provide a watertight and airtight seal for the entire joint length.
4. After placement of the sealant and caulking materials, concave-tool the surfaces to uniform density, using a water-wet tool. Do not use detergents or soapy water for the tooling operations.
5. Remove the temporary masking tape immediately after tooling, and before the sealant or caulking material has taken initial set.

F. Apply pouring self-leveling urethane sealant (Sealant designation **HL**) into horizontal joints in accordance with manufacturer's instructions, to a level approximately 1/16 inch below adjacent surfaces.

1. Apply sealant without open joints, voids or air pockets so as to provide a watertight and airtight seal for the entire joint length.
2. After placement of the sealant and caulking materials, concave-tool the surfaces to uniform density, using a water-wet tool. Do not use detergents or soapy water for the tooling operations.
3. Remove the temporary masking tape immediately after tooling, and before the sealant has taken initial set.

3.4 CLEANING

A. Clean all surfaces of adjacent surfaces which have been marked or soiled by the work of this Section, removing all excess sealant and caulking materials with solvents which will not damage the surfaces in any way.

3.5 PROTECTION

A. During the operation of sealant work, protect the work of other trades against undue soilage and damage by the exercise of reasonable care and precautions. Repair or replace any work so damaged and soiled.

3.6 SCHEDULE

A. General: Seal joints indicated and all interior and exterior joints, seams, and intersections between dissimilar materials.

B. Sealant Colors:

1. Colors for Sealant Types “P2” and “HL2”: Match colors furnished by the Architect, or match other building materials as directed. Should such custom

colors not be available from the approved manufacturer, except at additional charge, provide all such colors at no change in Contract Sum.

2. Colors for Sealant Types “HT”, “SC”, “SE”, “SG”, and “SM”: As selected by the Architect from manufacturer’s standard colors.
3. Color for Sealant Types “AA” and “AP”: White.
4. In concealed installation, and in partially or fully exposed installation where so approved by the Architect, standard gray or black sealant may be used.

C. Interior joints (Listed by primary building material abutting sealant joints):

1. Interior Concrete:

Joint Condition	Sealant Type
a. Concrete to concrete, vertical joints:	SC
b. Concrete to concrete: horizontal walkable surfaces:	HL2
c. Concrete and non-bituminous pavement ramps (5 to 12 Percent) horizontal joints at abutting vertical concrete or masonry surfaces:	HT
d. Concrete to all items which penetrate concrete walls, including, but not necessarily limited to, door frames, louver frames, pipes, vents, and similar items:	SC

2. Interior Masonry:
* Includes interior side of exterior masonry walls.

Joint Condition	Sealant Type
a. Masonry to masonry control joints*:	P2
b. Masonry to gypsum board:	SC
c. Masonry to all items which penetrate masonry walls, including, but not necessarily limited to, window frames, door frames, louver frames, and similar items:	SC
d. Masonry to all pipes, conduit and vents which penetrate non-rated masonry walls:	SC

3. Gypsum Board:

Joint Condition	Sealant Type
a. Gypsum board to metal or wood trim:	AP
b. Gypsum board to abutting surfaces at exposed tops and bottoms partitions and walls:	AA
c. Gypsum board to masonry:	SC
d. Gypsum board to interior door and window frames, penetrating conduits and piping, light-fixtures, electrical cover plates, building specialty items, ductwork, grilles, supply diffusers, faucets, piping, escutcheon plates and similar items:	AP
e. Gypsum board to plumbing fixtures:	SM

4. Architectural millwork:

Joint Condition	Sealant Type
a. Millwork to abutting materials, kitchens, toilet rooms	

SM and similar "wet spaces":

b. Millwork to abutting surfaces (except in "wet" AP spaces):

5. Interior metal:

Joint Condition	Sealant Type
a. Metal to metal:	SC

6. Interior floor drains:

Joint Condition	Sealant Type
a. Floor drains to concrete slab:	SE
b. Floor drains to flooring:	SE

7. Acoustical ceilings:

Joint Condition	Sealant Type
a. Acoustical ceiling edge angle to irregular wall surface	AP

8. Tile:

Joint Condition	Sealant Type
a. Tile to tile vertical, and horizontal non-traffic joints:	SM
b. Tile to tile, horizontal pedestrian traffic joints:	HL2

9. Interior Wood:

Joint Condition	Sealant Type
a. Wood to wood (natural or stained	SC
b. finishes) Wood to wood (painted opaque	AP
c. Wood to metal	SC
d. Wood base to wall surfaces	SC

END OF SECTION

SECTION 07 95 13
EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Expansion joint cover assemblies for floor and wall surfaces.

1.2 RELATED REQUIREMENTS

A. Section 09 2116 - Gypsum Board Assemblies: Gypsum board control joint trim.

B. Section 09 2116 - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.

1.3 REFERENCE STANDARDS

PART 2 PRODUCTS

2.1 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

A. Interior Floor Joints Subject to Thermal Movement:
   1. Products: Dual Elastomeric Seal with Cover Plate
      a. P 20-11-02 as manufactured by Architectural Art Mfg., Inc. :Division of Pittcon Industries.
      b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than 1 hour.

B. Interior Floor Joints at Walking Surface Subject to Thermal Movement:
   1. Products: Dual Elastomeric Seal with No Bump Floor to Floor Cover
      a. P 20-11-02 with D 20-12-21 as manufactured by Architectural Art Mfg., Inc. :Division of Pittcon Industries.
      b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than 1 hour.

C. Interior Raised Access Floor to Raised Access Floor:
   1. Products: Inpro, Heavy Duty, 734-A01-050 Series Floor Expansion Joint Covers, surface mounted.

D. Interior Fire-Rated Wall/Ceiling Joints Subject to Thermal Movement:
   1. Products:
      a. P-20-51-02 sealant with H-20-51-14 cover as manufactured by Architectural Art Mfg., Inc. :Division of Pittcon Industries. .
      b. Fire-Resistance Rating: Provide expansion control system and fire-barrier assembly with a rating not less than 1 hour.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

B. Verify that frames and anchors installed by others are in correct locations and suitable for installation of remainder of assembly.

3.2 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.

B. Align work plumb and level, flush with adjacent surfaces.

C. Rigidly anchor to substrate to prevent misalignment.

3.3 PROTECTION

A. Do not permit traffic over unprotected floor joint surfaces.

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 – GENERAL

1.1 SUMMARY

A. Furnish the following products to be installed under the designated Sections:

1. Hollow metal frames for doors, UL-Labeled and non-labeled, complete with internal reinforcing, installed under Section 06 10 00 - ROUGH CARPENTRY.
2. Glazing beads, loosely attached to hollow metal frames and doors, where so indicated, for removal and permanent installation during glazing operations; installed by Section 08 80 00 - GLAZING.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - ROUGH CARPENTRY:

1. Wood blocking and nailers.
2. Installation of hollow metal door frames.

B. Section 07 92 00 - JOINT SEALERS.

C. Section 08 71 00 - DOOR HARDWARE: Furnishing finish hardware, and installation templates for hardware cut-outs and reinforcing.

D. Section 08 80 00 - GLAZING: Furnishing and installing glass located in doors and frames.

E. Division 26 – ELECTRICAL: Wiring connections for electrified door hardware.

F. Building-in of frame anchors to wall and partition construction: By trade responsible for wall and partition erection.

1.3 REFERENCES

A. Reference Standards: Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ANSI A 117.1 - Specifications for Making Buildings and Facilities Accessible to and Usable by Physically Handicapped People.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frame Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.8 – *R2008* (formerly SDI 100) - Recommended Specifications for Standard Steel Doors and Frames.
4. ANSI/SDI A250.11 – Recommended Erection Instructions for Steel Frames.
5. SDI 111 Series (111A-111F): Recommended Details, Steel Doors and Frames.
6. SDI 117-93: Manufacturing Tolerances for Standard Steel Doors and Frames.
7. NFPA publication 80 - Fire Doors and Windows.
8. NFPA publication 105 – Standard for the Installation of Smoke Door Assemblies.

9. UL publication 10B - Fire Tests of Door Assemblies.
10. UL publication 10C – Positive Pressure Fire Tests of Door Assemblies.
11. UL 1784 – Air Leakage Tests of Door Assemblies.
12. All applicable federal, state and municipal codes, laws and regulations for exits.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. General: Coordinate the work of this Section with the respective trades responsible for installing anchorages furnished by this Section; make arrangements for delivery, receipt and installation of inserts and anchorages to prevent delay of the Work.
2. Coordinate the work of this Section with the respective trades responsible for furnishing hardware and installing doors and frames.
3. Ensure that the work performed hereunder is coordinated with issued templates authorized by the hardware supplier.
4. Do not fabricate doors or frames before receiving a copy of the approved hardware schedule, submitted by the hardware supplier, reviewed by the Contractor and accepted by the Architect. Verify that issued templates are coordinated with the approved schedule; immediately notify the Architect, in writing, of any conflicts.

B. Sequencing:

1. Field Measurements:
   a. Take field measurements before preparation of shop drawings and fabrication of frames scheduled for existing openings, to ensure proper fitting of Work.
   b. Allow for adjustments within specified tolerances wherever taking of field measurements before fabrication might delay Work.

1.5 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Product Data: Manufacturer's product data sheets, specifications, for doors, frames and shop applied finishes.
2. Shop Drawings:
   a. Door and Frame Schedule: A complete schedule coordinated with the door and frame schedule contained in the Contract Drawings.
   b. Large scale details of each type door and frame construction, indicating all gages, reinforcing, and anchorage.
      1) Indicated cutouts for glazing.
      2) Indicate cut-outs for louvers.
3. Certificates: Manufacturer's written certification stating that doors, frames, and all related items to be furnished hereunder, meet or exceed the requirements specified under this Section; that specified galvanized and shop priming has been performed; and that all U.L. fire-resistive requirements for the indicated Labels have been met.

B. Closeout Submittals: Submit the following under provisions of Section 01 78

00 - CLOSEOUT SUBMITTALS.

1. Bonds and Warranty Documentation: Manufacturer's standard warranty.

1.6 QUALITY ASSURANCE

A. General: Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.

B. Sole Source: Obtain doors and frames specified in this Section from a single manufacturer.

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:

1. Prior to shipping, identify each frame and door with a removable metal or plastic label which corresponds with door schedule identifying opening number and location.
2. Do not deliver items to the site, until all specified submittals have been submitted to, and approved by, the Architect.
3. Deliver doors and frames boxed or crated to provide protection during transit and job storage.
4. Inspect doors and frames upon delivery for damage. Minor damage may be repaired provided the refinished items are equal in respects to new work and acceptable to the Architect; otherwise remove and replace damaged items.

B. Storage and Handling Requirements:

1. Store and handle materials following manufacturer's recommended procedures.
2. Store doors and frames at the building site upright and under cover. Place the units on wood dunnage and cover in a manner that will prevent rust and damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or approved equal:

1. Amweld Building Products, Inc., (A Division of Amweld International, LLC), Coppell TX.
2. Ceco Door Products (A Division of Assa Abloy Group Company), Milan TN.
3. Curries Company (A Division of Assa Abloy Group Company), Mason City IA.
4. Republic Doors and Frames, McKenzie TN.
5. Steelcraft (A Division of Ingersoll-Rand Company), Cincinnati OH.

2.2 DESCRIPTION

A. Regulatory Requirements:

1. Fire rated door construction shall conform to UL publications 10B and 10C.
2. Install fire rated door assemblies in compliance with NFPA 80.
3. Corridor door assemblies shall be tested and listed per UL 1784.

2.3 DOORS

A. General: Refer to the Drawings for design of doors, sizes, glazing cut-outs in doors, and details.

B. Construction: Full flush commercial type, 1-3/4 inches thick, unless noted otherwise, meeting or exceeding the materials, gages, construction, and testing requirements of the referenced ANSI and SDI publications.

1. Exterior Door Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene or polyurethane core (at non-rated doors only). Fabricate exterior doors with specified R-value when tested according to ASTM C1363.
   a. Exterior Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
   b. Core construction:
      1) Manufacturer’s standard polyurethane complying with ASTM C 578
   c. Thermal properties when tested in accordance with ASTM C 1363:
      1) R-value: 10.0 (polyurethane core).
2. Interior Door Core Construction: Manufacturer's standard 99-pound (basis weight) kraft-paper honeycomb core.
   a. Interior Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

C. Interior Doors 1-3/4 inch thick (44.4 mm): ANSI 250.8, Level 2, Model 1 (Full Flush), ANSI A250.4 Physical Performance Level B, (Heavy Duty) having 18-gage, minimum 0.042 inch (1.0 mm) steel faces, with a minimum STC rating of 32.

1. Fire-rated doors: Modify specified construction to meet all construction requirements required for fire-resistive rating.
   a. Affix appropriate UL, FM or Warnock Hersey labels to each rated door, indicating applicable rating.

D. Interior temperature-rise-rated door: ANSI 250.8, Level 3, Model 1 (Full Flush), ANSI A250.4 Physical Performance Level B, (Extra-Heavy Duty) having 16-gage steel faces, Temperature-rise-rated type door, UL Class A.

1. Fire-rating: UL rated Class A having a tested fire resistance rating of up to 3 hours. Refer to Door Schedule on Drawings for specific ratings required. Modify specified construction to meet all construction requirements required for scheduled fire-resistive rating.
   a. Affix UL, label to door indicating applicable rating.
2. Temperature rise rating: Door shall be capable of withstanding a 250 degree Fahrenheit temperature rise for a minimum period of 30 minutes.
3. Core: Solid slab fire rated gypsum core, permanently bonded to the inside face of each face sheet.

E. Exterior Doors: ANSI 250.8, Level 3, Model 2 (Seamless), ANSI A250.4 Physical Performance Level B, (Extra Heavy Duty) having 16-gage, 0.058 inch thick (1.46 mm) A60 galvannealed steel faces, with a minimum core R-value of 6.25.

1. Visible edge seams: Epoxy fill edge seams and finish for seamless appearance (Model 2).

F. Louvers, non-rated doors: Sight-proof type fixed louver with inverse Y shape blades having an approximate free air area of 43 percent. Frame and core fabricated from 20 gage steel, minimum 0.032 inch (0.8 mm) thick.

1. Provide insect screen of 18 by 16 aluminum mesh, mounted on inside face of louver.

G. Louvers in rated doors: Extruded aluminum fusible link louver, UL and Warnock Hersey International approved, maximum size 24 by 24 inches.

1. Fabricated from 6063-T5 alloy aluminum, 0.05 inches (1.3 mm) thick, furnished with adjustable trim.
2. Fasteners: High strength aluminum or stainless steel, countersunk into trim.
3. Finish: Factory primed with baked enamel ready receive field applied finish.

H. Hardware reinforcing: Welded in place steel reinforcement, hot rolled pickled and oiled steel per ASTM A569. Provide G-60, hot-dipped galvanized reinforcing for all exterior openings, and locations where galvanized doors and frames are scheduled. Reinforcing shall be not less than the following minimum steel thicknesses:

1. Hinges: 7 gage, minimum 0.167 inch (4.2 mm) thick.
2. Closers: Box/channel-shape reinforcing, 12 gage, minimum 0.093 inch (2.3 mm) thick.
3. Locks: Box/channel-shape reinforcing,
   a. Cylindrical locks: 16 gage, minimum 0.053 inch (1.3 mm) thick.
   b. Mortise locks: 14 gage, minimum 0.067 inch (1.6 mm) thick.
4. Kick plates: 18 gage, minimum 0.042 inch (1.0 mm) thick.
5. All other hardware: 14 gage, minimum 0.067 inch (1.6 mm) thick.
6. Locations for reinforcing shall be determined from information and templates provided under Section 08 71 00 - DOOR HARDWARE.

I. Provide UL approved welded steel astragal at each UL pair of fire doors.

J. Fabrication

1. Fabricate exposed faces of door panels from cold-rolled steel only.
2. Fabricate concealed stiffeners, reinforcement, edge channels, louvers and moldings from either cold-rolled or hot-rolled steel (at manufacturer's option).
3. Fabricate doors with hardware reinforcement welded in place.
4. Attach fire rated label to each door unit.
5. Close top and bottom edge of exterior doors with flush end closure. Seal joints watertight.

2.4 HOLLOW METAL FRAMES

A. General: Refer to the Drawings for various types of frames, sizes, and profiles, UL fire- resistive Label frames, and other characteristics of frames and related items.

1. Frame type (all frames): Shop welded frames with mitered joints arc-welded, reinforced and ground smooth.

B. Materials for frames, reinforcement, anchors, anchor clips and related items: commercial grade cold-rolled steel conforming to ASTM A109 or commercial grade hot-rolled and pickled steel conforming to ASTM A415.

1. Frame gage:
   a. Interior frames for Level 2 and 3 doors: 16-gage, 0.053 inch thick (1.3 mm), except as otherwise required for specific U.L. Label.
   b. Exterior frames: 14-gage, 0.067 inch thick (1.7 mm), with an A60 zinc coating supplied by the hot-dip process conforming to ASTM A653, Grade 37, with coating applied in accordance with A 924.
2. Hinge reinforcement: 7 gage, minimum 0.167 inch (4.2 mm) thick.

3. Lock and strike reinforcement: 12 gage, minimum 0.093 inch (2.3 mm) thick.
4. Door closer reinforcement: 12 gage, minimum 0.093 inch (2.3 mm) thick.
5. Door closer reinforcement: 14 gage, minimum 0.067 inch (1.6 mm) thick.
6. Floor clips: 16 gage, minimum 0.053 inch (1.3 mm) thick.
7. Splice plates or channels: same gage as door frame.
8. Removable Glazing stops: Rectangular channel sections, not less than 20-gage, 0.032 inch thick (0.8 mm) steel; pre-drilled and loosely attached within the glazing cut- outs with countersunk tamper-resistant stainless steel screws; sized to properly accommodate the designated thicknesses of glass and glazing materials; and external edges set flush with, or slightly behind, door face. Modify glazing stops for UL Label doors to conform with UL fire rating requirements.

C. Frame construction:

1. Fire-rated frame assemblies: Modify specified construction to meet all construction requirements required for fire-resistive rating.
   a. Affix appropriate UL, FM or Warnock Hersey labels to each rated frame assembly, indicating applicable rating.
2. Shop-fabricate frames as whole single units per door opening, except when frame size is too large to ship as a single unit. Oversized frames may be shipped in large sections as practicable for field assembly with concealed splice plates or channels.
   a. Frame corner construction: Refer to paragraph A of this Article.
3. Reinforcements, stiffeners, and base angle clips: Welded to interior surfaces of frames to provide a stable base and so as to not interfere with installation of hardware.
4. Appearance of finished frames: Strong, rigid, completely free from warp and buckle, with miters well-formed and in true alignment, and with surfaces smooth and free from defects of any kind.
5. Silencer holes: Prepare frames for silencers at non-gasketed doors, coordinate with Section 08 71 00 – DOOR HARDWARE and Hardware Schedule. Provide three single silencers for single doors, and mullions of double doors on strike side. Provide two single silencers on frame head at double doors without mullions.
6. Glazing beads: Carefully place to properly accommodate the various thicknesses of glass and glazing materials, and loosely-attach to frames with flathead galvanized steel screws through pre-drilled holes having countersunk depressions.

D. Anchorage:

1. Anchor clips for frames in metal stud partitions: 16-gage (minimum 0.053 inch [1.3 mm] thick) steel z-shaped clips factory welded onto frame, 1-1/2 inch upturned and downturned legs, or equivalent type standard with the manufacturer, contained within the frames, for screw attachment to metal studs under Section 09 22 16 - NON- STRUCTURAL METAL FRAMING.
2. Anchors for frames in existing masonry walls: Counter-sunk bolts of minimum 3/8 inch diameter, set into masonry expansion shields.
3. Anchors for fire-resistive rated frames: Conform to all UL requirements for the specific fire-resistive ratings.
4. Provide the following number of anchors, clips, or bolts, per jamb:
   a. For frames 7’-6” in height or less: 3 anchors per jamb.

b. For frames 7'-6" in height or less and having doors exceeding 3'-0" feet width, and for cross corridor frames: 4 anchors per jamb.

c. For frames greater than 7'-6", up to 10'-0" in height: 4 anchors per jamb.

d. For frames greater than 7'-6", up to 10'-0" in height, and having doors exceeding 3'-0" feet width, and for cross corridor frames: 5 anchors per jamb.

e. For frames over 10'-0' in height: 5 anchors per jamb.

2.5 FABRICATION

A. General: Do not fabricate materials until all specified submittals have been submitted to, and approved by, the Architect.

B. Fabrication Tolerances, Maximum variation for doors and frames: Maximum diagonal distortion 1/16 inch measured with straight edge, corner to corner.

2.6 FINISHES

A. Preparation: Pressure-sand all surfaces of all doors, frames, accessory items, anchors, and related items, to remove blemishes and foreign matter and provide paint grip. Spot fill imperfections with metallic filler, and sand smooth. Thoroughly clean the surfaces by applying hot or cold phosphate treatment standard with the manufacturer.

B. Following cleaning apply one dip or spray coat of rust-inhibitive metallic oxide, zinc chromate, or synthetic resin primer to all surfaces, including those which will be concealed after erection. Bake or oven-dry the primer at time and temperature recommended by the manufacturer for developing maximum hardness and resistance to abrasion.

PART 3 - EXECUTION

3.1 ERECTION AND INSTALLATION

A. Installation of frames and doors, including all accessories and related items furnished hereunder, will be performed under Section 06 10 00 - ROUGH CARPENTRY

1. Section 06 10 00 - ROUGH CARPENTRY shall place frames in correct position within specified tolerances.

B. Final installation of loosely-attached glazing stops will be performed under Section 08 80 00
- GLAZING.

END OF SECTION

SECTION 08 31 00
ACCESS DOORS AND PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Fire resistive rated and non-rated access panels and frames, as specified under this Section, furnished by Sections requiring the same and installed under the following Sections:

1. Section 04 20 00 – UNIT MASONRY: Installation of access panels into exterior masonry assemblies.
2. Section 09 29 00 - GYPSUM BOARD: Installation of access panels into drywall assemblies.

1.2 RELATED REQUIREMENTS

A. Section 09 29 00 - GYPSUM BOARD: Installation of access panels into drywall assemblies.

B. Division 21 - FIRE SUPPRESSION: Furnishing access panels required for fire protection systems.

C. Division 22 - PLUMBING: Furnishing access panels required for plumbing systems.

D. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING: Furnishing access panels required for heating/cooling systems.

E. Division 26 - ELECTRICAL: Furnishing access panels required for electrical systems.

1.3 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Literature: Manufacturer's product data sheets, specifications and installation instructions.
2. Schedule: Submit Schedule of all access panels to be furnished hereunder, indicating locations for each size and type of access door.
   a. The Contractor is responsible to ensure that all of the types/styles of panels and frames specified herein can be furnished by the manufacturer submitted.
   b. Prior to submitting schedule, coordinate with the work of Division 21 - FIRE SUPPRESSION, Division 22 - PLUMBING, Division 23 - HEATING, VENTILATING
   AND AIR CONDITIONING and Division 26 - ELECTRICAL and meet with the Architect to determine exact quantities and locations required for the installation of access panels.
3. Shop drawings: Large scale details of access doors, indicating all sizes, gages and thickness; provide complete installation details, coordinated to the specific receiving conditions.

1.4 DELIVERY, STORAGE AND HANDLING

A. Do not deliver access doors to the site, until all specified submittals have been submitted to, and approved by, the Architect.

B. Store access door units inside, under cover, and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or approved equal:

1. Acudor Products Inc., Cedar Grove, NJ
2. Karp Associates Inc., Maspeth, NY.
3. Nystrom Products Company, Minneapolis, MN.
4. Williams Brothers Corporation of America, Front Royal, VA.

B. Single Source: All work of this Section shall be produced by a single manufacturer, unless otherwise approved by the Architect.

2.2 ACCESS PANELS - GENERAL

A. Keying: All access panels shall be keyed alike; furnish Owner with 6 keys.

1. Special consideration and attention shall be given to the fabrication lead time required, allow a minimum of 6 weeks after delivery of the required mortised locks to the access panel manufacturer.

2.3 ACCESS PANELS - FOR FIRE RESISTANCE RATED CONSTRUCTION

A. For fire-resistance rated wall and ceiling surfaces: Standard flush panel door meeting the following requirements:

1. Panel and frame rating: UL “B” label for 90 minutes.
2. Frame type:
   a. For gypsum board walls and ceilings: 16 gage galvanized bonderized steel frame, with 22 gage galvanized steel drywall bead.
      1) Acudor FW-5050DW
      2) Karp KRP-350FR series.
      3) Nystrom IW series.
      4) Williams WB-FR series.
3. Door: Insulated Flush panel door as follows:
   a. Typical wall types: Flush door, Sandwich construction with 2 inch thick mineral wool fiber insulation between two layers of 20 gage galvanized bonderized steel.
   b. For ceramic tile walls only: Flush door, Sandwich construction with 2 inch thick mineral wool fiber insulation between two layers of 20 gage Type 304 stainless steel.
4. Hinge: Flush continuous piano hinge with stainless steel pin.
5. Closer: Spring closer.
6. Lock: Latch bolt operated by recessed flush key.

B. For fire-resistance rated wall surfaces: Medium security type, with flush panel door meeting the following requirements:

1. Panel and frame rating: UL “B” label for 90 minutes.
2. Frame type:
   a. For tiled walls: 14 gage Type 304 stainless steel flanged frame, with flange exposed to view 1 inch or less, equal to:
      1) Nystrom ST series.
   b. For gypsum board and veneer plastered walls and ceilings: 14 gage galvanized bonderized steel frame, with 22 gage galvanized steel drywall bead.
      1) Nystrom SW series.
3. Door: Insulated Flush panel door as follows:
   a. Typical wall types: Flush door, Sandwich construction with 2 inch thick mineral wool fiber insulation between two layers of 14 gage galvanized bonderized steel.
   b. For ceramic tile walls only: Flush door, Sandwich construction with 2 inch thick mineral wool fiber insulation between two layers of 14 gage Type 304 stainless steel.
4. Hinge: Flush continuous piano hinge with stainless steel pin.
5. Closer: Spring closer.
6. Lock: Latch bolt operated by recessed flush key.

2.4 ACCESS PANELS - FOR NON- RATED CONSTRUCTION

A. For non-rated wall and ceiling surfaces (service and non-public areas): Flush panel door type meeting the following requirements:

1. Frame type:
   a. For masonry walls: 16 gage galvanized bonderized steel flanged frame, with flange exposed to view 1 inch or less.
      1) Acudor UF-5000 series.
      2) Karp DSC-214SM series.
      3) Nystrom NT series.
      4) Williams WB-GP series.
   b. For gypsum board walls and ceilings: 16 gage galvanized bonderized steel frame, with 22 gage galvanized steel drywall bead.
      1) Acudor DW-5040 series.
      2) Karp KDW series.
      3) Nystrom NW series.
      4) Williams WB-PL series.
2. Door: Flush panel door as follows:
   a. Typical all wall types: 14 gage galvanized bonderized steel.
3. Hinge:
   a. Typical: Concealed spring hinge enabling door to open 175 degrees and permit removal of door from frame.
   b. Panels greater than 24 by 36 inches: Flush continuous piano hinge with stainless steel pin.
4. Lock: Latch bolt operated by recessed flush key.

B. For non-rated gypsum board, walls and ceilings (public areas): Recessed door type

meeting the following requirements

1. Manufacturer's types:
   a. Acudor DW-5015 series.
   b. Karp:
      1) Walls: Karp RDW series.
      2) Ceilings: Karp KATR series.
   c. Nystrom RW series.
   d. Williams WB-DW series.
2. Frame type: 16 gage galvanized bonderized steel frame, with 22 gage galvanized steel drywall bead.
3. Door: Recessed 16 gage galvanized bonderized steel door. with 22 gage galvanized steel drywall bead.
4. Hinge: Concealed pivot rod hinge.
5. Lock: Latch bolt operated by recessed flush key.

C. For non-rated wall and ceiling surfaces (security type panels, where indicated): Flush panel door type meeting the following requirements:

1. Frame type:
   a. For tiled walls: 12 gage Type 304 stainless steel flanged frame, with flange exposed to view 1 inch or less, equal to:
      1) Acudor MS-7000 series.
      2) Karp DSB-123SD-MS series.
      3) Nystrom MT series.
      4) Williams WB series.
   b. For gypsum board and veneer plastered walls and ceilings: 12 gage galvanized bonderized steel frame, with 22 gage galvanized steel drywall bead.
      1) Nystrom MW series.
2. Door: Flush panel door as follows:
   a. Typical all wall types, except tile: 12 gage galvanized bonderized steel
   b. For tiled walls: 12 gage type 304 stainless steel.
3. Hinge: Flush continuous piano hinge with stainless steel pin.
4. Lock: Latch bolt operated by recessed flush key.

2.5 ACCESS PANELS - FOR EXTERIOR CONSTRUCTION

A. For wall surfaces: Standard flush panel door meeting the following requirements:

1. Frame type:
   a. For concrete walls: 0.080 inch 6063-T5 extruded aluminum flanged frame with flange exposed to view 1-1/4 inches or less, equal to:
      1) Nystrom XTA series.
2. Door: Insulated flush panel door as follows:
   a. Flush door, sandwich construction with 2 inch thick, 2-1/4 pound density foam insulation with a minimum R-value of 13 between two layers of 20 gage galvanized bonderized steel.
3. Hinge: Flush continuous stainless steel piano hinge and pin.
4. Handle: Non-locking dual acting die-cast lever handles.

5. Weatherstripping: Continuous extruded santoprene gasket.
6. Lock: Latch bolt operated by recessed flush key.

2.6 FACTORY FINISHING

A. Panel assemblies fabricated from stainless steel: Nº. 4 satin finish.

B. Panel assemblies fabricated from galvanized bonderized steel: Baked on rust inhibitive gray primer finish.

C. Panel assemblies fabricated from cold rolled steel: Phosphate dipped with baked on rust inhibitive gray primer finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces and verify that they are in proper condition to receive the work of this Section. Verify that prepared openings are ready to receive the work of this Section and opening dimensions are as indicated on the shop drawings. Verify that all blocking is set in place and secure.

B. Beginning of installation means acceptance of project conditions.

3.2 INSTALLATION

A. Install access panels in accordance with manufacturer's instructions and direction from authorities having jurisdiction. Install miscellaneous specialties absolutely level and in true line, with units securely anchored to the surrounding construction.

B. Test each door and latching device, and make adjustments required to ensure a bind-free operation and proper latching.

END OF SECTION

SECTION 08 70 00
HARDWARE

PART 1 - GENERAL:

1.1 SUMMARY

A. This section includes the following:

1. Commercial door hardware.
2. Electrified door hardware.

B. Substitutions:

1. The quality of all items of hardware has been clearly indicated by the manufacturer's name and product number. Only products as listed in the hardware schedule are acceptable.

1.2 REFERENCES

A. Door & Hardware Institute (DHI):

1. Recommended Locations for Builders Hardware for Standard Steel Doors and Frames, 1990 Edition.
2. Scheduling Sequence and Scheduling Format.
3. Processing Hardware Schedules and Templates.

B. Commonwealth of Virginia Construction Code:

1. 2012 Edition.

C. National Fire Protection Association (NFPA):

1. Standard No. 80 "Fire Doors & Windows", 2010 Edition.
2. Standard No. 101 "Life Safety Code", 2009 Edition.

D. American National Standards Institute (ANSI):

1. Standard A156.18 "Materials and Finishes".
2. Standard A156.23 "Electromagnetic Locks".
3. Standard A156.24 "Delayed Egress Locks".
4. Standard A117.1 "Accessible and Usable Buildings and Facilities", 2003 Edition.

E. Governing Codes:

1. Where conflict occurs between above codes and standards the most stringent requirement governs.

1.3 SUBMITTALS

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

B. Shop Drawings: Details of electrified door hardware, including wiring diagrams.

C. Door Hardware Schedule & Format:

1. Door Hardware Sets: Prepared by an Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams.

a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents. Vertical schedules only. Horizontal schedules will not be accepted.
b. The Finishing Hardware Schedule is to follow the guidelines and format as set forth in the DHI publication "*Scheduling Sequence and Scheduling Format*".
c. Content: Include the following information:
   1) Identification number, location, hand, fire rating and material of each door and frame.
   2) Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.
   3) Complete designations of every item required for each door or opening including name and manufacturer.
   4) Description of each electrified door hardware function, including location, sequence of operation, and interface with other building control systems.

D. Other Submittals:

1. Two complete sets of catalog cuts are to accompany the Finishing Hardware Schedule. The list of cuts is to include the item, manufacturer, and item number.
2. Name, address, and phone number of automatic door operator installer.
3. Letter from automatic door operator manufacturer certifying that the above listed installer is a factory-authorized installer.

E. Samples:

1. Furnish samples on a timely basis upon request of Architect.
2. Send samples to Architect or Owner as directed.
3. All hardware samples remain the property of the hardware supplier, and are to be returned prior to completion of the project.

F. Templates:

1. Send hardware template information for pre-fitted wood doors, plastic faced doors, aluminum doors, metal doors and frames, together with a copy of approved hardware schedule to the respective door and frame manufacturers or fabricators not later than 7 days after approval of schedule. These related trades are also to supply the necessary shop drawings to the hardware supplier, upon request.
2. Coordinate templates between manufacturers of different hardware items to allow installation of various hardware items without interference between items. Special templates may be necessary, even though they may not be listed.
3. Clearly indicate on templates, under door clearances for exit devices, automatic flush bolts to ensure latching, and thresholds having built-in or applied stops.
4. The submission for templates and template list are to follow the procedure as set forth in the D.H.I. publication, "For Processing Hardware Schedules and Templates".

G. Wiring Diagrams:

1. Furnish wiring diagrams for scheduled items requiring power.
2. Furnish elevation drawings for each door showing location of electric hardware; include point to point wiring and riser, diagrams and power requirements. See Part 3, "Doors with Electric Hardware", for operating and function requirements.
3. Submit wiring diagrams and door elevations with hardware submittal.

H. Keying Schedule:

1. Upon receipt of approved hardware schedule, arrange meeting between hardware supplier and Owner, through Architect, to obtain necessary keying information.
2. Submit 6 copies of keying schedule indicating door numbers in numerical sequence, and its particular keying. Obtain approval before proceeding.

I. Contract Closeout Submittals:

1. Comply with Section 01770.

2. Hardware Data and Maintenance Manuals: At time of acceptance of work, deliver two maintenance manuals. Include the following for each hardware item having operative parts:

   a. Catalog data.
   b. Isometric drawings, which identify and list part numbers.
   c. Installation templates including special templates.
   d. Installation instruction.
   e. Manufacturer's maintenance instruction and maintenance schedule; include special lubricate and fluids information.
   f. Assemble data in a clearly identified 3-ring binder.
   g. Manufacturer bitting list.
   h. Include in each manual one updated copy of hardware schedule, listing hardware installed, including changes and revisions approved by Architect during construction.

J. Certifications:

1. Arrange for hardware supplier to visit site, and certify the following:

   a. Hardware is installed and operating in a satisfactory manner.
   b. Hardware is installed as listed on approved door hardware submittal, including changes and revisions approved by Architect during construction.
   c. Submit certifications in writing addressed to Owner in care of Architect.

1.4 SYSTEM DESCRIPTION

A. Performance Requirements:

1. Furnish hardware complying with NFPA 80, and certified for use on fire-rated openings complying with UBC 7-2 (1997) and UL10c.
2. Furnish hardware listed by Underwriters' Laboratories or other approved testing agency.
3. Hardware for fire-rated openings: Comply with NFPA 80.
4. Hardware for non-fire-rated openings: Comply with ANSI A117.1.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by lock manufacturer.

B. Supplier Qualifications:

1. Recognized supplier to have, full-time, on staff an Architectural Hardware Consultant (AHC) certified by the Door and Hardware Institute.
2. Hardware supplier's AHC to be available at all reasonable times during course of work to meet personally with Owner, Architect or Contractor for hardware consultation.
3. Supplier willing to agree in writing to maintain parts inventory of items supplied for future service to Owner.
4. Supplier to furnish all the hardware listed in this Section 08710 Finishing Hardware. All material is to be furnished totally including the hardware for Aluminum Doors, as listed in the sets. No items may be excluded. Hardware listed as installed, is to be furnished and installed as part of the Finishing Hardware Bid. The installation is to be by an authorized installer as listed in the sets or by Addendum. The successful bidder is to furnish a letter from the factory certifying that the installer is a factory authorized installer. If either of these criteria is not met, the result will be the rejection of the bid or shop drawings, which could also result in the cancellation of contract or purchase order.

C. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that

are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable

D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252

E. Electric Hardware:

1. Unless noted otherwise in Division 16, furnish electric hardware items rated 24 VDC.
2. Coordinate electrical hardware requirements with Division 16 work for electrical distribution, fire alarm, and security systems.

F. Pre-Installation Conference:

1. Arrange for hardware supplier to meet with installer and discuss installation of hardware, templates and unique hardware applications.

G. Submittal Review Conference:

1. Hardware supplier to arrange a meeting with Contractor, Architect, and owner for the review of hardware, hollow metal, and wood door shop drawings.
2. The hardware supplier attendee is to be an AHC.
3. Representatives from the hollow metal and wood door manufacturers are also to attend. Representatives are to be factory employees, or factory sales agents. Wholesale warehouse employees are not acceptable.
4. Allow for one 8-hour working day.
5. Meeting location is to be determined by the Architect.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery:

1. All hardware is to be in its original package, properly wrapped. Package each item of hardware separately with necessary fasteners, screws, bolts, tampins, keys and installation templates.
2. Deliver packages clearly identified with heading number and door number as approved on hardware schedule.

B. Storage:

1. General Contractor or Construction Manager to provide storage area for hardware, which is dry, secure, and complete with shelving and tables for unpacking and sorting. A locked room is to be provided by the General Contractor or Construction Manager for storage of the finishing hardware.
2. Upon delivery, the General Contractor or Construction Manager and the hardware supplier to check in the hardware against the approved Finishing Hardware Schedule, and place the items on the shelves.
3. After delivery, the General Contractor or Construction Manager is responsible for the hardware against theft, misplacement, defacements, etc

1.7 WARRANTY

A. Special Warranties:

1. Submit manufacturer's standard written product warranty signed by manufacturer's authorized official, guaranteeing to repair or replace defective products during the following warranty periods:

a. Hinges: Life of Building Guarantee. (Only for 3-knuckle hinges).

b. Continuous Hinges: 10-year warranty on total hinge (not just bearings).
c. Door Closers: 10-year warranty.
d. Door Closers with electric or pneumatic components: 2-year warranty.
e. Exit Devices: 3-year warranty.
f. Locksets: 3-year warranty.
g. Remainder of hardware: 1-year warranty.

1.8 MAINTENANCE

A. Instructions:

1. Arrange for hardware supplier to provide a training program for Owner's maintenance personnel for instruction in proper use, servicing, adjustment and maintenance of door hardware. Training is to occur on Owner's premise, unless otherwise agreed to by Owner.
   a. Provide one 8-hour working day.
   b. This session is to be videotaped and handed over to owner.

2. Prior to acceptance of work, submit to architect a confirmation letter between hardware supplier and Owner setting a date to commence training 30 days after acceptance of work.

B. Maintenance Service:

1. Approximately 6 months after acceptance of work, arrange to have installer of hardware in company with representatives of lock, exit device and closer manufacturers contact Owner and make arrangements for an inspection of hardware. Time and date of inspection at Owner's convenience.
2. Re-adjust each piece of operating hardware for proper and smooth operation; consult with Owner's personnel pertaining to additional maintenance procedures; clean and lubricate hardware as needed; replace and provide new hardware which has deteriorated due to faulty materials or improper installation.
3. Submit written report covering current and predictable problems of substantial nature in performance of hardware to Architect.

C. Tools:

1. After final adjustment of door hardware, turn over to Owner tools furnished during

PART 2 - PRODUCTS:

2.1 SCHEDULED DOOR HARDWARE

A. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3.2 "Door Hardware Sets". Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required. No substitutions permitted unless equals listed below.

2.2 HINGES, GENERAL

A. No 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. Furnish at all reverse beveled locked doors.

2.3 HINGES

A. Butts and Hinges: BHMA A156.1.

B. Electric hinges to have Lynx quick connect Molex connectors.

C. Manufacturers:

1. Hager Companies (HA).
2. McKinney Hinge Company (MK)

2.4 CONTINUOUS HINGES

A. Continuous Hinges: BHMA 156.26.

B. Electric continuous hinges to have Lynx quick connect Molex connectors and removable module.

C. Manufacturer:

1. Hager Companies (HA).
2. McKinney Hinge Company (MK)

2.5 LOCKS AND LATCHES, GENERAL

A. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.

B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101.

C. Electrified Locking Devices: BHMA A156.25.

D. Electric locks to have quick connect Molex connectors. Electric modification of Schlage Locksets by Architectural Control Systems Inc (ACSI).

E. Lock Trim:

1. Levers: Schlage 06A

F. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors.

G. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

H. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set.

2.6 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: Function numbers and descriptions indicated in door hardware sets comply with the following:

1. Mortise Locks: BHMA A156.13.

B. Mortise Locks: Stamped steel case with steel or brass parts; BHMA A156.13**,** Grade 1, Series 1000.

1. Manufacturers:
   a. Schlage Lock Company; an Ingersoll-Rand Company (SC).

2.7 AUXILIARY LOCKS AND LATCHES

A. Auxiliary Locks: BHMA A156.5**,** Grade 1

1. Manufacturers:
   a. Schlage Lock Company; an Ingersoll-Rand Company (SC).

2.8 EXIT LOCKS AND EXIT ALARMS

A. Exit Locks: BHMA A156.29, Grade 1, surface mounted, battery powered, housed in metal case; with red-and-white lettering reading "EMERGENCY EXIT PUSH TO OPEN--ALARM WILL SOUND."

B. Stand-Alone Exit Alarms: BHMA A156.29, Grade 1, mounted separate from door and activated by door movement switch.

C. Manufacturers:

1. Von Duprin; an Ingersoll-Rand Company (VD).

2.9 DOOR BOLTS

A. Bolt Throw: Comply with testing requirements for length of bolts required for labeled fire doors.

B. Dustproof Strikes: BHMA A156.16, Grade 1.

1. Manufacturers:
   a. Hager Companies (HA).
   b. Rockwood Manufacturing (RO).
   c. Furnish at all manual, automatic and self latching bolts.

C. Surface Bolts: BHMA A156.16, Grade 1.

1. Manufacturers:
   a. Hager Companies (HA).
   b. Rockwood Manufacturing (RO).

D. Manual Flush Bolts: BHMA A156.16**,** Grade 1; designed for mortising into door edge.

1. Manufacturers:
   a. Hager Companies (HA).
   b. Rockwood Manufacturing (RO).

E. Automatic and Self-Latching Flush Bolts: BHMA A156.3**,** Grade 1; designed for mortising into door edge.

1. Manufacturers:
   a. Hager Companies (HA).
   b. Rockwood Manufacturing (RO).

2.10 EXIT DEVICES

A. Exit Devices: BHMA A156.3, Grade 1.

B. Accessibility Requirements: Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22 N).

C. Exit Devices for Means of Egress Doors: Comply with NFPA 101. Exit devices shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.

D. Fire Exit Devices: Devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252.

E. Removable Mullions: BHMA A156.3.

F. Fire-Exit Removable Mullions: Provide removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions shall be used only with exit devices for which they have been tested.

1. All Mullions to be equipped with key removable feature.

G. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.

1. Operation: Rigid.

H. Outside Trim: Lever with cylinder; material and finish to match locksets, unless otherwise indicated.

1. Match design for locksets and latchsets, unless otherwise indicated.

I. Through Bolts: For exit devices and trim on metal doors.

J. Electric Exit Devices: Electric exit devices to have quick connect Molex connectors. Electric modification of Von Duprin Exit Devices by Architectural Control Systems Inc (ACSI).

K. Manufacturers:

1. Von Duprin; an Ingersoll-Rand Company (VD).

2.11 LOCK CYLINDERS

A. Standard Lock Cylinders: BHMA A156.5**,** Grade 1.

B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:

1. Number of Pins: Seven.
2. Cylinders to be interchangeable core. Furnish brass construction cores.
3. Permanent Cores: By owner.

C. Manufacturers:

1. Schlage Lock Company; an Ingersoll-Rand Company (SC).

2.12 KEYING

A. Keying System: Temporary cores to be construction master keyed. Final keying of permanent cores by owner

2.13 CLOSERS

A. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 5 lbf to open door to minimum required width. Except exterior doors and fire doors which must positively latch.

B. Hold-Open Closers/Detectors: Coordinate and interface integral smoke detector and closer device with fire alarm system.

C. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

D. Surface Closers: BHMA A156.4**,** Grade 1. Provide type of arm required for closer to be located on non-public side of door, unless otherwise indicated.

1. Manufacturers:
   a. LCN Closers; an Ingersoll-Rand Company (LCN).

2.14 PROTECTIVE TRIM UNITS

A. Size: 2 inches less than door width on push side and 1inch less than door width on pull side, by height specified in door hardware sets.

B. Plates are to be .050 thick, with beveled 4 edges (B4E) and countersunk holes (CSK)

C. Manufacturer:

1. Hager Companies (HA)
2. Rockwood Manufacturing (RO).

2.15 DOOR GASKETING

A. Standard: BHMA A156.22.

B. General: Provide continuous weather-strip gasketing on computer room and exterior doors, and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

C. 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 gasketing on 20-minute-rated doors and on smoke-labeled doors.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Gasketing Materials: ASTM D 2000 and AAMA 701/702.

G. Door Thresholds: Assure installation meets applicable accessibility requirements. Select threshold appropriate to wall thickness and floor conditions. Model number and manufacturers listed in Hardware Schedule intended as an example only.

H. Overlapping astragals are installed on the pull side of the active door for out swinging doors and on the push side of the inactive door on in swinging doors.

I. Manufacturers:

1. Hager Companies (HA).
2. Pemko (PE).

2.16 MISCELLANEOUS DOOR HARDWARE

A. Door stops: Install wall or floor mounted door stops where necessary to prevent door from hitting adjacent walls or other interferences.

B. Auxiliary Hardware: BHMA A156.16, Grade 1.

1. Manufacturers:
   a. Hager Companies (HA).
   b. Rockwood manufacturing (RO).

2.17 ELECTRIC DOOR HARDWARE

A. Boxed Power Supplies: Modular unit in NEMA ICS 6, Type 4 enclosure; filtered and regulated; voltage rating and type matching requirements of door hardware served; and listed and labeled for use with fire alarm systems.

B. Furnish wire harness in the doors for electric locks and exits and in the frame from the hinge to the ceiling above the frame.

C. Manufacturer:

1. McKinney for Ingersoll Rand

2.18 MATERIAL FINISHES

A. All finishes as listed in the sets. Locks are US26D except the locks in the infrastructure yard wall which are US32D.

PART 3 - EXECUTION:

3.1 INSTALLATION

A. Steel Doors and Frames: Comply with DHI A115 Series. Drill and tap doors and frames for surface-applied door hardware according to ANSI A250.6.

B. Wood Doors: Comply with DHI A115-W Series.

C. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builders' Hardware for Custom Steel Doors and Frames."
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

D. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.

E. Configuration: Provide one power supply for each door opening that requires a power supply other than 24v. All 24v to be provided by security contractor.

F. Comply with DHI "Recommended Locations for Builder's Hardware" and hardware manufacturers instructions

3.2 HARDWARE SETS

A. The following schedule is furnished for whatever assistance it may afford the Contractor; do not consider it as entirely inclusive. Should any particular door or item be omitted in any scheduled hardware heading, provide door or item with hardware same as required for similar purposes. Hardware supplier is responsible for handing and sizing all products as listed in the hardware heading. Quantities listed are for each pair of doors, or for each single door.

B. Manufacturer’s Abbreviations:

1. VD – Von Duprin
2. SC – Schlage
3. RO – Rockwood
4. LC – LCN
5. PE – Pemko
6. MC - McKinney

SET #001

2	Electric Hinge	T4A3786 4 1/2 x 4 1/2 QC8	26D	MC
6	Hinges	T4A3786 4 1/2 X 4 1/2 NRP	26D	MC
1	Fire Exit Device	9827L-F x 996L-R&V ER-36 RG-27	US26D	VO
1	Fire Exit Device	9827EO-F ER-36 RG-27	US26D	VO
1	Rim Cylinder	12E-72 L/C	626	BE
1	Const Core	Green	626	BE
1	ACSI VR MOD	VR-1570-9927-24VDC-AE-LC		
1	RX MOD	VR-9827EO-AE-LC		
2	Closer	4040 XP EDA DEL SRT	AL	LC
2	Protection Plate	K1050 10 x LTS	US32D	RO
2	Wall Bumper	409	US32D	RO
2	ElectroLynx Harness	QC-C1500P		MC
2	ElectroLynx Harness	QC-C012P		MC
1	Smoke Seal	S88 BL x LTS		PE
1	Length Adhesive Seal	S771 C x LTS		PE
2	Auto Door Bottom	420 APKL x LTS		PE
1	Threshold	228 A x LTS		PE

NOTE: Reader, Door Contact, Power Supply (except at EL Exit Devices) and wiring by Security. Reader unlocks lever for entry. Exit by IS lever or push pad. No ADB's at Shell doors.

SET #001A

Same as #001 except add

2	Astragals	305 CN x LTS x TPS		PE

SET #002

1	Electric Hinge	T4A3786 4 1/2 x 4 1/2 QC8	26D	MC
3	Hinges	T4A3786 4 1/2 X 4 1/2 NRP	26D	MC
1	Lockset	L9070BD 06A	626	SC
1	Const Core	Green	626	BE
1	Closer	4040 XP EDA DEL SRT	AL	LC
1	Protection Plate	K1050 10 x LTS	US32D	RO
1	Wall Bumper	409	US32D	RO
1	ACSI Mortise Lock Mod.	M1520-AE-1-L9080-24VDC-LC		
1	ElectroLynx Harness	QC-C1500P		MC
1	ElectroLynx Harness	QC- To suit door		MC
1	Smoke Seal	S88 BL x LTS		PE
1	Auto Door Bottom	420 APKL x LTS		PE
1	Threshold	228 A x LTS		PE

NOTE: Reader, Door Contact, Power Supply (except at EL Exit Devices) and wiring by Security. Reader unlocks lever for entry. Exit by IS lever or push pad.

SET #003

1	Electric Hinge	T4A3786 5 x 4 1/2 QC8	26D	MC
3	Hinges	T4A3786 5 x 4 1/2 NRP	26D	MC
1	Fire Exit Device	9875L-F x 996L-M	US26D, US32D	VO
1	Mortise Cylinder	1E-74 L/C C4	626	BE
1	Const Core	Green	626	BE
1	Closer	4040 XP EDA DEL SRT	AL	LC
1	Protection Plate	K1050 10 x LTS	US32D	RO
1	Wall Bumper	409	US32D	RO
1	ACSI Mortise Exit Conversion	ME-1520-9875-24VDC-AE-LC		
1	ElectroLynx Harness	QC-C1500P		MC
1	ElectroLynx Harness	QC-C012P		MC
1	Smoke Seal	S88 BL x LTS		PE
1	Auto Door Bottom	420 APKL x LTS		PE
1	Threshold	228 A x LTS		PE

NOTE: Reader, Door Contact, Power Supply (except at EL Exit Devices) and wiring by Security. Reader unlocks lever for entry. Exit by IS lever or push pad.

SET #004

8	Hinges	T4A3786 4 1/2 X 4 1/2 NRP	26D	MC
2	Fire Exit Device	9847EO-F ER-ADJ10 LBRAFL	US32D	VO
2	Closer/Stop	4040 XP CUSH DEL SRT	AL	LC
2	Protection Plate	K1050 10 x LTS	US32D	RO
1	Smoke Seal	S88 BL x LTS		PE
1	Length Adhesive Seal	S771 C x LTS		PE
1	Threshold	228 A x LTS		PE

SET #005

1	Electric Hinge	T4A3786 4 1/2 x 4 1/2 QC8	26D	MC
7	Hinges	T4A3786 4 1/2 X 4 1/2 NRP	26D	MC
1	Set Flush Bolts	2845	US26D	RO
1	Dust Proof Strike	570	US26D	RO
1	Lockset	L9070BD 06A	626	SC
1	Const Core	Green	626	BE
1	Coordinator	2672	BLK	RO
2	Closer	4040 XP EDA DEL SRT	AL	LC
2	Protection Plate	K1050 10 x LTS	US32D	RO
1	ElectroLynx Harness	QC-C1500P		MC
2	Mounting Bracket	2601C	US28	RO
1	ElectroLynx Harness	QC- To suit door		MC
1	Smoke Seal	S88 BL x LTS		PE
1	Length Adhesive Seal	S771 C x LTS		PE
1	Threshold	228 A x LTS		PE
1	ACSI Mortise Lock Mod	M1520-AE-I-L9080-24VDC-LC		

NOTE: Reader, Door Contact, Power Supply (except at EL Exit Devices) and wiring by Security. Reader unlocks lever for entry. Exit by IS lever or push pad.

SET #006

Exterior Man Gates:

Prehung	By Others	
1 Exit Device	98NL x 990NL-R&V	US26D, US32D
1 Rim Cylinder Housing	80-129	US26D
1 Cylinder Core	Construction	
1 Cylinder Core	Perm. By Owner	
1 Closer/Stop	4040 XP SCUSH	AL
1 Electric Strike	6111	US26D

NOTE: See Set 003 except Reader on both sides. Coordinate hardware with gate details.

END OF SECTION

SECTION 08 80 00
GLAZING

PART 1 – GENERAL

1.1 SUMMARY

A. General requirements and definition of glass types for glazing work specified under other individual specifications.

B. Furnish and install the following:

1. Tempered glass in hollow metal doors and frames.
2. Wireless fire resistant rated glazing in designated rated doors and frames.
3. All materials required to properly install glass furnished hereunder, including sealant, tapes, setting blocks, and spacers.

C. Work of this section includes installation of glazing beads furnished under related sections.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - ROUGH CARPENTRY: Installation of steel door frames.

B. Section 07 92 00 - JOINT SEALANTS: Requirements for sealants and backing materials.

C. Section 08 11 13 - HOLLOW METAL DOORS AND FRAMES: Steel doors, door and window frames, and related glazing stops, for both fire-resistance rated (labeled) and non-rated (labeled) conditions.

1.3 REFERENCES

A. Referenced Standards: Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. AAMA 804.1 - Ductile Back-Bedding Compound.
2. ASTM C 1036 - Flat Glass.
3. ASTM C 1048 - Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass.
4. ANSI Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Used in Buildings.
5. Consumer Product Safety Commission (CPSC) 16CFR 1201 Code of Federal Regulations for Architectural Glazing Materials.
6. Federal Safety Standards for Architectural Glazing Materials 16CFR1201.
7. NFPA Publication 80 - Fire Doors and Windows.
8. SGCC: Certified Products Directory, and Certification Guidelines.

B. Inclusionary References: The following reference materials are hereby made a part of this Section by reference thereto:

1. GANA Laminated Glazing Reference Manual (2009 edition).
2. GANA - Glazing Manual (50th Anniversary edition).
3. Consumer Product Safety Commission-Safety Standard for Architectural Glazing Materials.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. General: Coordinate the work of this Section with the respective trades responsible for installing interfacing and adjoining work for proper sequence of installation, and ensure that the work performed hereunder is acceptable to such trades for the installation of their work.

B. Sequencing:

1. Field Measurements:
   a. Take field measurements before preparation of shop drawings and fabrication, where possible, to ensure proper fitting of Work.
   b. Allow for adjustments within specified tolerances wherever taking of field measurements before fabrication might delay Work.

1.5 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Product Data:
   a. Product data sheets on glazing products: Provide chemical, functional, and environmental characteristics, size limitations, special application requirements. Identify available colors.
   b. Sample Warranty: Provide copies of manufacturers' actual warranties for all materials to be furnished under this Section, clearly defining all terms, conditions, and time periods for the coverage thereof.
2. Shop Drawings: Show sufficient detail to show fabrication, installation, anchorage, and interface of the work of this Section with the work of adjacent trades.
   a. Plans and elevations 1/4 inch scale of each type of glazing assembly, and mirror assembly; indicate dimensions, and reference details. Verify dimensions with field measurements.
3. Verification Samples:
   a. 12 x 12 inch pieces of each specified type and thickness of glass, bearing labels indicating locations where each type of glass will be used.
   b. Glazing tape: 12 inch length of specified type and size.
4. Certificates: Manufacturer's written certification stating that the materials installed, meet or exceed the requirements specified under this Section.

B. Closeout Submittals: Submit the following under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS.

1. Bonds and Warranty Documentation:
   a. Manufacturer’s Warranties and Guarantees as specified elsewhere herein this Section.

1.6 QUALITY ASSURANCE

A. General: Perform glazing work in accordance with GANA - Glazing Manual, FGMA Glazing Manual, SIGMA and LSGA standards for glazing and installations methods.

1. Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.

B. Glass Labeling:

1. General: Manufacturer's Label shall be acid-etched, sandblasted, ceramic-fired, laser- etched, embossed, or other similar type which, once applied, cannot be removed without being destroyed.
2. Safety glass: Label tempered and laminated safety glass with permanent manufacturer's label on each light with the mark visible after installation.
   a. Furnish SGCC certification for safety glass in compliance with CPSC 16 CFR 1201 Cat 1 or Cat 11, or ANSI Z-97.1.
3. Fire-rated glass: Label each individual glazing unit with appropriate UL, Warnock Hersey, or other approval labeled markings with the listing mark visible after installation.

C. Qualifications:

1. Fabricators: Glazier specializing in applying the work of this Section with a minimum of 5 years' experience.
2. Installer/Applicator: Minimum of 3 years documented experience demonstrating previously successful work of the type specified herein.

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:

1. Do not deliver items to the site, until all specified submittals have been submitted to, and approved by, the Architect.
2. Deliver materials in labeled, protective packages, when and as required.

B. Storage and Handling Requirements:

1. Store and handle in strict compliance with manufacturer's instructions and recommendations of GANA Glazing Manual. Use clean gloves and tools when handling materials, avoid contamination. Use rolling blocks and suction cups to move glass units not in shipping crates.
   a. Carefully store materials to avoid overloading any building component or structure.
   b. Do not unpack material until it is to be set, unless un-packing is required for inspection by the Architect.
2. Protect factory finished materials from damage due to moisture, direct sunlight, excessive temperatures, surface contamination, corrosion and damage from construction operations and other causes.

1.8 SITE CONDITIONS

A. Do not install glazing when ambient temperature is less than 50 degrees Fahrenheit.

B. Maintain minimum ambient temperature before, during and 24 hours after

installation of glazing compounds.

1.9 WARRANTY

A. General: Submit warranties under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS.

B. Manufacturer Warranty/Guarantee: All shall include replacement of defective glass and mirrors, and delivery of replacement glass products furnished f.o.b. from point of manufacturer to project site.

1. Laminated glass: Manufacturer's 4 year written guarantee covering against defects in materials and workmanship of laminated glass and replacement of the same. Warranty shall be effective from date of original factory shipment to site.

a. Provide coverage in Guarantee for manufacturing defects, including failure of laminated glass units as evidenced by edge separation, delamination, or discoloration of inner layer.

PART 2 - PRODUCTS

2.1 GLASS - GENERAL

A. General requirements for glass: Of domestic and foreign manufacture, conforming to the referenced standards and with the additional requirements specified herein; factory labeled on each pane stating the strength, type, thickness and quality; with all labels remaining on glass until final cleaning.

1. Glass thickness shown and heat treatment specified are minimum requirements. Provide glass thickness and heat treatment as required to meet specified performance criteria, State and local codes and ordinances.

B. Float Glass: Comply with ASTM C 1036, Class 1 clear, quality q3 glazing select.

C. Heat Strengthened Glass: Comply with ASTM C 1048 HS, heat strengthened, Class 1 clear, quality q3 glazing select.

D. Tempered Glass: Comply with ASTM C 1048 FT, fully tempered, Class 1 clear, quality q3 glazing select, conforming to ANSI Z97.1.

E. Laminated glass: consisting of an outer face and inner face of specified glass, factory laminated to translucent polyvinyl butyl (PVB) innerlayer equal to Monsanto "Saflex" or DuPont "Butacite. Certified by Safety Glazing Certification Council. Glass shall be free from foreign substances and air pockets.

2.2 GLASS – TYPES

A. Glass Type 1: Not Used

B. Glass Type 2: Not Used.

C. Glass Type 3: Not Used

D. Glass Type 4: 8mm-9 mm thick (5/16 inch-3/8 inch) transparent wire-less fire rated ceramic glazing material with polished finish.

1. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or approved equal:

a. Nippon Electric Glass Co., Ltd., “Firelite Plus”.
b. Vetrotech Saint-Gobain, “SSG Keralite FR-L”.
c. SAFTI First, “Pyran Platinum L”.

2. For fire rated door assemblies, conform with latest edition of ASTM E152, ASTM E163, NFPA-80, NFPA 252, NFPA 257.
3. Conforms to ANSI Z97.1 - Safety Performance Specifications and Methods of Test for Safety Glazing Used in Buildings.
4. Permanently identify each individual glazing unit with a listing mark visible after installation.
5. In accordance with manufacturer's specifications, Firelite Plus must be glazed into frames with a similar rating, using silicone glazing compound which shall be supplied with the Firelite Plus material.

2.3 FABRICATION

A. General: Do not fabricate materials until all specified submittals have been submitted to, and approved by, the Architect.

B. Fabricate glass as required to openings with edge clearances and bite on glass as recommended by the manufacturer with clean-cut edges where concealed, and smooth- ground, polished and seamed edges where exposed to view. Do not cut, seam, nip or abrade glass after heat-tempering.
   1. For non-tempered to be cut at site, provide glass larger than required so as to obtain clean cut edges without seaming or nipping.

C. Fabricate glass with the following edge treatments.
   1. Exposed edges: Polished-finished radiused (penciled).
   2. Concealed edges: Cut edges with minimum edge work.
   3. Butt-joint edges: Flat round and finished with edges eased.

D. Shop Fabrication:
   1. All vision panels and baffles shall be cut to size by manufacturer or by fabricator prior to delivery to site. All glass edges shall be ground smooth, polished and eased. Provide all necessary holes wherever required by the approved Shop Drawings, drilled and tapped to suite project requirements. Do all cutting and drilling prior to tempering.

2.4 ACCESSORIES

A. Glazing tape: Preformed butyl-polyisobutylene rubber with 100 percent solids contained in extruded tape roll form and complying with AAMA 804.1; coiled on release paper; of sizes required for proper glazing. equal to one of the following:
   1. Protective treatments 3030 or 606.
   2. Tremco Preshimmed 440.
   3. Woodmont Chem-Tape 40.

B. Setting blocks: Neoprene, 80-90 shore A durometer hardness, certified to be “silicone compatible”; sized as follows:
   1. Length: 0.1 inch per square foot of glass, but not less than 4 inches.
   2. Width: equal to glazing rabbet space minus 1/16 inch.
   3. Height to suit glazing method and pane weight and area.

C. Spacers: Neoprene, 60-80 shore A durometer hardness; sized as required.

D. Glazing sealant:

1. General glazing sealant: One-part medium modulus, neutral curing, synthetic rubber sealant, having a useful life expectancy of at least 20 years, conforming to ASTM

   C 920, Type S, grade NS, Class 25 for uses NT, G and A, FS TT-S-001543A, Type, Class A. Color as selected by Architect.

   a. Dow Corning Corporation, Midland MI; product, “Silicone Glazing Sealant”.
   b. General Electric Company (GE Silicones) Waterford NY; product, “SilGlaze II SCS2800”.
   c. Tremco, Beachwood OH: product, “Proglaze.

E. Bond-breakers and backing materials: Type recommended by manufacturer of sealants and gaskets.

F. Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

G. Adhesive for back painted glass, clear silicone:

1. Dow Corning Corporation, Midland MI; product, “791”.
2. General Electric Company (GE Silicones) Waterford NY; product, “Silpruf”.
3. Pecora Corporation, Harleysville PA; product, “895”.
4. Sika Corp, Lyndhurst NJ; product, “Sika Sil-C 995”.

2.5 ACCESSORIES FOR WIRE-LESS FIRE-RATED GLAZING

A. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent.

B. Silicone Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable. Available Products:

1. Dow Corning Corporation, Midland MI.; product, “795”.
2. General Electric Company (GE Silicones) Waterford NY.; product “Silglaze-II 2800”
3. Tremco, Beachwood OH.; product, “Spectrem 2”.

C. Setting Blocks: Neoprene, EPDM, or silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.

PART 3 - EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Inspect receiving surfaces and ensure that they are dry and free from dust, or other foreign materials before glazing. Clean all surfaces with cloth saturated with mineral spirits of high- flash naphtha as recommended by glazing tape manufacturer, before glazing.

B. Field Measurements: Verify that field measurements are as indicated on approved

Shop Drawings.

1. Check all openings, prior to glazing, to make certain that the opening is square, plumb and secure in order that uniform face and edge clearances are maintained.
2. Determine the actual sizes required by measuring the receiving openings. Size glass and mirrors to permit required clearance and bite around full perimeter of glass, as set forth in the referenced FGMA standards, or as recommended by the glass manufacturer. Do not nip edges, to remove flares or to reduce oversize dimensions, under any circumstance.

C. Beginning of installation means acceptance of existing conditions.

3.2 GENERAL INSTALLATION OF GLASS HAVING PERMANENT LABELS

A. Install glass units so that appropriate manufacturer's permanent label for safety glass, and permanent label for fire-rated glass are visible.

3.3 INSTALLATION - DRY GLAZING

A. Utilize dry glazing methods for field installation of glass in interior doors and frames.

1. Install in vision panels in fire-rated doors and frames to requirements of NFPA 80.

B. Cut glazing tape to length and set against permanent stops, projecting 1/16 inch (2 mm) above sight line.

C. Place setting blocks at 1/4 points with edge block no more than 6 inches from corners.

D. Rest glazing on setting blocks and push against tape for full contact at perimeter of pane.

E. Place glazing tape on free perimeter of glazing in manner as described above.

F. Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.

G. Knife trim protruding tape.

3.4 INSTALLATION - WET GLAZING

A. Place setting blocks at quarter points on web of sill receiving member. Set glass unit in place with equal spaces on all sides.

B. Install spacers at a spacing not exceeding 24 inches apart uniformly around perimeter, between interior face of glass unit and the fixed glazing rabbet.

C. Apply a continuous heel bead of specified sealant between the outer edges if the glass unit and the web of the receiving member, in sufficient quantity to engage the leg of the applied glazing stop, when installed.

D. As the glazing stop is being applied, install spacers between the outer face of the glass unit and the stop, locating the spacers directly opposite the previously installed interior spacers. Install the glazing stops, ensuring that all clearances around the perimeter of the glass unit conform to the requirements of the respective standards referenced herein.

E. Apply a continuous bead of sealant around the exterior and interior perimeters, between the glass unit and the fixed rabbet, and between the glass unit and the applied glazing stop, extending the sealant material slightly above the sight line to permit proper tooling thereof.

F. Tool all exposed sealant at a 45 degree angle away from the glass surface, leaving the sealant surface uniformly dense and smooth.

G. Immediately remove all excess sealant from surfaces of metal and glass.

3.5 PROTECTION

A. Protect glass from breakage immediately upon installation. Use streamers or ribbons suitably attached to framing and held free of the glass. Do not apply warning markings directly to the glass.

B. Cover glass to protect it from activities that might abrade the glass surface.

3.6 CLEANING

A. Clean glass surfaces promptly after installation, exercising care to avoid damage to the same. Remove excess glazing tape, labels, dirt, and other contaminants.

END OF SECTION

SECTION 08 91 00
LOUVERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Louvers, frames, and accessories for small exhaust louvers.

1.2 RELATED REQUIREMENTS

A. Section 07 9200 - Joint Sealants: Sealing joints between frames and adjacent construction.

1.3 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.

1.4 SUBMITTALS

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

B. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.

C. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, and frames. Include locations, sizes, profiles, and anchoring requirements for louver support brackets.

D. Samples: Submit full size sample to be used when approved; in size illustrating finish and color of exterior surfaces.

E. Test Reports: Independent agency reports showing compliance with specified performance criteria.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

C. Delegated Design of Support Brackets. Engage a qualified professional engineer to design louver support brackets and bracket anchoring system.

1.6 WARRANTY

A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.

B. Provide twenty-year manufacturer warranty against distortion, metal degradation, and failure of connections.
   1. Finish: Include coverage against degradation of exterior finish.

PART 2 PRODUCTS

2.1 LOUVERS

A. **FIXED, EXTRUDED-ALUMINUM LOUVERS**

1. Vertical, Wind-Driven-Rain-Resistant Louver:
2. Basis-of-Design Product: Subject to compliance with requirements, provide Louver Type Model EL-2, by United Enertech or comparable product approved by the architect:
3. Extruded Aluminum Louver - 8” diameter round
4. Louver Depth: 2.16 inches,
5. Frame and Blade Nominal Thickness: Not less than 0.060 inch. Blade extruded aluminum positioned on a 37degree angle on approximately 1.47” centers.
6. Louver Performance Ratings:
   a. Free Area: minimum .25SF of free area.
   b. Air Performance: Not more than 0.26-inch wg static pressure drop at 1000-fpm free-area intake velocity.
   c. Wind-Driven Rain Performance: Not less than 99 percent effectiveness when subjected to a rainfall rate of 8 inches per hour and a wind speed of 50 mph at a core-area intake velocity of 400 fpm.
   d. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
7. Screen: Provide screen at each exterior louver.
   a. Screen Location for Fixed Louvers: Interior face.
   b. Screening Type: .75” x 051”, flattened aluminum wire screen.
   c. Secure screen frames to louver frames with machine screws with heads finished to match louver.
   d. Metal: Same type and form of metal as indicated for louver to which screens are attached. Reinforce extruded-aluminum screen frames.
   e. Finish: Same finish as louver frames to which louver screens are attached.

2.2 MATERIALS

A. Extruded Aluminum: ASTM B221 **(**ASTM B221M**).**

2.3 FINISHES

A. Clear Anodize 204 R-1 Class II (AA-C22A31) (0.4 to 0.7 mil)

PART 3 EXECUTION

3.1 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.

END OF SECTION

SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install:

1. Metal furring and framing where indicated on the Drawings, including cross bracing and knee bracing.
2. Metal ceiling and soffit framing.
3. Metal ceiling and soffit framing, including hanger attachments, wire hangers, and screwable metal tee grid system.
4. Reinforcing plate blocking.
5. Deflection track assemblies at tops of metal stud partitions.
   a. Provide fire-rated assemblies at fire-rated, corridor, and smoke partitions.
   b. Provide non fire-rated assemblies at all other partitions.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - ROUGH CARPENTRY:

1. Wood blocking.
2. Installation of metal door frames in gypsum board work.

B. Section 07 21 00 - THERMAL INSULATION.

C. Section 08 11 13 - HOLLOW METAL DOORS AND FRAMES: Furnishing steel door frames.

D. Section 08 31 00 - ACCESS DOORS AND PANELS: Shop primed access panels, occurring in partitions and walls.

E. Section 09 29 00 - GYPSUM BOARD: Gypsum board, applied over metal framing installed by this Section 09 22 16 including: gypsum board, and related trim components.

F. Section 09 51 00 - ACOUSTICAL CEILINGS: Suspended acoustical tile ceiling, including metal suspension system.

G. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING: Supply and return air registers.

H. Division 26 - ELECTRICAL: Independent hangers for suspended lighting fixtures.

1.3 REFERENCES

A. Reference Standards: Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ASTM C 525 - General Requirements for Steel Sheet, Zinc-Coated

(Galvanized) by the Hot-Dip Process.

2. ASTM C 645 - Non-Load Bearing Steel Studs, Runners, and Rigid Furring Channels for Screw Application of Gypsum Board.
3. ASTM C 646 - Steel Drill Screws for the Application of Gypsum Sheet Material to Light Gage Steel Studs.
4. ASTM C 754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Wallboard.
5. ASTM E 90 - Method of Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
6. ASTM E 119 - Fire Tests of Building Construction and Materials.
7. GA 203 - Installation of Screw-Type Steel Framing Members to Receive Gypsum board.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work of this Section with the respective trades responsible for installing interfacing work, and ensure that the work performed hereunder is acceptable to such trades for the installation of their work
2. Work of this Section shall be closely coordinated with the work of Section 09 29 00 - GYPSUM BOARD to assure the steady progress of the Contract.

1.5 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Product Data: Manufacturer's product data sheets, specifications, performance data, physical properties for each item furnished hereunder.

1.6 QUALITY ASSURANCE

A. General: Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.

B. Sole Source: Obtain products required for the Work of this Section from a single manufacturer.

C. Qualifications:

1. Installer/Applicator: Minimum of 3 years documented experience demonstrating previously successful work of the type specified herein.

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:

1. Do not deliver items to the site, until all specified submittals have been submitted to, and approved by, the Architect.

B. Storage and Handling Requirements:

1. Store and handle materials following manufacturer's recommended procedures, and in accordance with material safety data sheets.
2. Protect materials from damage due to moisture, surface contamination,

corrosion and damage from construction operations and other causes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or approved equal:

1. Metal components and related items (including non-rated deflection track assemblies):
   a. Clarkwestern Dietrich Building Systems, LLC, Schiller Park, IL.
   b. Marino\Ware, Division of Ware Industries, South Plainfield, NJ.
   c. Cemco Steel Framing and Metal Lath, City of Industry, CA.
   d. Telling Industries, Mentor, OH.
   e. Super Stud Building Products, Inc., Edison, NJ.
2. Fire rated deflection track assemblies:
   a. Clarkwestern Dietrich Building Systems, LLC, Schiller Park, IL.
   b. Cemco Steel Framing and Metal Lath, City of Industry, CA.
   c. The Steel Network, Inc., Durham, NC.
   d. Fire Trak Inc., Watkins, MN.
3. Suspended furring system for ceilings and soffits:
   a. Armstrong World Industries, Inc., Lancaster, PA.
   b. Chicago Metallic Corporation, Chicago, IL.
   c. USG Corporation, Chicago, IL.

B. The design and details as shown on the drawings and the model numbers specified herein are to establish the standards of design and quality and not to limit competition.

2.2 DESCRIPTION

A. Regulatory Requirements:

1. Obtain certificate of compliance from authority having jurisdiction indicating approval of specified products.
2. Fire resistance ratings: Where gypsum board systems with fire-resistance ratings are indicated, provide materials and assemblies of the rating required, tested per ASTM E 119, which are identical to those indicated by reference to Gypsum Association file numbers in "Fire Resistance Design Manual" or to design designation in the Underwriters Laboratories "Fire Resistance Directory" or in listing of other testing agencies acceptable to authorities having jurisdiction and to the Owners' insurance underwriters.
   a. Fire-Test-Response Characteristics: Provide components that comply with rating requirements specified for fire-rated assemblies under UL 2079 for non-load bearing wall systems.
      1) Deflection Clips and Firestop Track: Connections and/or top runner provided in fire-resistance-rated assemblies shall be certified by UL 2079 for cyclic movement requirements.

2.3 FRAMING MATERIALS

A. “Hat shaped” Furring channels: 7/8 x 2-3/4 inch, roll-formed, hat-shaped, furring channel 25 gage hot-dip galvanized steel galvanized steel conforming to ASTM C 645.

B. Resilient furring channels: Roll-formed, hat-shaped, 1/2 x 2-5/8 inch, 26 gage hot-dip galvanized steel conforming to ASTM C 645, with pre-punched holes, equal to Dietrich Industries, Inc., Pittsburgh PA, Metal Channel "RC1".

C. Furring channels: 'Z-shaped' 1-1/2 inch depth, roll-formed, 25 gage (0.179 inch [0.45 mm] minimum thickness), hot-dip galvanized steel.

D. Studs: 'C-shaped' screw studs, hot-dip galvanized steel complying to ASTM C 645, 20 gage-equivalent (nominal 0.02 inches [0.75 mm] factory ribbed and/or embossed for performance equivalent to 20 gage (0.0329 inch [0.84 mm] minimum thickness studs), of widths indicated on the Drawings.

1. Acceptable products include the following or approved equal:
   a. Clarkwestern Dietrich Building Systems, LLC, product ""UltraSTEEL, USTE series".
   b. Marino\Ware, Division of Ware Industries, product: "ViperStud Viper20".
   c. Cemco Steel Framing and Metal Lath, product; "ViperStud Viper20".
   d. Telling Industries, product; "ViperStud".
   e. Super Stud Building Products Inc., product: "Edge EQ, EDS20P".
2. Provide full 20 gage (0.0329 inch [0.84 mm] minimum thickness studs where required under the indicated UL assemblies to meet fire resistance ratings.

E. Runners for metal studs: 'U-shaped' hemmed, hot-dip galvanized steel track conforming to ASTM C645, of gage and width to match respective stud sizes, or heavier gage per design requirements, having 1-1/4 inch leg, provided at tops and bottoms of all studs and at heads of all openings in stud partitions.

F. Internal reinforcement for various stud conditions, and bracing as required: 10 gage, minimum, galvanized steel.

G. Furnish cross bracing and knee bracing, as required to assure a completely rigid assembly on metal stud partitions and furred areas.

2.4 DEFLECTION TRACK ASSEMBLIES:

A. Non Fire-Rated Assemblies

1. Deflection Track: Manufacturer's standard top runner with extended flanges designed to prevent cracking of gypsum board applied to interior partitions resulting from deflection of the structure above fabricated from steel sheet complying with ASTM A 653 or ASTM A 568. Thickness as indicated for studs, and width to accommodate depth of studs, and the following configuration.
   a. Top runner with extended deep flanges that have one of the following: V-shaped offsets that compress, slots 1 inch on center that allow fasteners for stud attachment; 16 gage sliding clip assemblies attached to top track and clipped to stud, or double track systems as required to meet anticipated vertical movement.
2. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or approved equal:
   a. Clarkwestern Dietrich Building Systems, LLC, product; "Deep Leg Deflection Track System", "Fast Top Clip", or "DoubleTrack System".
   b. Marino\Ware, Division of Ware Industries, product: "Slotted Track".
   c. Cemco Steel Framing and Metal Lath, product; "Slotted Track CST".

d. Telling Industries, product; “ViperTrack Deep Leg Deflection Track”.

e. Super Stud Building Products Inc., product: “ITTC 450 Top Track Deflection Clip”.

f. The Steel Network, Inc., product; “VertiTrack VT”, “VertiTrack VTD”, or “VertiClip SLD”.

B. Fire-Rated Assemblies: Head of wall dynamic fire rated joint systems for assemblies in compliance with UL 2079 HW-D. Provide clips or deep leg track system including step bushings complying with ASTM C 645 fabricated from steel sheet complying with ASTM A 653 or ASTM A 568. Thickness as indicated for studs, and width to accommodate depth of studs.

1. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or approved equal:

a. Clarkwestern Dietrich Building Systems, LLC, product; ”SLP-TRK Slotted Deflection Track”.

b. Clarkwestern Dietrich Building Systems, LLC, product; ” Blazeframe DL2 Deep Leg Deflection Track”.

c. Cemco Steel Framing and Metal Lath, product; “FAS Track UL Assemblies”.

d. The Steel Network, Inc., Durham, NC. product; “VertiClip SLD”.

e. Fire Trak Inc., Watkins, MN, product “Fire Trak”, or “Posi Clips”

C. Coordination: Verify with partition schedule on the Drawings to ensure proper depth of flange offsets at various partitions types.

2.5 CEILING AND SOFFIT SUSPENSION MATERIALS

A. Hanger attachments: Galvanized steel hanger eyes, of size and capacity to safely sustain a live load of at least 150 pounds per hanger attachment.

B. Hangers: Soft temper, pre-stretched galvanized carbon steel wire, conforming with ASTM A641, with a yield stress load of at least three times design load, but not less than 12 gage.

C. Grid system for direct attachment of finish board: Comprised of double web main furring tees, 1 1/2 inches high by 1-3/8 inches flange face by 0.020 inch thick; double web cross tees, 1 1/2 inches high by 15/16 inch flange face by 0.020 inch thick; 0.020 inch thick wall channels, with 1 1/2 inches interior web height; and all splices, clips, and related items. Provide Underwriters Laboratories Label fire-rated assemblies for locations requiring fire- rated ceilings and soffits

1. Chicago Metallic product “system 640 Furring System”.
2. Armstrong Word Industries product “Drywall Furring System”.
3. Donn (USG) Corporation, Chicago IL., product “USG Drywall Furring System” with DGLW tees.

2.6 CEILING AND SOFFIT FRAMING MATERIALS

A. Carrying channels, 2 inches deep, 16 gage cold-rolled channels, galvanized.

B. Support channels: 3/4 inches deep, 16 gage cold-rolled channels, galvanized.

C. Furring Channels: 7/8 x 2-3/4 inch, roll-formed, hat-shaped, furring channel 25 gage hot-dip galvanized steel galvanized steel conforming to ASTM C 645.

D. Metal Studs used in soffit and ceiling framing: 'C-shaped' screw studs, hot-dip galvanized steel complying to ASTM C 645, 25 gage, of widths indicated on the Drawings, or other gages as required under the specified standards to meet fire resistance ratings.

2.7 ACCESSORIES

A. Metal sheet plate blocking and bracing, where indicated: galvanized sheet 0.0312 inch thickness (20 gage).

B. Fasteners:

1. Expansion-type fasteners for securing vertical concrete and masonry surfaces.
2. Concrete stub nails for securing runners to concrete.
3. Nº.7 by 7/16 inch Pan head self-drilling screw to attach metal framing components.

C. Reinforcing plates for blocking: 20 gage cold rolled sheet steel, provide minimum 6 inch width, or as otherwise indicated on the drawings.

PART 3 – EXECUTION

3.1 INSTALLATION, QUALITY STANDARDS

A. General: Perform erection procedures for the various gypsum board system conditions, except as otherwise specified, as set forth in GA 201, GA 206, the written instructions of gypsum board manufacturer, together with the additional requirements specified herein and as indicated on the Drawings.

B. Wherever fire-resistive rated assemblies are indicated on the Drawings, erect gypsum board systems in strict accordance with the manufacturers' UL listed test constructions for the required fire rating on each specific assembly.

3.2 INSTALLATION OF FURRING

A. Install metal furring channel horizontally, with channels spaced not more than 16-inch on centers , and attaching the channels to the masonry or concrete substrates with expansion type fasteners spaced not more than 8 inches on centers. Shim beneath channels as needed to ensure that a uniform receiving plane is maintained throughout.

3.3 INSTALLATION OF PARTITION FRAMING, GENERAL

A. Install metal runners at floor and ceiling to structural elements with suitable fasteners located 2 inches from each end and intermediate fasteners spaced no greater than 24 inches.

B. Install metal stud framing with open side facing in same direction, engaging floor and ceiling runners.

1. Stud spacing:
   a. Typical: 16 inches on-center.
   b. For cement board substrate to receive tile finishes: 16 inches on-center.
   c. For partitions supporting wall cabinets and other wall mounted equipment: 12 inches on-center.
   d. For curved partitions space framing closer together than normal to prevent flat areas between framing members.
2. When necessary to splice studs, nest stud with 8 inch overlap and screw

studs together with screws on both flanges.

3. Where studs are installed directly to exterior masonry walls, install asphalt felt between stud and wall.

C. Install studs in direct contact with all door and window frame jambs, abutting partitions, partition corners and existing construction elements; screw fasten with screw through both flanges of studs and track, top and bottom.

D. Securely anchor studs to jamb and head anchors of steel door and window frames. Over head of frames and openings in partitions install a horizontal section of runner with a web flange bent at each end horizontally and secure to strut studs with two screws in each bent web. Provide cripple studs over wall openings.

E. Where horizontal studs are used for wall reinforcing or framing, cut pieces of stud and install horizontally between vertical studs. Cope horizontal studs to fit between flanges of vertical studs. Bend ends of horizontal studs or install clip angles in order to secure by screwing to vertical studs.

F. Furnish and install additional cross bracing and knee bracing and other framing elements, as required to assure a completely rigid assembly on metal stud partitions and furred areas, whether or not such bracing has been indicated on the Drawings, and for proper receipt of items which will be attached to partition surfaces.

3.4 INSTALLATION OF DEFLECTION TRACK

A. Isolate interior metal stud framing and shaft wall framing from building structure to prevent transfer of loading imposed by structural movement due to deflection.

1. Install deflection track top runner in accordance with manufacturer's instructions and as required to attain lateral support and avoid axial loading.
2. Install fire-rated deflection track top runner in accordance with manufacturer's instructions at top of fire-rated, corridor and smoke partitions.

3.5 INSTALLATION OF REINFORCING PLATE BLOCKING

A. Install steel reinforcing plates in partitions and furred walls for the support of wall mounted objects as follows:

1. Wherever such reinforcing plates are indicated on the drawings.
2. In locations where wall bumpers are to be installed for the protection of wall surfaces from swinging doors. (See Section 08 71 00 - DOOR HARDWARE).

B. Secure gage sheet metal reinforcing plates to steel studs with 1-1/4", Type "S" bugle head screws.

3.6 INSTALLATION - CEILING SUSPENSION SYSTEM

A. Coordinate layout and installation of suspension system components for suspended ceilings with other work supported by, or penetrating work of this section. Re-adjust ceiling suspension system, prior to the installation of the gypsum board and after installation of mechanical and electrical equipment and fixtures by the respective trades.

B. Install all components of concealed grid system in accordance with the manufacturer's instructions, with current ASTM C 636 requirements, with design and installation of suspended grid system safely sustaining a membrane loading of at least 7.9 pounds per square foot.

C. Install hangers not more than 24 inches on centers over locations of main tee members. Install hanger wires to hanger attachment with triple twists. Install additional wires as required to provide support for main tees, at intervals not exceeding four feet, wherever

main tees must be interrupted in order to install other work and at all other locations as may be directed by the Architect.

D. Install main tees parallel to long dimension of the area, at spacing not to exceed 48 inches on-center. Secure with hanger wire as the work progresses. Install cross tees as recommended by the system manufacturer, except spacing shall not exceed16 inches on- center.

3.7 INSTALLATION OF CEILING AND SOFFIT FRAMING

A. Install framing to height indicated, independent of walls, columns, and above ceiling work. Erect after Work above ceiling is complete. Coordinate the location of hangers with other work.

B. Securely anchor hangers to structural members or embed in structural slab. Space hangers to achieve deflection limits indicated.

C. Space main carrying channels at maximum 48 inch centers; not more than 4 inches from wall surfaces. Lap splice securely.

D. Securely fix furring channels or metal studs to hangers to prevent turning or twisting and to transmitted full load to hangers.

1. Place furring channels perpendicular to carrying channels at 16 inches on center, not more 1 inch from perimeter walls and rigidly secure. Lap splice securely.
2. Screw fasten metal studs perpendicular to carrying channels at 16 inches on center, not more 1 inch from perimeter walls. Lap splice securely.

E. Reinforce openings in suspension system which interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.

3.8 TOLERANCES

A. Install partition and ceiling framing and furring with a maximum variation from true flatness of 1/8 inch per 10 feet, noncumulative.

END OF SECTION

SECTION 09 29 00
GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install:
   1. Taped, compounded and sanded gypsum board finishes.
   2. All trim and accessory components related to gypsum board work. Acoustical joint sealant and backing at perimeter of gypsum board partitions.
   3. Shaftwall system(s), including framing, liner panels, and gypsum board finish components.

B. Install access panels occurring in gypsum board work furnished by Section 08 31 00 - ACCESS DOORS AND PANELS, and by trades requiring the same.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - ROUGH CARPENTRY:
   1. Wood blocking supporting gypsum board.
   2. Installation of metal door frames in gypsum board work.

B. Section 06 20 00 - FINISH CARPENTRY: Interior wood trim.

C. Section 08 11 13 - HOLLOW METAL DOORS AND FRAMES: Furnishing steel door frames.

D. Section 08 31 00 - ACCESS DOORS AND PANELS: Shop primed access panels, occurring in partitions and walls.

E. Section 09 22 16 - NON-STRUCTURAL METAL FRAMING: Non-load bearing partition and ceiling framing and furring.

F. Section 09 51 00 - ACOUSTICAL CEILINGS: Suspended acoustical tile ceilings.

G. Section 09 81 00 – ACOUSTICAL INSULATION: Acoustical batt insulation.

H. Section 09 91 00 - PAINTING: Applied finish coatings.

I. Section 10 40 00 - SAFETY SPECIALTIES.

J. Division 21 - FIRE SUPPRESSION: Sprinkler heads in ceiling system.

K. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING: Supply and return air registers.

L. Division 26 - ELECTRICAL: Independent hangers for suspended lighting fixtures.

1.3 REFERENCES

A. Reference Standards: Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 -

REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ASTM C 475 - Joint Treatment Materials for Gypsum Wallboard Construction.
2. ASTM C 630 - Water Resistant Gypsum Backing Board.
3. ASTM C 754 - Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board.
4. ASTM C 919 - Use of Sealants in Acoustical Applications.
5. ASTM C 1002 - Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
6. ASTM C 1047 - Accessories for Gypsum wall board and veneer base.
7. ASTM C 1396 - Gypsum Wallboard.
8. ASTM D 3678 - Polyvinyl chloride material for indoor exposure.
9. ASTM D 1784 - Polyvinyl chloride material for outdoor exposure.
10. ASTM E 90 - Method of Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions.
11. ASTM E 119 - Fire Tests of Building Construction and Materials.
12. GA 201 - Gypsum Board for Walls and Ceilings.
13. GA 214 - Recommended Specifications for Levels of Gypsum Board Finish.
14. GA 216 - Recommended Specifications for the Application and Finishing of Gypsum Board.
15. GA 220 - Recommended Specifications for Gypsum Board Winter Related Job Problems.
16. UL - Fire Resistance Directory.
17. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
18. All applicable federal, state and municipal codes, laws and regulations for fire rated assemblies.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. General: Coordinate the work of this Section with the respective trades responsible for installing interfacing and adjoining work for proper sequence of installation, and ensure that the work performed hereunder is acceptable to such trades for the installation of their work.
2. Work of this Section shall be closely coordinated with the work of Section 09 22 16 - NON-STRUCTURAL METAL FRAMING, to assure the steady progress of the Contract.

B. Sequencing:

1. Do not install gypsum board until all pipes, ducts, conduits, and other such items which are to be enclosed thereby, have been permanently installed, inspected and approved.

1.5 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Product Data: Manufacturer's product data sheets, specifications, performance data, physical properties for each item furnished hereunder.
2. Shop Drawings:
   a. Details of any special conditions associated with fireproofing.
   b. Mark-up a set of blackline interior elevations indicate corrections to grid layout and provide dimensioning showing locations of all proposed control joints and expansion joints.
      1) Provide interior elevation drawings for interior elevations which are not included as part of the Contract Drawing set.

1.6 QUALITY ASSURANCE

A. General: Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.

B. Sole Source: Obtain products required for the Work of this Section from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum board.

C. Qualifications: Installer/Applicator: Minimum of 3 years documented experience demonstrating previously successful work of the type specified herein.

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:
   1. Do not deliver items to the site, until all specified submittals have been submitted to, and approved by, the Architect.
   2. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B. Storage and Handling Requirements:
   1. Store materials inside, under cover and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes.
      a. Neatly stack board materials flat to prevent sagging.
   2. Handle board materials so to prevent damage to edges, ends and surfaces.
   3. Protect trim, accessories and corner beads from being bent or damaged.

1.8 SITE CONDITIONS

A. Environmental Conditions: In accordance with GA 216, maintain minimum ambient temperature of 50 degrees Fahrenheit 48 hours before, during taping and compounding, and until completely dry thereafter.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering similar products include the following:
   1. Gypsum board products:

a. United States Gypsum Company, Chicago, IL. (USG).
b. National Gypsum Company, Gold Bond Products Division, Charlotte, NC. (Gold Bond).
c. G-P Gypsum Corporation, Atlanta, GA.
d. Lafarge Corporation, Hendron, VA.

2. Polyvinyl chloride trim and accessories:
   a. Plastic Components, Inc., Miami, FL.
   b. Vinyl Corporation, Miami, FL.
   c. Alabama Metal Industries Corporation, (AMICO) Birmingham, AL.
3. Integrated functional reveal with 2 inch chart-rail insert as manufactured by Fry Reglet Corporation, Norcross, GA.
4. Joint Sealants:
   a. Tremco, Beachwood, OH.
   b. United States Gypsum Company, Chicago, IL.
   c. Pecora Corporation, Harleysville, PA.
5. Shaft wall system components:
   a. United States Gypsum Company, Chicago IL. (USG).
   b. National Gypsum Company, Gold Bond Products Division, Charlotte NC. (Gold Bond).
   c. G-P Gypsum Corporation, Atlanta GA.

B. The design and details as shown on the Drawings and the model numbers specified herein are to establish the standards of design and quality and not to limit competition.

2.2 DESCRIPTION

A. Regulatory Requirements:
1. Fire resistance ratings: Where gypsum board systems with fire-resistance ratings are indicated, provide materials and assemblies of the rating required, tested per ASTM E 119, which are identical to those indicated by reference to Gypsum Association file numbers in "Fire Resistance Design Manual" or to design designation in the Underwriters Laboratories "Fire Resistance Directory" or in listing of other testing agencies acceptable to authorities having jurisdiction and to the Owners' insurance underwriters.

2.3 BOARD MATERIALS

A. Non-rated and fire rated gypsum board (for wall fire resistant ratings 120 minutes and less): UL fire resistance rated, ASTM C 1396 ‘Type X’ board, 5/8 inch thick and ¾ inch thick, 48 inch width, of lengths to minimize end joints, with tapered edges.
1. Acceptable products include the following:
   a. USG Sheetrock brand “Firecode Core”
   b. National Gypsum Company, Gold Bond brand product “Fireshield Gypsum Board”.
   c. G-P Gypsum Corporation product, “Toughrock Fireguard”.

B. Sag-resistant gypsum board ceiling panels: Non-rated 1/2 inch thick, 48 inch width, of lengths to minimize end joints, with tapered edges, conforming to ASTM C1396,

ASTM C1395 and ASTM C1396.

1. Acceptable products include the following or approved equal:
   a. USG Sheetrock brand product “Interior Ceiling Panel, Sag Resistant”.
   b. National Gypsum Company, Gold Bond brand product “High Strength Ceiling Board:
   c. G-P Gypsum Corporation product, “Toughrock” 1/2 CD Ceiling Board”
   d. Lafarge Corporation, product “Sagcheck”

2. At fire-resistant rated ceilings, provide 5/8 inch thick fire-rated gypsum board as specified herein.

C. Moisture resistant (MR) gypsum board, fire resistant: Conforming to ASTM C630 and C1396, with Type “X” core 5/8 inch thick, 48 inch width, of lengths to minimize end joints, with tapered edges.

1. Acceptable products include the following or approved equal:
   a. USG Sheetrock brand “Mold Tough Firecode Panels”
   b. National Gypsum Company, Gold Bond brand product “XP Fireshield Gypsum Board”.
   c. G-P Gypsum Corporation product, “Toughrock Fireguard Moisture Guard

2.4 SHAFT WALL COMPONENTS

A. Studs for shaft wall assemblies: or, 20, gage, galvanized and complying with ASTM C 645, 2-1/2 inch size, or as indicated otherwise in the drawings. Acceptable products include the following or approved equal:

1. Dietrich Metal Framing product, “CT” Studs
2. Gold Bond product, “I-Studs”.
3. USG product, “C-H Studs”.

B. Runners for studs in shaft wall assemblies: J-track, galvanized and complying with ASTM C 645, with 2-1/4 inch leg, in size, gage and manufacturer to match shaft wall studs.

C. Struts for jamb framing of door openings in shaft wall assemblies: J-type strut, galvanized and complying with ASTM C 645, 20 gauge, with minimum 3 inch return.

D. Shaftwall liner: UL fire resistance rated, ASTM C 442 - Type X board with beveled edges, 1 inch thick, 24 inches wide, of lengths to minimize end joints. Acceptable products include the following, or approved equal:

1. USG Sheetrock Brand Gypsum Liner Panels
2. National Gypsum Company, Gold Bond brand product “Fire-Shield Shaftliner”.
3. G-P Gypsum Corporation product, “Toughrock Fireguard C”.

E. Standard gypsum board: UL fire resistance rated, ASTM C 1396 ‘Type X’ board, 5/8 inch thick, except where 1/2 inch thickness is indicated on Drawings, 48 inch width, of lengths to minimize end joints, with tapered edges. Acceptable products include the following, or approved equal:

1. USG Sheetrock brand “Firecode C-Core”
2. National Gypsum Company, Gold Bond brand product “Fireshield G, Enhanced Version”.

3. G-P Gypsum Corporation product, “Toughrock Fireguard C”.

2.5 ACCESSORIES

A. Gypsum board polyvinyl chloride trim accessories, conforming to ASTM D 1784 and C 1047.

1. J Bead: Edge trim with exposed 1/2 inch face cap, furnish trim model number corresponding to the board thickness where installed.
   a. Plastic Components model number: 200X-50 (for 1/2 inch thick board) or 200S-58 (for 5/8 inch thick board).
   b. Vinyl Corp. model number: JB50 (for 1/2 inch thick board) or JB58 (for 5/8 inch thick board).
2. L Bead: casing edge trim, furnish trim model number corresponding to the board thickness where installed
   a. Plastic Components model number: 221-50 (for 1/2 inch thick board) or 221-58 (for 5/8 inch thick board).
   b. Vinyl Corp. model number: SB50 (for 1/2 inch thick board) or SB58 (for 5/8 inch thick board).
3. L-Bead with removable leg: Casing edge trim for joints at ceilings doors and windows, with removable leg strip, furnish trim model number corresponding to the board thickness where installed
   a. Plastic Components model number: 224-50 (for 1/2 inch thick board) or 224-58 (for 5/8 inch thick board).
   b. Vinyl Corp. model number: CT-50(for 1/2 inch thick board) or CT-58 (for 5/8 inch thick board).
4. Corner beads, 90 degree with 1-1/4 inch flanges:
   a. Plastic Components model number: 209.
   b. Vinyl Corp. model number: CB125.
5. Arch corner beads with 1-1/4 inch flanges, one flange slotted
   a. Plastic Components model number: 209A.
   b. Vinyl Corp. model number: CB125A.
6. Control joints: “V” type joint with nominal 3/16 inch reveal and removable temporary tape:
   a. Gold bond model “EZ Strip Expansion Joint”.
   b. Plastic Components model number: 2027-16.
   c. Vinyl Corp. model number: CJV16.

B. Tapes and compound:

1. Joint tape: Nominal 2 inch wide, high strength, cross-fibered paper drywall tape.
2. Joint Compound for setting paper joint tape: ‘Speed-setting type compound’, field mixed.
   a. Acceptable products, or approved equal:
      1) USG product “Durabond 20”.
      2) Gold bond product “Stay Smooth 30”.
      3) Georgia Pacific Gypsum LCC, product “ToughRock All-Purpose Dry Mix”
3. Joint Compound for finishing: field mixed joint compound or factory pre-

mixed compound.

a. Field-mixed compounds: acceptable products, or approved equal:
   1) USG product “Durabond 90”.
   2) Gold bond product “Stay Smooth 90”.
   3) Georgia Pacific Gypsum LCC, product “ToughRock Setting Compound 90”.

b. Factory pre-mixed compounds: acceptable products, or approved equal:
   1) USG product “Ready-Mixed Joint Compound”.
   2) Gold bond product “All Purpose Compound”.
   3) Georgia Pacific Gypsum LCC, product “ToughRock Ready Mix All-Purpose Compound”

C. Fasteners (shaft wall framing):

1. Expansion-type fasteners for securing vertical concrete and masonry surfaces.
2. Concrete stub nails for securing runners to concrete.
3. Nº.7 by 7/16 inch Pan head self-drilling screw to attach metal framing components.

D. Fasteners (interior board systems):

1. Type S, bugle head screws complying with ASTM C 1002, for applying gypsum board to metal framing, ceiling grid system, and furring channels.
   a. Not less than 1 inch long for single layer gypsum board.
   b. Not less than 1-5/8 inch [41mm] long for double-layer gypsum board.
2. Type S-12, fine thread self-drilling screws complying with ASTM C 1002,for applying gypsum board to light gage metal framing.
   a. Not less than 1 inch [25 mm] long for 1/2 inch thick single layer gypsum board.
   b. Not less than 1-1/4 inch [31mm] long for 5/8 inch thick single layer gypsum board.
   c. Not less than 1-5/8 inch [41mm] long for double-layer gypsum board,

E. Ceiling buttons, perforated type, 1 inch diameter, for use at multiple layered gypsum board ceiling systems.

F. Laminating adhesive: Ready mix joint compounds as specified herein above.

G. Joint Sealers (interior acoustical sealant type): One component acrylic latex, permanently elastic, non-staining, non-shrinking, non-migrating and paintable. Acceptable products include the following, or approved equal.

1. Tremco, Beachwood OH.; product, “Acoustical Sealant”.
2. United States Gypsum Company, Chicago IL.; product “USG Acoustical Sealant”.
3. Pecora Corporation, Harleysville PA.; product “ AC-20 FTR”.

H. Liquid sealer for cuts, holes and ends of moisture resistant board; provide one of the following or acceptable equal.

1. Shellac type sealer: mix 4 pounds of orange or bleached shellac dissolved in 1 gallon of denatured ethyl-alcohol.
2. Varnish type sealer: Fast setting marine varnish.

2.6 SOURCE QUALITY CONTROL

A. Obtain gypsum board and shaft wall products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that all items which are to be enclosed by Work of this Section, have been permanently installed, inspected and approved.

B. Inspect framing and other substrates; verify that they are in proper condition to receive the work of this Section.

C. Beginning of installation means acceptance of existing substrate and site conditions.

3.2 PREPARATION

A. During the operation of gypsum board work, protect all wood, metal, glass, flooring, and other finished materials against undue soilage and damage by the exercise of reasonable care and precautions. Repair or replace any work so damaged and soiled.

3.3 INSTALLATION - GENERAL

A. General: Perform erection procedures for the various gypsum board system conditions, except as otherwise specified, as set forth in GA 201, GA 216,GA 220, the written instructions of gypsum board manufacturer, together with the additional requirements specified herein and as indicated on the Drawings.

B. Where fire-resistive rated assemblies are indicated, erect gypsum board systems in strict accordance with the manufacturers' UL listed test constructions for the required fire rating on each specific assembly.

C. Install specified control joints where indicated on Drawings and where run of partitions, or furred surfaces exceeds 30 feet. Show locations of all control joints on shop drawings.

1. Locate control joints at corners of head frames of doors.
2. Run vertical control joints continuously to top of partition, shaft wall or furred area, as applicable.

3.4 INSTALLATION OF GYPSUM BOARD

A. Screw fasten only, gypsum board to framing and furring, with ends and edges occurring over firm bearing. At all door jambs screw fasten gypsum panels 8 inches on center to both box studs

1. Erect single layer fire-resistance rated gypsum board vertically.
2. Erect standard and moisture resistant layer board in most economical direction.
3. Erect ceiling and soffit gypsum boards to meet UL requirements, where applicable, stagger end joints over supports. Secure gypsum board with fasteners inserted through ceiling buttons; anchor fasteners directly to framing or suspended support system.

B. Wherever items penetrate the gypsum board surfaces, use extra care in cutting the

gypsum board to ensure a uniformly-dimensioned joint between the penetrating item and the gypsum board, and fill joints with specified sealant material. Verify the expected deflection factor of the penetrating members, and cut the gypsum accordingly, to prevent damage thereto from the deflecting members.

C. Treat cut edges and holes in moisture resistant gypsum board with approved liquid sealer.

1. If shellac is used, apply in thin layers to dry quickly.

D. Installing Trim Accessories:

1. General: For trim with back flanges intended for fasteners, attach to framing with same screw fasteners used for gypsum board. Otherwise, attach trim according to manufacturer's written instructions.
   a. Nailing, stapling, or crimping methods to install trim components is prohibited.
2. Install corner beads at all exterior corners of gypsum boards.
3. Install casings (PVC trim) wherever gypsum board meets a dissimilar material, and in other locations indicated on the Drawings, except at floors where bottom of the board will be concealed by base, integral with flooring, resilient base, wood base or carpeted base.

3.5 INSTALLATION OF SHAFT WALL

A. General: Install shaft wall system in strict accordance with manufacturer's instructions to obtain the required fire rating.

1. Box all openings and penetrations through shaft wall system partitions and ceilings ready to receive firestopping.

B. Installation of framing:

1. Install J runners or E studs at floor and ceiling structural elements with suitable fasteners located 2 inches from each end. Space intermediate fasteners 24 inches on center.
   a. Install runners and studs prior to fireproofing.
   b. Do not splice studs, all studs shall extend from the floor to the underside of the structure above in one single length.
2. Install studs in direct contact with all door and window frame jambs, abutting partitions, partition corners and existing construction elements; screw fasten with one screw per flange.
   a. Where studs are installed directly to exterior masonry walls, install 15 pound asphalt felt between stud and wall.
3. Install C-H studs 3/8 inch to not more than 1/2 inch less than opening height and install between liner panels with liner inserted in the groove. Install full-length steel E- studs over shaft wall liner at T-intersections, corners, columns and both sides of closure panels. Frame openings cut within a liner panel with E-studs around perimeter. For openings, frame with vertical E-studs at edges, horizontal J-strut at head and sill, and reinforcing as recommended by the shaft wall manufacturer. Suitably frame all openings to maintain structural support for wall.
4. Furnish and install additional cross bracing and other framing elements, as required to assure a completely rigid assembly on metal stud partitions and furred areas, whether or not such bracing has been indicated on the Drawings, and for proper receipt of items which will be attached to partition surfaces.

C. Walls surfaces:

1. Liner boards: Cut liner board panels 1 inch less than opening height and erect vertically between J-runners. Where shaft walls exceed 14 feet in height, position liner panel end joints within upper and lower third points of wall. Stagger joints top and bottom in adjacent panels.
2. Erect 1/2 inch fire rated gypsum panel base layer horizontally on one side of studs with end joints staggered. Fasten base layer to studs with 1 inch, Type S-12 screws. Caulk perimeter of base layer panels.
3. Apply 1/2 inch fire rated gypsum panels face layer vertically over base layer with joints staggered and attach with 1-5/8 inch Type S-12 screws staggered from those in base, spaced 12 inches on center, and driven into studs.

D. Horizontal ceiling installation, two hours:
1. Install gypsum panels to horizontally installed CH or E studs.
2. Install the base layer with edges parallel to the studs and attached with 1 inch Type S screws 24 inches on center
3. Install face layer perpendicular to the studs and attach with 1-5/8 inch type S screws 12 inches on center
4. Place face layer end joints between studs and secure with 1-1/2 inch Type G screws 12 inches on center

E. Finish face layer board materials as specified here-in below.

3.6 APPLICATION OF ACOUSTICAL SEALANT

A. General: Install sealant and backing in accordance with the recommendations of ASTM C-919 and sealant manufacturer's recommendations.
1. Perform preparation in accordance with C-790. Thoroughly clean all joints, removing all loose mortar, oil, grease, dust, frost, and other foreign materials that will prevent proper adhesion of primers and sealant materials.
2. If so recommended and furnished by the specific sealant manufacturer, apply primer to all joint surfaces, taking care not to stain adjacent surfaces.

B. Seal all partition perimeters prior to taping or compounding. Where perimeters are edged with metal trim, apply sealant and backing material between trim and dissimilar material.

C. Seal all penetrations in partition types designated for "acoustical" insulation. Penetrations to receive sealant include electrical boxes, plumbing, heating and air conditioning ducts, telephone, intercom hookups and similar items.
1. Install joint bead back-up in all joints in excess of 5/8-inch depth, and joints that have no back-up therein, placing the joint bead in the joint in a manner that will assure a constant depth 1/8 inch greater than the sealant and caulking material depth tolerances.
   a. Set beads into joints continuously, by slightly stretching during placement, to permit compression against sides of joint, without surface wrinkles or buckles.
   b. Do not stretch back-up material into joints.
   c. Install bond breaker wherever recommended by the sealant manufacturer to prevent bond of the sealant to surfaces where such bond might impair the Work.
2. Apply sealant in continuous beads without open joints, voids or air pockets

a. The depth of sealant and caulking materials shall be in accordance with manufacturer's recommendations for the specific joint function, but in no case exceed 1/2-inch in depth, nor less than 1/4-inch, regardless of the joint width.

3. Remove the temporary masking tape immediately after tooling, and before the sealant or caulking material has taken initial set.

3.7 APPLICATION OF JOINT TREATMENT

A. Install joint tape at all joints where gypsum boards abut and where boards form internal corners, whether or not such joints will be concealed from view.

B. Apply compound to all joints, edges, corners, fastener head depressions and abrasions in the surfaces, whether or not such conditions will be concealed from view. Sand completely smooth all compound surfaces, which will be exposed to view, and leave ready to receive applied coatings or finish.

C. Provide the minimum levels of gypsum board finishes as defined by the Gypsum Association recommended specifications GA-214 and GA-216, per the following:

1. At areas hidden from view, except as otherwise specified: Level 1.
2. At areas hidden from view, requiring a fire resistance rating: Level 1.
3. At areas hidden from view, requiring smoke-resistance: Level 1.
4. At concealed plenum spaces above ceilings attic spaces: Level 1.
5. At non-occupied spaces: Level 1.
6. At surfaces scheduled to receive painted finishes: Level 4.

3.8 TOLERANCES

A. Maximum variation for gypsum board partitions and ceilings from true flatness: 1/8 inch per 10 feet, noncumulative.

3.9 CLEANING

A. Daily clean work areas by sweeping and disposing of debris, scraps, and deposits of compound and gypsum fill.

B. After completion of the work of this Section, remove equipment, and clean all wall, partition, and floor areas free from deposits of gypsum fill, and other materials installed under this Section.

END OF SECTION

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install suspended acoustical tile ceiling including suspension system and associated edge moldings.

1. Provide edge moldings to fit penetrations exactly, including circular penetrations.
2. Furnish and install joint sealant at ceiling edge angles where abutting walls.

1.2 RELATED SECTIONS

A. Section 07 92 00 - JOINT SEALANTS: Sealant at gaps between new acoustical ceiling edge angles and all irregular walls.

B. Section 09 29 00 - GYPSUM BOARD: Suspended drywall construction ceilings and soffits.

C. Division 23 - FIRE SUPPRESSION: Sprinkler heads in ceiling system.

D. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING: Air diffusion devices in ceiling.

E. Division 26 - ELECTRICAL:

1. Fire alarm and smoke detection equipment mounted in ceiling system.
2. Light fixtures and independent hangers for suspended fixtures.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES.

1. ASTM A 641 - Zinc- Coated (Galvanized) Carbon Steel Wire.
2. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method "UL Classified".
3. ASTM C 523 - Light reflectance of Acoustical Material by the Integrating Sphere Reflectometer.
4. ASTM C 635 - Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
5. ASTM C 636 - Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
6. ASTM E 84 - Surface Burning Characteristics of Building Material "UL Classified".
7. ASTM E 119 - Fire Tests of Building Construction and Materials "UL Classified".
8. ASTM E 413 - Classification for Rating Sound Insulation.
9. ASTM E 580 - Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint.
10. ASTM E 1264 - Classification of Acoustical Ceiling Products.
11. ASTM E 1414 - Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum. "UL Classified".
12. UL Fire Resistance Directory and Building Material Directory.
13. All applicable federal, state and municipal codes, laws and regulations

regarding flammability and smoke generation of interior finishes.

B. The following reference materials are hereby made a part of this Section by reference thereto:

1. CISCA (Ceilings and Interior Systems Contractors Association) - Acoustical Ceilings: Use and Practice.

1.4 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties for each item furnished hereunder.
2. Shop drawings:
   a. 1/4 inch scale plans of each room or space; indicate grid layout and related dimensioning, junctions with other work or ceiling finishes, interrelation of mechanical and electrical items related to the system.
   b. Large scale installation details of special conditions.
   c. All drawings bearing dimensions of actual measurements taken at the project.
3. Verification samples:
   a. 12 by 12 inch samples of acoustical units, illustrating material and finish.
   b. 12 inch long samples of suspension system components including main runners, cross runner and edge trim.

1.5 QUALITY ASSURANCE

A. Light Fixture Loading: Acoustical tile ceiling grid shall be designed and installed to support loading of all light fixtures installed into, and surface mounted from, ceiling grid.

1.6 QUALIFICATIONS

A. Applicator specializing in applying the work of this Section with a minimum of 3 years' experience.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver acoustical ceiling panel in original, unopened packages and store protected in a fully enclosed space.

1.8 PROJECT CONDITIONS

A. Maintain uniform temperature of minimum of 60 degrees Fahrenheit and humidity of 20 to 40 percent prior to, during, and after installation.

1.9 SEQUENCING AND SCHEDULING

A. Coordinate the work of this Section with the respective trades responsible for installing interfacing work, to allow work which will be concealed by the ceilings to be completed prior to commencing installing the ceilings in such locations.

B. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated and overhead work is completed, tested and approved.

C. Install acoustical units after interior wet work is dry.

1.10 WARRANTY

A. In addition to the specific guarantee requirements of the GENERAL CONDITIONS and SUPPLEMENTAL GENERAL CONDITIONS, the Contractor shall obtain in the Owner's name the standard written manufacture's guarantee of all materials furnished under this Section where such guarantees are offered in the manufacturer's published product data.

B. All these guarantees shall be in addition to, and not in lieu of, other liabilities which the Contractor may have by law or other provisions of the Contract Documents.

1.11 EXTRA MATERIALS

A. Provide to the Owner, extra ceiling panel and suspension components, 3 percent of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering similar products include the following:

1. Armstrong World Industries, Inc., Lancaster, PA.
2. USG Interiors Inc., Chicago, IL.

2.2 ACOUSTICAL CEILING PANELS

A. Type ACT-2 Ceiling panel:

1. Panel size: 24 by 48 inch by 1/2 inch thick.
2. Panel edge: Square lay-in edge.
3. Description: ASTM E-1264 Type III, Form 2, Pattern CE, wet formed mineral fiber, non-directional fissured, medium textured panel, non-combustible, vinyl latex paint finish.
4. Color: White.
5. Minimum light reflectance range: LR 0.77.
6. Acoustical characteristics:
   a. NRC range: N/A.
   b. CAC range: 40.
7. Acceptable products:
   a. USG product "Climaplus Vinyl", product number 3270.

2.3 CEILING GRIDS

A. Type ACT-2 ceiling grid: 15/16 inch exposed tee grid in white color matching ceiling panel; acceptable products are:

1. Armstrong: 15/16" Prelude Exposed Tee System.

2.4 ACCESSORIES

A. Edge moldings: Standard edge trim: Grid system manufacturer's standard L-shape edge trim compatible with exposed grid system and color matched.

B. Hanger attachments: Of the most appropriate types for the specific receiving surfaces.

C. Hangers: ASTM A641 Soft temper, pre-stretched galvanized carbon steel wire, with a yield stress of at least 3 times design load, but not less than 12 gage.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces and verify that they are in proper condition to receive the work of this Section.

B. Beginning of installation means acceptance of site conditions.

3.2 PREPARATION

A. Carefully examine all receiving surfaces, to which attachments will be made hereunder, and determine the most practical way of making such attachments. Request Architect's approval of any attachment method which differs from that indicated on the approved shop drawings before proceeding with installation.

B. Permit acoustical ceiling tile to reach room temperature and a stabilized moisture content prior to installation.

3.3 INSTALLATION

A. Locate system on room axis, leaving equal sized border units of not less than one-half tile width.

B. Install all components of the suspended grid systems in accordance with the manufacturer's instructions, the approved shop drawings, conforming to ASTM C-636 requirements. Ensure a deflection not to exceed 1/360 span of 48-inch simple span.

C. Install specified edge moldings wherever ceilings intersect a wall or partition surface, and around all items having any dimension of 4 inches or more which penetrate the ceilings, including circular penetrations. Set moldings absolutely level, using as long lengths as practicable, and secure with fasteners recommended by manufacturer for the type of substrate.

1. Sealant Bed: Apply continuous ribbon of acoustical sealant (type AA specified under Section 07 92 00), concealed on back of vertical leg before installing moldings.
2. Screw-attach moldings to substrate at intervals not over 16 inches on center. and not more than 3 inches from ends, leveling with ceiling suspension system to tolerance of 1/8 inch in 12'-0". Miter corners accurately and connect securely.

D. Install hanger attachments to overhead construction in accordance with the approved shop drawings, spacing the attachments not more than 48 inches on centers over location of each main tee member.

1. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers to span the extra distance.
2. Install hanger wire to attachments with triple twists.

E. Install main tees parallel to the long dimension of each area, spacing the tees 48 inches on centers. Secure the bottom of hanger wires through slots in the main tee members and tie with triple twists. Level the main tees as the work progresses.

F. Uniformly space the cross tees at 24 inches on centers, and secure the cross tees into the main tees as recommended by the system manufacturer.

G. Fit acoustical ceiling tile units in place, free from damaged edges or other defects detrimental to appearance and function. Install acoustical ceiling tile level, in uniform plane, and free from twist, warp or dents.

1. Field cut tegular type tile with a tegular reveal at all edge conditions.
2. Where required by governmental agencies having jurisdiction, install retention clips, provide two clips per ceiling panel installed on opposite sides of panel.

H. Manually connect tees where necessary to coordinate with light fixture sizes. Coordinate main grid framing with light fixture sizes.

I. Where field cutting of tegular tiles is necessary field paint exposed edges in compatible color to match tile.

3.4 TOLERANCES

A. Maximum variation from flat and level surface: 1/8 inch in 10 feet.

B. Maximum variation from plumb of grid members caused by eccentric loads: 2 degrees.

3.5 CLEANING

A. Properly clean surfaces of panels and open grids free from dirt and handling marks. Wherever surfaces cannot be cleaned by normal methods or have defects, remove and replace with new components.

END OF SECTION

SECTION 09 65 13
RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Prepare substrate to receive resilient base.

B. Furnish and install the following:

1. Coved resilient base at resilient flooring.
2. Transition strips between access flooring and abutting dissimilar flooring, where no thresholds occur.

1.2 RELATED REQUIREMENTS

A. Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS: Application of protection paper to finished resilient flooring.

B. Section 09 29 00 - GYPSUM BOARD: Gypsum board substrate to receive resilient base.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ASTM E 84 - Surface Burning Characteristics of Building Materials.
2. ASTM F 1861 - Standard Specification for Resilient Wall Base
3. All applicable federal, state and municipal codes, laws and regulations regarding flammability and smoke generation of interior finishes.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. General: Coordinate the work of this Section with the respective trades responsible for installing interfacing and adjoining work for proper sequence of installation, and ensure that the work performed hereunder is acceptable to such trades for the installation of their work.

B. Sequencing:

1. Sequence work to ensure resilient flooring is not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, wet work is dry and cured, and work overhead is completed.
2. Ensure that installation of flooring and accessories occurs after other finishing operations, including painting.

1.5 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of

Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Product Data: Manufacturer's product data sheets, specifications, performance data, physical properties and installation instructions.
   a. Include certification of data indicating Volatile Organic Compound (VOC) content of all adhesives. Submit MSDS highlighting VOC limits.
2. Selection Samples: Manufacturers' sample chain of colors available for selection by Architect.
3. Verification Samples: Each type resilient base and color selected, 24 inches long.

B. Maintenance Material Submittals: Submit the following under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS. Clearly label and package extra materials securely to prevent damage.
   1. Extra Stock Materials: Upon completion of the Work of this Section, deliver to the Owner extra materials for future repairs and maintenance, an amount equal 24 linear feet for each color and type of resilient base installed.

1.6 QUALITY ASSURANCE

A. General: Avoid color and pattern differential; provide base from one production run in any single room or contiguous areas.

1.7 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:
   1. Do not deliver items to the site, until all specified submittals have been submitted to, and approved by, the Architect.
   2. Deliver resilient base materials in original, unopened packages and store protected for three days prior to installation in area of installation to achieve temperature stability.

B. Storage and Handling Requirements:
   1. Store materials in a clean dry, enclosed space off the ground and protected from the weather. Protect adhesives from freezing.

1.8 SITE CONDITIONS

A. Maintain uniform temperature of minimum of 65 degrees Fahrenheit and humidity of 20 to 40 percent 48 hours prior to, during, and 48 hours after installation. Store resilient flooring materials and accessories in the spaces where they will be installed for at least 48 hours before beginning installation. Thereafter, maintain a minimum temperature of 55 degrees Fahrenheit in the areas where the work is completed.

1.9 WARRANTY

A. General: Submit warranties under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS.

B. Manufacturer Warranty:
   1. Resilient Base: Provide manufacturer’s standard one year limited product warranty for resilient base materials.
   2. Adhesives: Provide manufacturer’s one year limited product warranty for adhesion reliability.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Specified Manufacturer: To establish a standard of quality, design and function desired, Drawings and specifications have been based on Johnsonite, Middlefield, OH.

2.2 DESCRIPTION

A. Regulatory Requirements:

1. Provide materials and assemblies conforming to applicable building codes and regulatory agencies for flame/fuel/smoke rating requirements of base trim in accordance with ASTM E 84.

2.3 THERMOPLASTIC-RUBBER BASE

A. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).

1. Group: I (solid, homogeneous).

B. Thickness: Refer to drawings

C. Height: Refer to drawings

D. Lengths: Manufacturer's longest available lengths

E. Outside and Inside Corners: Job formed mitered cuts

F. Colors: Refer to drawings

2.4 ACCESSORIES

A. Transition/reducing strips: Provide tapered profiles required for transition to abutting materials, in colors and material as selected by the Architect.

1. Provide rubber edge strips of width shown on the Drawings of equal gage to adjacent flooring having tapered or bull nose edge, with color(s) to match (or contrast) flooring as selected by the Architect from full range of manufacturer's available colors.

B. Adhesives

1. General: Water resistant, low VOC, acceptable to the resilient flooring manufacturer, for substrate conditions.
   a. Cove Base Adhesives: Maximum VOC 50 [gIL less water]
2. Acceptable manufacturers:
   a. Advanced Adhesive Technology, Inc. Dalton GA, product: "No. 432 Modified Acrylic Cove Base Adhesive".
   b. DAP Incorporated, Dayton OH, product: "Cove Base Construction Adhesive".
   c. W.W. Henry Company, Aliquippa PA., product: "Henry 440 Cove Base Adhesive".
   d. Roberts Consolidated Industries, Inc., City of Industry, CA, product: "Premium Solvent-Free Cove Base Adhesive".

C. Joint Sealer for between the top of wall base and irregular wall surfaces: Plastic filler as recommended by manufacturer.

D. Cleaning material: Domestic neutral floor detergent having a pH 7 or pH 8, as recommended by the flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces and verify that they are in proper condition to receive the work of this Section.

B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

C. Beginning of installation means acceptance of existing substrate and site conditions.

3.2 INSTALLATION

A. Install all products in strict accordance with each manufacturer's written installation procedures and other provisions specified herein.

B. Spread only enough adhesive to permit installation of materials before initial set.

C. Install Resilient base: Install base on solid backing, bond to vertical substrate with continuous contact at horizontal and vertical surfaces. Apply wall base to walls, columns, casework and other permanent fixtures in areas where base is required.

1. Install in lengths as long as practical.
2. Scribe to fit to door frames and other interruptions.
3. Form all external and internal corners in accordance with manufacturer's written instructions. Cope inside corners and fit neatly.
4. Fill voids with plastic filler along the top edge of the resilient wall base on masonry surfaces or other similar irregular substrates.

3.3 CLEANING

A. Comply with requirements of Section 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL for handling and disposition of all construction and demolition waste.

B. Post-installation Cleaning: As installation progresses, continually remove excess adhesive from floor, base and wall surfaces without damage.

END OF SECTION

SECTION 09 69 00
ACCESS FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install the following:
   1. Access flooring panels, perforated floor panels and understructure systems.

1.2 RELATED REQUIREMENTS

A. Division 26 - ELECTRICAL: Receptacles, wiring, and conduit for service outlets.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
   1. ASTM E84 - Test for Surface Burning Characteristics of Building Materials.
   2. CISCA (Ceilings & Interior Systems Construction Association) - “Recommended Test Procedures for Access Floors”.
   3. All applicable federal, state and municipal codes, laws and regulations regarding flammability and smoke generation of interior finishes.

B. The following reference materials are hereby made a part of this Section by reference thereto:
   1. All applicable federal, state and municipal codes, laws and regulations regarding flammability and smoke generation of interior finishes.

1.4 PERFORMANCE REQUIREMENTS

A. Pedestals: Maximum axial load of 5,000 pound (2,722 kg) without permanent deformation, and shall resist an average 1,000 inch-pound turnover moment when bonded to a clean concrete slab. Ultimate strength, not less than twice design load.

B. Type AF-1 Floor Panels shall conform to the following requirements:
   1. Design load: 1,250 pounds (454 kg).
   2. Uniform load: 400 pounds per square foot (16.75 kPa).
   3. Impact load: 150 lbs. @ 36 inches above floor surface.
   4. Concentrated load of 1,250 pounds on one square inch (500 kg on 710 sq mm) at any location with a maximum deflection of 0.10 inch (2 mm).
   5. Permanent deformation 0.02 inch (0.2 mm) maximum at design load.
   6. Ultimate strength: Not less than twice design load.
   7. Class A flame spread rating when tested in accordance with ASTM E84.

C. Type AF-5 Floor Panels shall conform to the following requirements:
   1. Design load: 3,000 pounds (1361 kg).
   2. Ultimate Load: 6000 pounds per square foot (2711kg).
   3. Impact load: 200 lbs. @ 36 inches above floor surface.

4. Concentrated load of 6,000 pounds on one square inch (907 kg on 710 sq mm) at any location with a maximum deflection of 0.010 inch.
5. Permanent deformation 0.010 inch maximum at design load.
6. Ultimate strength: Not less than twice design load.
7. Class A flame spread rating when tested in accordance with ASTM E84.

D. Type AF-6 Floor Panels shall conform to the following requirements:
1. Design load: 3,000 pounds (1361 kg).
2. Ultimate Load: 6000 pounds per square foot (2711kg).
3. Impact load: 200 lbs. @ 36 inches above floor surface.
4. Concentrated load of 6,000 pounds on one square inch (907 kg on 710 sq mm) at any location with a maximum deflection of 0.010 inch.
5. Permanent deformation 0.010 inch maximum at design load.
6. Ultimate strength: Not less than twice design load.
7. Class A flame spread rating when tested in accordance with ASTM E84.

E. Lateral stability: Design system for lateral stability in all directions, with or without panels in place.

F. Surface electrical resistance: Maximum one ohm per panel.

1.5 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:
1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties and installation instructions for each item furnished hereunder.
2. Certification: Manufacturer's written certification stating that flooring system and all related components meets or exceeds the requirements specified under this Section and in particular meets or exceeds specified design strength and electrical resistance requirements.
3. Manufacturer’s instructions: Manufacturer’s installation instructions indicating special procedures, and perimeter conditions requiring special attention.
4. Warranty: Provide sample copies of manufacturers' actual warranties for all materials to be furnished under this Section, clearly defining all terms, conditions, and time periods for the coverage thereof.
5. Shop drawings:
   a. Plans showing floor layout, interruptions to grid, special sized panels, panels requiring drilling or cut-out for services, appurtenances or interruptions. Indicated elevation differences, stairs ramps, grilles and registers.
   b. Large scale details of edge conditions, assembly components and anchoring.

B. Submit the following under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS:
1. Manufacturer’s maintenance data; include recommended cleaning methods, cleaning materials stain removal methods.
2. Manufacturer’s warranties.

1.6 QUALIFICATIONS

A. Fabricator, with a minimum of 5 years documented experience demonstrating previously successful work of the type specified herein.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with NFPA 75 requirements for raised flooring.

B. Performance Certification: Product tests to be witnessed and certified by independent engineering and testing laboratory based in the U.S. in accordance with CISCA “Recommended test procedures for access floor”.

C. Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.

D. Test and ensure that pedestal base adhesive is compatible with concrete sealer specified under Section 03 05 13 - CONCRETE SEALERS.

1.8 DELIVERY, STORAGE AND HANDLING

A. Protect materials from damage due to moisture, direct sunlight, excessive temperatures, surface contamination, corrosion and damage from construction operations and other causes.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Maintain ambient temperatures between 35° to 95° F and relative humidity levels between 20% to 80%. At least 24 hrs. before installation begins, all floor panels shall be stored at ambient temperatures between 50° to 90° F and relative humidity levels between 20% to 80% and shall remain within these environmental limits until Substantial Completion.

1.10 FIELD MEASUREMENTS

A. Take field measurements before preparation of shop drawings and fabrication, where possible, to ensure proper fitting of Work.

B. Allow for adjustments within specified tolerances wherever taking of field measurements before fabrication might delay Work.

1.11 SEQUENCING AND SCHEDULING

A. Schedule work to commence after sub-floor work and utilities are installed.

1.12 WARRANTY

A. Provide 5 year warranty under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS.

1.13 EXTRA MATERIALS (ATTIC STOCK)

A. Upon completion of the Work of this Section, deliver to the Owner the following extra materials for future repairs and maintenance:
   1. Floor panel (floor tile) attic stock general requirements:
      a. Finish to match other tiles installed.
      b. Each attic stock panel shall be furnished with an identification sticker at the underside corner of each panel. Identification sticker shall indicate Flooring System (A or B), panel type, load rating and size.
   2. Perforated Floor Panels (general stock): one perforated tile per every 4 kw of UPS power plus an additional 5 percent stock.

a. Verify quantity and location of perforated tiles and floor cut outs with engineers.

3. System “AF-1” floor panels: Furnish sufficient stock to back fill 75 percent of perforated tiles for initial build out of first pod. Verify with Owner quantities for each addition pod.
4. System “AF-5” floor panels: Furnish 10 floor panels per computer room.
5. System “AF-6” floor panels: Furnish 10 floor panels per computer and IDF room.
6. Stringers: 25 spare stringers for each system type.
7. Pedestals: Furnish 25 spare pedestals for each system type.

B. Panel Lifting Devices: Furnish to Owner one panel lifting device per door and an additional quantity of one per every 1,500 square feet of access flooring.

C. Clearly label and package extra materials securely to prevent damage.

PART 2 - PRODUCTS

2.1 MANUFACTURER AND MODELS

A. Specified Manufacturer: To establish a standard of quality, design and function desired, Drawings and specifications have been based on the Tate Access Floors, Inc., Jessup, MD. No substitution will be accepted for named products.

1. Type ‘AF-1’ Flooring System: Tate Access Floors, Product; “ConCore CC1250” access floor panels, having both solid and perforated panels (as indicated) with bolted stringer understructure system.
   a. Concentrated Load: 1,250 lbs
   b. Uniform Load: 300 lbs/ft2
   c. Rolling load: 10,000 Passes 800 lbs
   d. Impact Loads: 150 lbs
   e. Finish: 1/16” HPL with integral trim edge.
2. Type ‘AF-2’ Flooring System: Tate Access Floors, Product; “ConCore CC2000” access floor panels with bolted stringer understructure system.
   a. Concentrated Load: 2,000 lbs
   b. Uniform Load: 550 lbs/ft2
   c. Rolling load: 10,000 Passes 1250 lbs
   d. Impact Loads: 150 lbs
   e. Finish: 1/16” HPL with integral trim edge.
3. Type ‘AF-6’ Flooring System: Tate Access Floors, Product; “ConCore CC3000” access floor panels with 2” bolted stringer understructure system.
   a. Concentrated Load: 3,000 lbs
   b. Ultimate Load: 6000 lbs/ft2
   c. Rolling load: 10,000 Passes 2400 lbs
   d. Impact Loads: 200 lbs
   e. Finish: 1/16” HPL with integral trim edge.
4. Perforated Steel Airflow Panels: Tate series “PERF 1250” Air Flow Panels (Open area 25 percent).
   a. 725 cfm at 0.1-inch of H2O (static pressure) Without Damper
   b. Concentrated load: 1250 lbs.
   c. Finish: 1/16” HPL with integral trim edge
   d. Quantity: Refer to Drawings.
5. Aluminum Grate Airflow Panels: Tate Series GrateAire die-cast aluminum Airflow Panels: Tate series GrateAire 24” for bolted string systems having 56% open area.
   a. 2100 cfm at 0.1-inch of H2O (static pressure) with damper.
   b. Concentrated load: 1000 lbs.

c. Finish: SparkLite White antistatic powder coat
d. Quantity: Refer to Drawings.

1.14 MATERIALS

A. Recycled content of access flooring system: Use maximum available percentage of materials by weight. Products incorporated into the work shall contain not less than 32.8 percent of recycled content.

1.15 SUPPORT COMPONENTS

A. Pedestals: Hot dip galvanized pedestal base assembly shall consist of a formed steel plate welded to a 7/8” square steel tube designed to engage the head assembly.
   1. Loading:
      a. Axial load: 6,000 lbs.
      b. Overturn Moment: 1,000 lbs.
   2. Minimum base size: 16 square inches.
   3. Threaded stud Type A: 5/8 inch diameter steel.
   4. Threaded stud Type B: 7/8 inch diameter steel.
   5. Pedestal assemblies shall be corrosive resistant, all welded steel construction, with an adjustment range of +/- 1 inch for finished floor heights of 6 inches or greater.
   6. Pedestal assemblies shall provide a means of leveling and locking the assembly at a selected height and prevent vibration displacement.
   7. Threaded stud shall be provided with an anti-rotation device, preventing the head assembly once engaged in the base assembly, from freely rotating.
   8. Hot dip galvanized pedestal base assembly shall consist of a formed steel plate with no less than 16 inches of bearing area, welded to a 7/8” square steel tube and shall be designed to engage the head assembly.

B. Stringers: 2” deep x ¾” wide bolted stringers, 4 foot long steel stringers with conductive galvannealed coating with manufacturer’s standard bolts providing a positive electrical contact between the stringer and the pedestal.
   1. Stringer Grid Pattern: 4’/4’ Basketweave.

1.16 PANEL COMPONENTS

A. Floor Panels: Panels shall consist of a top steel sheet welded to a formed steel bottom pan filled internally with a lightweight cementitious material and painted with an electrically conductive epoxy paint. Mechanical or adhesive methods for attachment of the steel top and bottom sheets will not be accepted.
   1. Floor panel size: 24 inches square.
   2. Floor panel finish: High Pressure Laminate, Formica Cheyenne – Unless noted otherwise.
   3. Cementitious fill material shall be totally encased within the steel welded shell except where cut for special conditions.
   4. Corner of panel shall have a locating tab and integral shape design to interface with the pedestal head for positive lateral retention and positioning with or without fasteners.
   5. Top surface of the panel shall have four positioning location holes to engage positioning buttons on the carpet tile for precise matching of the carpet tile to the panel.

6. Fit between the pedestal head, panel, and screw shall enable an installation with an average panel to panel gap of 0.015”.
7. Maximum electrical resistance: 1 ohm or less from the top edge of the panel, less surface covering to the understructure.

1.17 ACCESSORIES

A. Electrostatic grounding connectors: Solid copper.

B. Cable cutout protection: Extruded polyvinyl chloride or neoprene edging, 3/8 inch (90 mm) thick, self-extinguishing.

C. Panel lifting devices: Two per panel, recommended manufacturer’s standard type.

D. Gaskets: Closed cell sponge rubber, preformed to suit.

E. Edge trim: Extruded plastic channels.

F. Plenum divers: Aluminum plate, thickness as recommended by the manufacturer.

G. Sealant: As specified under Section 07 92 00 - JOINT SEALANTS.

1.18 FABRICATION – ACCESS FLOORING

A. Refer to the Drawings for location and details of access flooring to be furnished and installed hereunder.

1. Verify pedestal heights shown on Drawings comply with referenced codes and regulations.

B. Access flooring performance requirements; conform to all requirements of those codes and regulations referenced under Section 01 41 00 - REGULATORY REQUIREMENTS.

1.19 FABRICATION TOLERANCES

A. Floor panel flatness measured on a diagonal: +/- 0.035 inch.
B. Floor panel flatness measured along edges: +/- 0.025 inch.
C. Floor panel width or length of required size: +/- 0.010 inch.
D. Floor panel out of square tolerance: +/- 0.015 inch.

1.20 FACTORY FINISHING

A. Exposed metal surfaces: Baked enamel finish, color as selected from manufacturer’s full available library of colors.

PART 3 - EXECUTION

1.21 EXAMINATION

A. Inspect all surfaces and verify that they are in proper condition to receive the work of this Section.

B. Verify field measurements are as shown on shop drawings.

C. Verify that required sub-floor utilities are available, in proper locations and ready to use.

D. Beginning of installation means acceptance of existing substrate and project conditions.

3.2 PREPARATION

A. Clean substrate surfaces concealed by flooring system.

B. Clean understructure components within the plenum of dust and dirt, excess loose galvanizing, or any other contaminant capable of becoming airborne in the plenum.

3.3 INSTALLATION

A. Install components in accordance with manufacturer's instructions. Install access flooring system and accessories under supervision of access flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of instability, rocking, rattles, and squeaks.

B. Secure pedestal base plate to subfloor with metal fasteners.

C. Install additional pedestals where grid pattern is interrupted by room appurtenances and at cutouts.

D. Install floor panels solidly on pedestals and securely in place, properly seated with panel edges flush. Do not force panels into place.
   1. Scribe perimeter panels to provide a close fit with adjoining construction with no voids greater than 1/8 inch (3 mm) where panels abut vertical surfaces

E. Seal field cuts of floor panels with edge trim.

F. Cut holes in floor panels for installation of Owner's equipment as directed.

G. Provide positive electrical earth grounding of entire floor assembly.

H. Install plenum dividers to provide a positive air seal between sub-floor and elevated floor. Include gasket and sealant to insure airtight seal where holes are cut in elevated floor for penetration of cable.

I. Seal underfloor air cavities at construction seams, penetrations, and perimeter to control air leakage as recommended in writing by manufacturer. Provide gasketing around through floor equipment such as CRAC's and CRAC stands. Verify results of air leakage test

   performed by mechanical contractor and provide additional seals as required. Floor not to exceed 10% air leakage.

3.4 ERECTION TOLERANCES

A. Maximum out of level tolerance: 1/16 inch in 10 feet (1.6 mm in 3 m).

3.5 ADJUSTING AND TESTING

A. Testing access flooring system and verify in writing air leakage test have been performed and there is less than 10% air leakage of closed floor system.

B. Adjust pedestals to achieve a level floor and to assure adjacent floor panel surfaces are flush.

3.6 CLEANING

A. Clean and vacuum subfloor area as installation of floor panels proceeds.

B. Daily clean work areas, dispose all debris and scraps.

3.7 PROTECTION

A. Protect finished work under provisions of Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS. Do not permit traffic over unprotected floor surface.

B. Advise Architect if flooring has been overloaded after completion and prior to Substantial Completion.

END OF SECTION

SECTION 09 81 00
ACOUSTICAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Furnish and install: Acoustical insulation as scheduled and where indicated.

1.2 RELATED REQUIREMENTS

A. Section 06 10 00 - ROUGH CARPENTRY: Wood blocking.

B. Section 09 22 16 - NON-STRUCTURAL METAL FRAMING: Framing cavities to receive acoustical insulation.

C. Section 09 29 00 - GYPSUM BOARD: Installation of wallboard over acoustical insulation.

D. Division 23 - HEATING, VENTILATING AND AIR CONDITIONING: Ductwork and piping insulation.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ASTM C 518 - Thermal Transmission Properties by Means of the Heat Flow Meter.
2. ASTM C 553 - Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
3. ASTM C 665 - Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
4. ASTM E 84 - Surface Burning Characteristics of Building Materials.
5. ASTM E 96 - Water Vapor Transmission of Materials.

1.4 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Product Data: Manufacturer's product data sheets, specifications, performance data, physical properties for each item furnished hereunder.

1.5 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:

1. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.
2. Do not deliver items to the site, until all specified submittals have been submitted to, and approved by, the Architect.

B. Storage and Handling Requirements:

1. Store materials under cover and in manner to keep them dry, protected from

weather, direct sunlight and damage from construction traffic and other causes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering similar products include the following:

1. Acoustical glass fiber insulation:
   a. CertainTeed Corporation, Valley Forge, PA.
   b. Johns Manville Building Insulation, Denver, CO
   c. Owens Corning Fiberglas Corp., Toledo, OH.
   d. (Goldline brand) Schuller International, Inc., Denver, CO.
   e. USG Corp./ USG Interiors Inc., Chicago, IL.
2. Acoustical mineral fiber insulation:
   a. Fibrex Insulations Inc., Sarnia, Ontario
   b. Thermafiber Inc., Wabash, IN.
   c. Roxul, Inc., Milton, Ontario.

2.2 MATERIALS

A. Acoustical batt insulation at rated partitions: Mineral wool fiber insulation batts, conforming to ASTM C665 Type 1, and ASTM C553 with a nominal density of 2.5 pounds per cubic foot, nominally 3-1/2 inches thick.

1. Flame Spread Classification: Class A (less than 25, per testing by NFPA 255, ASTM E-84 or UL 723).
2. Recycled content of slag in mineral wool insulation: Use maximum available percentage of material (slag). Mineral wool insulation products incorporated into the work shall contain not less than 75 percent of recycled material (slag) by weight.
3. Acceptable products include:
   a. Fibrex Insulations Inc. product: “Fibrex Sound Attenuation Fire Batt (SAFB)”
   b. Roxul, Inc., product “Roxul AFB”.
   c. Thermafiber, Inc. product “Thermafiber SAFB”.

B. Acoustical batt insulation at non-rated partitions: Unfaced glass fiber insulation nominal 3- 1/2 inches [89mm] thick conforming to ASTM C-665 Type I, of width appropriate for spacing of framing or furring members with which used.

1. Flame Spread Classification: Class A (less than 25, per testing by NFPA 255, ASTM E-84 or UL 723).
2. Recycled content of glass in glass-fiber insulation: Use maximum available percentage of recycled glass. Fiber glass insulation products incorporated into the work shall contain not less than 20 percent of recycled glass cullet.

2.3 ACCESSORIES

A. Staples, tape, adhesives and fasteners required for the proper and complete installation for work of this Section shall be as recommended by each respective manufacturers of each insulation type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Acoustical insulation:

1. Install insulation in accordance with insulation manufacturer's instructions.
2. Install in interior walls, and ceiling spaces where indicated. Trim insulation neatly to fit spaces. Fit insulation tight in spaces. Leave no gaps or voids.

END OF SECTION

SECTION 09 91 00
PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: This Section consists of painting work where shown on the Drawings, as specified herein, and as required for a complete and proper installation. Painting work includes, but is not limited to the surface preparation and application of coated finishes, and subsequent touch-up, of interior and exterior items and surfaces as indicated on the Contract Drawings and as scheduled herein.

B. Surfaces and Materials: In general, without limiting the generality thereof, the following surfaces, fixtures and equipment require a painted finish:

1. Gypsum board partition and wall surfaces, ceilings and soffits.
2. Metal doors and frames.
3. Interior handrails and guardrails.
4. Wood trim.
5. Exposed to view sprinkler piping.
6. Exposed to view electrical conduit and raceways.
7. Access panels and frames.

C. DO NOT PAINT the following surfaces and materials.

1. Concealed from view surfaces, except as indicated otherwise in the Contract Documents or as specified herein.
2. Chrome or nickel plating, stainless steel, bronze, brass.
3. Aluminum other than mill finished or factory primed.
4. Factory finished mechanical and electrical equipment, pumps, machinery and similar items which occur in mechanical, storage or equipment rooms or areas.
5. Factory finished materials, specialties, and accessories unless otherwise specified.
6. Acoustical tile, resilient flooring, and other integrally finished floor, wall and ceiling finishes.
7. Prefinished millwork items.
8. Fire resistant testing and certification labels, code required labels, safety warning labels, performance rating plates, nomenclature plates, identification plates, and similar other labels.

1.2 RELATED REQUIREMENTS

A. Section 06 20 00 - FINISH CARPENTRY: Wood trim items, setting and filling of nails, sanding of wood trim.

B. Section 07 92 00 - JOINT SEALANTS: Requirements for sealant and backing materials.

C. Section 08 11 13 - HOLLOW METAL DOORS AND FRAMES: Shop priming of metal frames and steel doors.

D. Section 08 31 00 - ACCESS DOORS AND PANELS: Shop primed access panels, occurring in partitions and walls.

E. Section 09 29 00 - GYPSUM BOARD: Drywall partitions, ceilings and soffits, including joint treatment and sanding.

F. Document 09 91 23 - INTERIOR PAINTING SCHEDULE:
   1. Painting schedule for interior surfaces and materials.
   2. Painting schedule for Mechanical and Electrical Equipment.

G. Division 22 - PLUMBING: Prefinished items such as plumbing fixtures, sprinkler heads, convectors, anemostates and similar surfaces and materials.

H. Division 26 - ELECTRICAL: Prefinished items such as light fixtures, switch gear, electrical distribution cabinets and similar surfaces and materials.

I. Respective sections: Factory-finishing of mechanical, plumbing, fire protection and electrical equipment.

1.3 REFERENCES

A. Referenced Standards: Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
   1. ANSI/ASTM D 16 - Definitions of Terms Relating to Paint, Varnish, Lacquer, and Related Products.
   2. ASTM D 2016 - Test Method for Moisture Content of Wood.
   3. All applicable federal, state and municipal codes, laws and regulations for flammability and smoke generation of interior finishes.

B. Definitions:
   1. "Paint" includes coating systems materials, primers, emulsions, enamels, stains, sealers and fillers, and other applied materials specified herein, whether used as prime, intermediate or finish coats.
   2. Sheen: Specular gloss readings in accordance with ASTM D52.
      a. Flat: less than 5 (measured at 85 degrees).
      b. Eggshell: 5 – 20 (measured at 60 degrees).
      c. Satin: 15-35 (measured at 60 degrees).
      d. Low Luster: 25 – 35 (measured at 60 degrees).
      e. Semi-Gloss: 30 -65 (measured at 60 degrees).
      f. Gloss: 65 or more (measured at 60 degrees).
   3. Gloss as defined for VOC requirements. Specified specular gloss readings below are as tested in accordance with ASTM D52.
      a. Flat: less than 15 (measured at 85 degrees), less than 5 (measured at 60 degrees).
      b. Non-Flat: greater than 15 (measured at 85 degrees), greater than 5 (measured at 60 degrees).

1.4 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Literature: Manufacturer's product data sheets, specifications, performance data, physical properties, material compositions, and application instructions for all finishing products to be applied hereunder.

   a. Include certification of data indicating Volatile Organic Compound (VOC) content of all paint materials.

2. Samples:

   a. Manufacturer's color selector for custom mixed colors for Architect's color scheduling.

   b. Opaque coatings: Two 9 x 12 inch finished samples on hardboard of each color scheduled in each finish for review and approval. Identify boards with finish type, color mix number and scheduled substrate surfaces or materials.

   c. Transparent finishes and stains: Two 9 x 12 inch finished samples on same species of solid wood and plywood to be furnished under Section 06 20 00 - FINISH CARPENTRY, of each color scheduled in each finish for review and approval. Identify boards with finish type, color mix number and scheduled substrate surfaces or materials.

B. Submit the following under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS:

1. Color chips: After final approval of all colors and tints by the Architect, submit to the Owner, color chips of all coatings used, with manufacturer's name and mix designation of the coating for the purpose of future re-ordering of coatings. Color chips shall be at least six (6) square inches in size, for each color and tint.

1.5 QUALITY ASSURANCE

A. Applicator: Company specializing in commercial painting and finishing with 3 years minimum documented experience.

B. Single source responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

C. Environmental Requirements for Volatile Chemicals:

1. For interior applications use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA method
24) and the following chemical restrictions:

   a. Flat Paints and Coatings: VOC not more than 50 g/L.

   b. Non-Flat Paints and Coatings: VOC not more than 150 g/L.

   c. Anti-Corrosive Coatings: VOC not more than 250 g/L.

   d. Clear wood finishes:

      1) Varnishes: VOC not more than 350 g/L.

      2) Lacquer: VOC not more than 550 g/L

   e. Floor coatings: VOC not more than 100 g/L

   f. Sealers:

      1) Waterproofing sealers: VOC not more than 250 g/L.

      2) Sanding sealers: VOC not more than 275 g/L.

3) All other sealers: VOC not more than 200 g/L.

g. Stains: VOC not more than 250 g/L.

2. Do not use water based paints formulated with aromatic hydrocarbons (organic solvent with a benzene ring in its molecular structure), formaldehyde, halogenated solvents, mercury or mercury compounds, or tinted with pigments of lead, cadmium, chromium VI and their oxides. Water based paints shall be low VOC and shall have a flash point of 61 degrees C or greater.

3. Where it is necessary to use solvent-based paints, with less than 1.0 percent by weight total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).

4. The following shall be low VOC and not be formulated with aromatic hydrocarbons (organic solvent with a benzene ring in its molecular structure).
   a. High performance water based acrylic coatings.
   b. Pigmented acrylic sealers.
   c. Catalyzed epoxy coatings.
   d. High performance silicone grafted epoxy coatings.

5. Restricted Components: Paints and coatings used on this Project shall not contain any of the following compounds. (Excluded from this restriction are residual quantities of naturally occurring elements and chlorinated organics which are found in chlorinated water supplies; contaminate levels shall be below that of the National Primary Drinking Water Standard):
   a. 1,2-dichlorobenzene
   b. Alkylphenol ethoxylates (APEs)
   c. Formaldehyde-donors
   d. Heavy metals, including lead, mercury, cadmium, hexavalent chromium and antimony in the elemental form or compounds
   e. Phthalates
   f. Triphenyl tins (TPT) and tributyl tins (TBT).

1.6 FIELD SAMPLES

A. Provide field samples under provisions of Section 01 45 00 - QUALITY CONTROL for purpose of verifying selected colors.

B. Paint on-site sample areas, minimum 40 square feet, illustrating selected color, and tint.

C. Locate samples where directed. The Contractor shall provide in the base Contract, a total amount of samples equal to one sample per room.

D. Accepted samples may not remain as part of the work.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site in sealed and labeled containers; container labeling shall include manufacturer's name, type of paint, color mix designation, expected coverage, surface preparation instructions, instructions for mixing and reducing, drying time, and clean-up recommendations.

B. Store materials, conforming with applicable codes and fire regulations, in designated spaces. Keep storage area secure when direct access is not required or when not

performing work under this Section. Take precautionary measures to prevent fire hazards and spontaneous combustion, maintain a dry-chemical type fire extinguisher in all areas where materials of this Section are being stored or used.

C. Store paint materials in a well-ventilated area at minimum ambient temperature of 45 degrees Fahrenheit and a maximum of 90 degrees Fahrenheit.

D. Do not use the sanitary system for mixing or disposal of refuse material. Carry water to mixing rooms and dump waste material in a suitable refuse receptacle. Remove oily rags and waste each day.

1.8 PROJECT CONDITIONS

A. Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 45 degrees Fahrenheit for 24 hours before, during and 48 hours after application of finishes, unless required otherwise by manufacturer's instructions.

B. Apply paints and finishes above minimum temperature conditions in strict accordance with manufacturer's instructions.

C. Provide sufficient lighting to maintain 80 foot-candles measured mid-height at substrate surface.

1.9 SEQUENCING AND SCHEDULING

A. The applicator of work specified herein is responsible to ensure that all paints, enamels, and coatings, proposed to be applied hereunder, are compatible with coatings used for shop-primed items and items which have been prime-coated under the work of other trades.

B. Immediately notify the Architect in writing of conditions which may require a change in the specifications of this Section before proceeding with the work. Failure to do so, in a timely fashion, so as not to interfere with the schedule of work of this Contract, shall be construed as acceptance of the coatings specified. Perform all corrective measures, at no cost to the Owner, for any defects in the work, resulting from the use of such materials.

C. Painting work should be scheduled so as to minimize touch-ups. Interior painting is to be without flashmarks. Should flashmarks occur due to touch-ups, the Contractor shall be required to redo the entire surrounding wall surface.

D. Do not order materials until all required schedules have been properly submitted, reviewed by the Contractor and Approved by Architect.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering similar products include the following:

1. Paints and general finishes:
   a. California Paints, Andover, MA.
   b. Glidden Professional, Strongsville, OH
   c. Benjamin Moore & Company, Montvale, NJ.

d. Pittsburgh Plate Glass Company (PPG), Pittsburgh, PA
e. The Sherwin Williams Company, Cleveland, OH

2. Cold galvanizing touch-up paint:
   a. ZRC Worldwide Inc., Marshfield, MA.
   b. Duncan Galvanizing, Malden, Ma.
   c. Rustoleum Corp., Vernon Hills, IL.

2.2 MATERIALS

A. Coatings: Ready mixed, except for field catalyzed coatings with good flow and brushing properties; capable of drying or curing free of streaks or sags. Color pigments shall be processed to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating. Provide best quality grade, where manufacturer makes more than one grade of any material specified.

B. Liquid zinc coating, for touch-up of welds, scratches, and abrasions in galvanized steel: Low VOC organic zinc-rich coating containing 92% metallic zinc, by weight in the dried film (ASTM D520, Type III) and conforming to SSPC Paint 20, Type II, Level 1. Liquid zinc coating shall be recognized under the Component Program of Underwriter's Laboratories, Inc. as an equivalent to hot-dip galvanizing; conforming to MIL-P-21035B and SSPC Paint 29, Type II, Level I, for repair of hot-dip galvanizing and meeting the requirements for Zinc- Rich Paints.
   1. VOC limit: not more than 250 g/L.
   2. Specified manufacturer and product: ZRC Worldwide, Marshfield MA, product “ZRC- 221”.

C. Joint sealant for fill of minor cracks in plaster prior to painting: One component acrylic latex caulking compound, conforming to FS 19-TP-21M and ASTM C 834, paintable within 24 hours after application, with a minimum movement capability of ±12.5 percent, equal to one of the following:
   1. Pecora, product “AC-20+”.
   2. Sonneborn Building Products Inc., product, “Sonolac”.
   3. Tremco, product, “Trimflex 834”.

2.3 ACCESSORIES

A. Accessory materials: other materials not specifically indicated, but are required to achieve the finishes specified of commercial quality.

B. Cleaning Materials: Tri-Sodium Phosphate (TSP) substitute. Acceptable products include the following, or approved equal:
   1. Savogran, Norwood, MA, products “TSP-PF”, or “Liquid TSP Substitute”.
   2. Custom Building Products, Seal Beach, CA., product “Custom T.S.P. Substitute”.
   3. DAP Inc., Baltimore, MD., product “T.S.P. Substitute Heavy Duty Cleaner”.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces and verify that they are in proper condition to receive the work of this Section. Notify Contractor of any condition that may potentially affect proper

application of coatings.

B. Measure moisture content of surfaces, do not apply finishes unless moisture content of surfaces are below the following maximums:

1. Gypsum board and joint treatment: 12 percent.
2. Interior wood: 15 percent.

C. Beginning Work of this Section means acceptance of substrate surfaces and site conditions.

3.2 PREPARATION

A. Furnish and lay suitable drop cloths in all areas where coating work is being done to protect floors and all other surfaces from damage during the work. Protect adjoining surfaces with painters mask tape.

B. Prior to preparing surfaces or finishing, remove all finish hardware for painting doors and frames, except hinges and locks on exterior door; remove electrical plates, light fixture trim,

and fittings. Re-install hardware and other removed items after painted surfaces are thoroughly dry.

C. Mix coatings thoroughly, unless otherwise directed by the manufacturer of the specific coating used, to ensure uniformity of color and mass. Strain previously opened coatings to remove skins, lumps, and other foreign matter prior to painting.

D. Thin or reduce materials only as recommended by the specific material manufacturer, and only with the approval of the Architect.

E. Impervious surfaces: Remove mildew by scrubbing with solution of tri-sodium phosphate and bleach. Rinse with clean water and allow surface to thoroughly dry.

F. Uncoated steel and iron surfaces:

1. Remove grease, scale, dirt, rust, and all foreign materials, down to bright metal by wire brushing, scraping, sanding, or sandblasting where heavy coatings of scale are evident.
2. Wash steel with solvent, apply a treatment of phosphoric acid solution, ensuring weld joints, bolts and nuts are similarly cleaned.
3. Spot prime after repairs with metal primer product of the finish coating manufacturer.

G. Shop primed steel surfaces:

1. Remove rust, blistered and defective shop prime paint, and all foreign materials, down to bright metal by wire brushing, scraping, sanding, or commercial paint remover. Feather edges to make touch-up patches inconspicuous.
2. Remove all grease or dirt with mineral spirits.
3. Spot prime bare metal with metal primer product of the finish coating manufacturer. Seal top and bottom edges of metals doors with primer.

H. Previously painted steel surfaces:

1. Remove rust, blistered and defective paint, down to bright metal by wire brushing, scraping, or sanding. Feather edges to make touch-up patches inconspicuous as possible

2. Remove grease, dirt and all foreign materials.
3. Spot prime bare metal with metal primer product of the finish coating manufacturer.

I. New galvanized surfaces: Remove surface contamination and oils and wash with solvent. Apply coat of etching primer.

J. New interior wood items scheduled to receive paint finish.
1. Smooth minor defects and remove all foreign matter by sanding, and if necessary, steel wool.
2. Wash sap spots and knots with mineral spirits. When dry, touch up knots, pitch streaks, and sappy sections with commercial stain sealer.
3. Fill up nail holes and cracks with wood putty or plastic wood after primer or first coat of finish is dry and sand smooth.

K. Gypsum board surfaces: Fill minor defects with latex based spackle. Spot-seal all compound surfaces and repair areas in gypsum board, with specified first coat material before application of the first coat.

3.3 APPLICATION

A. Apply all materials in strict accordance with the approved manufacturer's printed instruction, and in accordance with the best trade practices. Each coat shall be reviewed and approved by the Architect before succeeding coats are applied.

B. Do not apply successive coating until the preceding coat is thoroughly dry, and in no case in less than 24 hours after the preceding coat.

C. Number of coats is indicated under Painting Schedules. Number of coats is indicated as a minimum number to be applied over scheduled substrates. An additional coat or coats may be required for proper color coverage of substrate as determined by the Architect, at no additional cost to the Owner. Examples of these conditions include, but are not limited to:
1. Dark colored substrates may require an additional primer or intermediate coat to stabilize color, if final applied top-coat color is light.
2. Pre-finished or pre-primed products may require an additional field applied coat to stabilize the shop/factory applied base color prior to application of top-coat finishes.
3. Dark color top coat finishes may require additional finish coat over white or light colored substrates to obtain correct color density.

D. Apply each coat to a uniform finish; Apply primer and first coat of slightly lighter in color tint than the scheduled color of the final coat.

E. Sand lightly between coats to achieve required finish and remove sanding dust prior to applying succeeding coat.

F. Where clear finishes are required, tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.

G. Prime back surfaces of all interior and exterior woodwork scheduled for painted finish with primer.

H. Prime back surfaces of interior woodwork scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with mineral spirits.

3.4 CLEANING

A. Upon completion of the work in each area, remove all coating splatters from glass, prefinished surfaces, bright metals, and from other surfaces that have not been painted or finished hereunder. Do not use abrasive paper or abrasive cleaner on any prefinished surface or bright metal. Remove all materials and debris; leave work area in a clean condition.

3.5 PROTECTION AND TOUCH-UP

A. During painting work, protect the work of other trades against undue soilage and damage by the exercise of reasonable care and precautions. Properly clean, repair or replace any work so damaged and soiled.

B. Protect all painted and finished surfaces against damage until the date of final acceptance of the work. The Architect will conduct a final review of all work performed hereunder. Re- coat or touch-up, all scratches and other blemishes on surfaces, and as directed by the Architect, any areas found which do not comply with the requirements of this Section, and bear all costs therefore.

C. Any re-coating or touch-up work, required after the work of this Section has been reviewed and accepted by the Architect, will be paid for by the Contractor.

3.6 PAINTING SCHEDULE

A. Colors: The Architect will furnish a schedule of colors for each area and surface. Tinting and matching shall be to the satisfaction of the Architect. No limit is placed on the number of colors that may be required, or the number of colors in any one room, area, or surface. Premium paints of deep-hued, bright, pigment intensive, accent and primary colors may be scheduled for up to 25 percent of all interior and exterior surfaces without additional cost to the Owner.

1. Colors of priming coats (and body coats where specified) shall be lighter in tint than those of finish coat.
2. Colorants: Pure, non-fading pigments, mildew-proof, ultra-violet resistant, finely ground in approved medium; and be limeproof, when used in coatings to be applied on masonry, concrete, plaster, and gypsum board surfaces.

B. Paint schedule for interior surfaces and materials: Refer to Document 09 91 23.

C. Paint schedule for labeling and identifying fire resistive and rated designations: Refer to Document 09 91 23.

D. Painting schedule for mechanical and electrical equipment: Refer to Document 09 91 23.

END OF SECTION

DOCUMENT 09 91 23
INTERIOR PAINTING SCHEDULE

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

A. General: Number of coats scheduled herein below is minimum required, refer to Article entitled “APPLICATION” in specification Section 09 91 00 - PAINTING, regarding coverage.

1.2 PAINTING SCHEDULE FOR INTERIOR SURFACES AND MATERIALS

A. Interior GYPSUM BOARD (drywall) partitions:
   1. One coat latex primer.
      a. California: “Elements 100% Acrylic White Primer”, Nº. 74600.
      b. Glidden Professional: Lifemaster No VOC Primer Nº. 9116.
      c. Moore: “Eco Spec Interior Latex Primer Sealer”, Nº. 231.
      d. Pittsburgh: “Pure Performance Interior Latex Primer”, Nº. 9-900.
      e. Sherwin-Williams: "Harmony Interior Latex Primer”, B11W900 Series.
   2. Two coats eggshell paint:
      a. California: “Elements 100% Acrylic Zero VOC Eggshell”, Nº. 731.
      b. Glidden Professional: Lifemaster No VOC Eggshell Nº. 9300.
      c. Moore: “Eco Spec Interior Latex Eggshell”, Nº. 223.
      d. Pittsburgh: “Pure Performance Eggshell”, Nº. 9-300.
      e. Sherwin-Williams: "Harmony Low Odor Interior Latex Eg-Shel”, B9 Series”.

B. Interior GYPSUM BOARD (drywall) ceilings and underside of soffits:
   1. One coat latex primer.
      a. California: “Elements 100% Acrylic White Primer”, Nº. 74600.
      b. Glidden Professional: Lifemaster No VOC Primer Nº. 9116.
      c. Moore: “Eco Spec Interior Latex Primer Sealer”, Nº. 231.
      d. Pittsburgh: “Pure Performance Interior Latex Primer”, Nº. 9-900.
      e. Sherwin-Williams: "Harmony Interior Latex Primer”, B11W900 Series.
   2. Two coats flat paint:
      a. California: “Elements Zero VOC Flat 100% Acrylic”, Nº. 733.
      b. Glidden Professional: Lifemaster No VOC Flat Nº. 9100.
      c. Moore: “Eco Spec Interior Latex, Flat”, Nº. 219.
      d. Pittsburgh: “Pure Performance, Flat”, 9-100 Series.
      e. Sherwin-Williams: “Harmony Low Odor Interior Latex Flat”, B5 Series.

C. Interior METAL, FERROUS, excluding railings, to receive semi-gloss finish: (includes galvanized metal doors and frames):
   1. One coat of rust prohibitive primer for unfinished metal surfaces, and touch up bare metal at shop primed, existing and previously coated surfaces:

a. California: “Rust-Stop DTM Primer/Finish”, Nº. 1061.
b. Devoe Coatings: Devflex 4020PF DTM Primer and Flat Finish.
c. Moore: “Acrylic Metal Primer”, Nº. P04.
d. Pittsburgh: “Pitt-Tech DTM Primer/Finish 100% Acrylic”, 90-709/712 Series
e. Sherwin-Williams: "DTM Acrylic Primer Finish", B66 W1 Series.

2. Two coats acrylic semi-gloss enamel:
   a. California: “Rust-Stop DTM Primer/Finish”, Nº. 1061.
   b. Devoe Coatings: Devflex 4216HP High Performance Waterborne Acrylic Semi- Gloss Enamel.
   c. Moore: “Super Spec HP DTM Semi-Gloss Enamel”, Nº. P29.
   d. Pittsburgh: “Pitt-Tech Plus High Performance, Semi -Gloss DTM Industrial Enamel”, 90-1210 Series.
   e. Sherwin-Williams: “Sher-Cryl HPA Semi-Gloss”, B66 Series.

D. Interior METAL, GALVANIZED, (includes exposed ductwork):
1. Touch-up with metal primer.
   a. California: “Rust-Stop DTM Primer/Finish”, Nº. 1061.
   b. Devoe Coatings: Devflex 4020PF DTM Primer and Flat Finish.
   c. Moore: “Acrylic Metal Primer”, Nº. P04.
   d. Pittsburgh: “Pitt-Tech DTM Primer/Finish 100% Acrylic”, 90-709/712 Series.
   e. Sherwin-Williams: "DTM Acrylic Primer Finish" B66 W1 Series.
2. Two coats acrylic semi-gloss enamel:
   a. California: “Rust-Stop DTM Primer/Finish”, Nº. 1061.
   b. Devoe Coatings: Devflex 4216HP High Performance Waterborne Acrylic Semi- Gloss Enamel.
   c. Moore: “Super Spec HP DTM Semi-Gloss Enamel”, Nº. P29.
   d. Pittsburgh: “Pitt-Tech Plus High Performance, Semi -Gloss DTM Industrial Enamel”, 90-1210 Series.
   e. Sherwin-Williams: “Sher-Cryl HPA Semi-Gloss”, B66 Series.

E. Interior exposed METAL, PIPING: Same as specified for ferrous metal.

F. Interior METAL, RAILINGS (handrails and guardrails):
1. One coat of epoxy primer (dry film coat 3.0 to 4.0 mils)
   a. California: No equivalent.
   b. Devoe Coatings: Tru-Glaze-WB” 4030 Waterborne Epoxy Primer
   c. Moore: “Epoxy Metal Primer”, P33 Series.
   d. Pittsburgh: “Aquapon WB Epoxy Primer”, 98 Series
   e. Sherwin-Williams: “Recoatable Epoxy Primer”, B67 Series.
2. Two coats of gloss finish epoxy coating (dry film coat 1.5 to 2.0 mils).
   a. California: “Tile-Cote Polyamide Epoxy”, Nº. 12.
   b. Devoe Coatings: Tru-Glaze-WB 4408 Waterborne Gloss Epoxy Coating.
   c. Moore: “Acrylic Epoxy Gloss Coating”, Nºs. P43/P44.
   d. Pittsburgh: “Aquapon WB Epoxy Coatings”, 98 Series.

e. Sherwin-Williams: “Hi-Solids Polyurethane-Low VOC, B65 Series”.

G. Interior underside of METAL DECKING, exposed to view joists, overhead steel, sprinkler piping, conduits, ducts and similar items:

1. Two coats waterborne acrylic dry fall finish:
   a. California: “Economy Latex Dry Fall Spray Flat”, Nº. 3701.
   b. Glidden Professional: Waterborne Dry Fall Flat Nº 1280.
   c. Moore: “Sweep-Up Spray Latex Flat, Nº. 153.
   d. Pittsburgh: “Speedhide Latex Dry Fog Spray Paint”, 6-714/715 Series.
   e. Sherwin-Williams: “Waterborne Arcylic Dry Fall”, B42 Series.

H. Interior WOOD TRIM, new, unfinished, to receive painted (opaque) finish:

1. One coat acrylic primer-sealer (undercoater):
   a. Glidden: Wall and Woodwork Primer Sealer, Nº 1020.
   b. Moore: “Alkyd Enamel Underbody”, Nº. 217.
   c. Pittsburgh: “Speedhide Alkyd Interior Quick-Drying Enamel Undercoater”, 6-6 Series.
   d. Sherwin-Williams: "PrepRite Classic Latex Primer”, B28W200 Series.
2. Two coats acrylic semi-gloss enamel:
   a. California: “Fres-Coat Unite Semi-Gloss”, Nº. 563.
   b. Glidden Professional: Ultra Hide 150 Semi-Gloss Nº. 1416.
   c. Moore: “Superspec Latex Semi Gloss”, 276 Series.
   d. Pittsburgh: “Speedhide Interior Semi-Gloss”, 6-500 Series.
   e. Sherwin-Williams: “ProClassic Waterborne”, B31W20 Series.

1.3 PAINTING SCHEDULE FOR FIRE RESISTIVE AND RATED DESIGNATIONS

A. In compliance with Section 703.6 of the 2009 International Building Code and as additionally specified herein, provide identification for all fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions and any other wall or partition which is required to have protected openings or penetrations.

1. Application:
   a. Apply to outside of fire rated shafts, and to both sides of partitions at intervals not to exceed 30’-0” for entire length of partition or wall, or once on any partition 30’- 0 feet or less in length.
   b. Locate identification in all accessible concealed floor, floor-ceiling and attic spaces. Locate identification within 12 to 18 inches above finished ceilings.
   c. Apply stenciled lettering by spray or brush, or provide permanent signage. Identification shall be waterproof, fade-proof and non-combustible. Signage shall be mechanically fastened or permanently adhered to partition.
   d. Stencil character height: 1 inch minimum.
   e. Color: Easily identifiable color, contrasting with background, acceptable to Owner.
2. Apply stenciled lettering to the following types of partitions using wording specified:
   a. Applied identification for 4 hour fire rated partitions shall read: “4 HOUR

FIRE WALL – PROTECT ALL OPENINGS”

b. Applied identification for 3 hour fire rated partitions shall read: “3 HOUR FIRE WALL - PROTECT ALL OPENINGS”.

c. Applied identification for 2 hour fire rated partitions shall read: “2 HOUR FIRE WALL - PROTECT ALL OPENINGS”.

d. Applied identification for 1 hour fire rated partitions shall read: “1 HOUR FIRE WALL - PROTECT ALL OPENINGS”.

e. Applied identification for Smoke barriers shall read: “1 HOUR SMOKE BARRIER
- PROTECT ALL OPENINGS”.

f. Applied identification for Smoke partitions shall read: “SMOKE BARRIER PARTITION - PROTECT ALL OPENINGS”.

1.4 PAINTING SCHEDULE FOR MECHANICAL AND ELECTRICAL EQUIPMENT

A. Paint interior surfaces of air ducts, and convector and baseboard heating cabinets that are visible through grilles and louvers with one coat of flat black enamel.

B. Paint dampers exposed behind louvers, grilles, and convector and baseboard cabinets to match face panels.

C. Remove unfinished louvers, grilles, covers and access panels on and paint as scheduled above.

D. Plywood backboards for electrical panels and other equipment. Paint both front and back surfaces and all edges of plywood backboards before backboards are installed.

1. One coat latex primer-sealer (undercoater):
   a. Glidden Professional: Lifemaster No VOC Primer Nº. 9116.
   b. Moore: “EcoSpec Interior Latex Primer Sealer” 231.
   c. Pittsburgh: “Pure Performance Interior Latex Primer”.
   d. Sherwin-Williams: "Harmony Interior Latex Primer” B11W900.
2. Two coats latex semi-gloss paint:
   a. Glidden Professional: Lifemaster No VOC Semi-Gloss” Nº. 9200.
   b. Moore: “EcoSpec Interior Latex Semi-gloss” Nº. 224.
   c. Pittsburgh: “Pure Performance Interior Semi-gloss”, 9-500 Series.
   d. Sherwin-Williams: "Harmony Interior Latex Semi-gloss" B10 Series.

E. Prime and paint insulated and exposed cold pipes, conduit, electrical boxes, insulated and exposed ducts, hangers, brackets, collars and supports, except where items are located in storage, mechanical or equipment spaces or those items which are factory prefinished.

F. Exposed to view un-insulated hot pipes within finished painted areas: Two coats heat- resistant enamel conforming to Federal Specification TT-E-496, Type I, applied when surfaces are less than 140 degrees Fahrenheit.

END OF DOCUMENT

SECTION 09 97 26
EXTERIOR TEXTURED COATINGS

PART 1 - GENERAL

1.1 SUMMARY

A. General:

1. Section includes surface preparation and application of both the polymer-modified, cement-based vertical surface leveling and the textured coatings over concrete masonry unit construction.

1.2 RELATED REQUIREMENTS

A. Section 04 20 00 – MASONRY: Concrete masonry unit construction for infill of existing tilt-up panels.

B. Section 09 91 00 - PAINTING: Applied finish coatings.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. ASTM B 117 - Standard Practice for Operating Salt Spray (Fog) Apparatus**.**
2. ASTM C 109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or [50-mm] Cube Specimens).
3. ASTM C 580 - Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacings, and Polymer Concretes.
4. ASTM C 642 - Standard Test Method for Density, Absorption, and Voids in Hardened Concrete.
5. ASTM C 666 - Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
6. ASTM C 672 - Standard Test Method for Scaling Resistance of Concrete Surfaces Exposed to Deicing Chemicals.
7. ASTM C 882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear.
8. ASTM D 4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
9. ASTM G 154 - Practice for Operating Light and Water Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Non-metallic materials.

1.4 SUBMITTALS

A. Information and Review Submittals: Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Product Data: Manufacturer's product data sheets, performance data, chemical

and physical properties and installation instructions for each item furnished hereunder.

2. Selection Samples: Sample card indicating Manufacturer's full range of colors available for selection by Architect.
3. Verification Samples: 12 inch long samples of sealant for verification of color, installed where directed by Architect.
4. Certificates: Manufacturer's certification that the Products supplied meet or exceed specified requirements.
5. Test and Evaluation Reports:
   a. Compatibility and adhesion test reports: Test reports from manufacturer indicating that coatings proposed for use have been tested for compatibility and adhesion with actual samples of substrates to be used on this project. Include manufacturer's interpretation of test results, and recommendations for primers and substrate preparation specific to this Project.

B. Closeout Submittals: Submit the following under provisions of Section 01 78 00 - CLOSEOUT SUBMITTALS.
   1. Bonds and Warranty Documentation: Manufacturer's standard Warranties and Guarantees.

1.5 QUALITY ASSURANCE

A. General: Notify the Architect where conflicts apply between referenced standards and existing materials, and existing methods of construction.

B. Qualifications:
   1. Installer/Applicator: Minimum of 3 years documented experience demonstrating previously successful work of the type specified herein.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivery and Acceptance Requirements:
   1. Do not deliver items to the site, until all specified submittals have been submitted to, and approved by, the Architect.
   1. Deliver materials in original unopened packages, containers or bundles bearing brand name, and identification of manufacturer, with labels and package seals intact and legible.

B. Storage and Handling Requirements:
   1. Store and handle materials following manufacturer's recommended procedures, and in accordance with material safety data sheets.
   2. Protect materials from damage due to moisture, direct sunlight, excessive temperatures, surface contamination, corrosion and damage from construction operations and other causes.

C. Damaged material: Remove any damaged or contaminated materials from job site immediately, including materials in broken packages, packages containing water marks, or show other evidence of damage, unless Architect specifically authorizes correction thereof and usage on project.

1.7 SITE CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between 40 and 90 degrees F unless otherwise permitted by manufacturer's written instructions.

B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

1. Monitor weather reports, and do not apply finishes if rain is expected within 8 hours of completing application.

C. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before starting or continuing coating operation.

D. Primer shall not be exposed to ultra violet for more than four weeks prior to application of coating. If exposure exceeds four weeks, primer shall be recoated, as recommended by manufacturer.

E. Material use is above grade only. Do not use below grade.

1.8 WARRANTY

A. In addition to the specific guarantee requirements of the GENERAL CONDITIONS and SUPPLEMENTAL GENERAL CONDITIONS, the Contractor shall obtain in the Owner's name the standard written manufacturer's guarantee of all materials furnished under this Section where such guarantees are offered in the manufacturer's published product data. All these guarantees shall be in addition to, and not in lieu of, other liabilities which the Contractor may have by law or other provisions of the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compatibility:

1. Provide finish coatings and crack fillers and primers as applicable for use within finish coatings 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 material or coat, provide products and spreading rates recommended in writing by elastomeric coating manufacturer for use on substrate indicated.

B. Primer: Exterior Textured Coating manufacturer's recommended, factory-formulated, alkali- resistant primer compatible with substrate and other materials indicated.

2.2 POLYMER-MODIFIED, CEMENT-BASED, VERTICAL, STRUCTURAL SURFACE LEVELER

A. Basis-of-Design: To establish a standard of quality, design and function desired, Drawings and specifications have been based on Sto SkimCoat by Sto Corp, or approved equal.

B. Performance/Design Criteria: Meet or exceed the following values for material cured at 73 degrees F (23 degrees C) and 50 percent relative humidity:

1. Application: Trowel.
2. Working Time: 25-45 minutes
3. Compressive Strength: 1,200 psi (8.3 MPa) at 3 days, 2,200 psi (15.2 MPa) at 7 days,
   3,000 psi (20.7 MPa) at 28 days, ASTM C 109.
4. Bond Strength: 250 psi (1.7 MPa) at 7 days, 500 psi (3.4 MPa) at 28 days, ASTM C 882 modified.
5. Flexural Strength: 850 psi (5.9 MPa) at 7 days, 1,030 psi (7.1 MPa) at 28 days, ASTM
   C 580.
6. Tensile Bond Strength: 145 psi (1.0 MPa) at 7 days, 220 psi (1.5 MPa) at 28 days, ASTM D 4541 to concrete
7. Tensile Strength: 385 psi (2.6 MPa) at 28 days, ASTM C 190
8. Trowel-application consistency
9. Color: Concrete Gray.
10. Combustibility: Non-combustible, both before and after use.

2.3 EXTERIOR TEXTURED COATINGS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Tammscoat Coarse by The Euclid Chemical Company, or approved equal.

B. Finish: Coarse Texture

C. Color: Refer to Drawings

D. Performance Criteria:

1. Weight per gallon - 10.5 lbs + 0.5
2. Viscosity – 125-128 KU
3. Solids, Weight % - 53-56
4. Weather-o-meter (Hours) - 5,000- ASTM G154 with no crazing, cracking, chipping or flaking.
5. Water absorption %- ASTM C642- 48 hours-0.18, 50 days-0.46
6. Freeze/Thaw Durability – ASTM C666- 300 cycles with no visible defects
7. ASTM D2794, Impact Resistance, 1/2” indenter, 6 inch lb.load with no chipping.
8. Salt Spray Test ASTM: B-117-95 (Hours) - 3,000 with no deterioration
9. ASTM C672- Scaling Resistance, 50 cycles with no scaling.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces and verify that they are in proper condition to receive the work of this Section.

B. Verify substrate is sufficiently dry to achieve a bond in accordance with the manufacturer's recommendations.

C. Beginning of installation means acceptance of existing substrate and site conditions.

3.2 INSTALLATION OF STRUCTURAL SURFACE LEVELER

A. Examine substrates and conditions under which materials will be installed. Do not proceed with installation until unsatisfactory conditions are corrected.

B. Coordinate installation with adjacent work to ensure proper sequence of construction. Protect adjacent areas and landscaping from contact due to mixing and handling of materials.

C. Surface Preparation: Comply with manufacturer's printed instructions and the following.

1. Remove loose and deteriorated materials from surfaces to be leveled using high pressure (>300 psi (20.7 MPa)) water-blasting, sand blasting, or mechanical wire brushing.
2. Provide right-angle cuts at perimeter of repair by saw-cutting or chipping; do not feather edge.
3. Clean surfaces of bond-inhibiting materials including oil, dust and dirt, laitance and standing water

D. Mixing: Comply with manufacturer's printed instructions and the following.

1. Precondition components to temperature of 70 plus or minus 5 degrees F (21 plus or minus 2.5 degrees C) prior to mixing.
2. Using StoSilo or Sto S-25 Continuous Mixer:
   a. Connect to a source of clean, potable water.
   b. Set the water flow rate to provide the desired consistency (suggested initial setting 450 L/hr).
3. Drill and Paddle:
   a. Mix with 7 to 7.5 pints (3.3 to 3.6 L) of clean, potable water per 60-pound (27.2 kg) bag.
   b. Mix with a slow-speed drill (<300 rpm), adding the dry material slowly, approximately 1/3 bag at a time.
   c. Do not exceed the maximum water content.
   d. Mix up to 3 minutes or to achieve a uniform, lump-free consistency. Avoid over- mixing.
4. Mortar Mixer:
   a. Predampen the inside of a clean mortar mixer, and then remove any excess water.
   b. Pour 7.0 pints (3.3 L) of water, per bag of powder, into the mortar mixer, start the mixing blades, and slowly add all of the powder.
   c. If more water is needed, add up to 0.5 pints (0.24L) per bag.
   d. Do not exceed maximum water content.
   e. Mix to a uniform, lump-free consistency. Avoid over-mixing.

E. Application: Comply with manufacturer's printed instructions and the following.

1. Apply when ambient and surface temperatures are 45 degrees F (7.5 degrees C) and rising.
2. Do not apply in freezing conditions or during precipitation.

3. Comply with manufacturer's guides for hot and cold weather application.
4. Dampen substrate to fill concrete pores with water. Remove ponding, glistening, or surface water (saturated surface dry).
5. Apply scrub coat of repair mortar into substrate to ensure intimate contact and establish bond.
6. Apply mortar while scrub coat is wet. Consolidate and trowel to the desired finish, with a minimum thickness of 1/8 inch.
7. Maximum thickness per lift is ½-inch.
8. If applications thicker than ½-inch are required, scarify the first lift and allow to harden sufficiently to support the next lift (about 30 minutes at 75 degrees F (23 degrees C). Apply a scrub coat and complete the next lift while the scrub coat is wet. Trowel the final lift to the desired finish.

F. Curing

a. 1. Keep surface damp for 48 hours with continuous light water-fogging, or cover with damp burlap or burlene curing blankets.

b. 2. If no coating or sealer is to be applied, a water-based curing compound meeting ASTM C309 may be used.

c. 3. Do not use solvent-based curing compounds.

G. Cleaning: Remove excess material before material cures. If material has cured, remove using mechanical methods that will not damage substrate.

3.3 MOISTURE TESTING

A. Following the application and drying of the surface leveler, perform the standard test described in ASTM D 4263-83 "Standard Test Method for Indicating Moisture in Concrete by Plastic Sheet Method." Tape tightly to the concrete surface an 18" x 18" sheet of clear polyethylene film, approximately 4 mils thick, and allow it to remain in place for at least 16 hours. Do not continue if any moisture is visibly present.

B. Preform Moisture Testing on each Exterior Tilt-up concrete panel infill area.

3.4 INSTALLATION OF TEXTURED COATING

A. Examine substrates and conditions, with Applicator present, for compliance with manufacturer's requirements for maximum moisture content, alkalinity, and other conditions affecting performance of work.

B. Verify that substrate is within the range of alkalinity recommended by manufacturer.

C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

D. Surface Preparation:

1. General: Perform preparation and cleaning procedures in accordance with coating system manufacturer's instructions and as herein specified, for each particular substrate and coating condition.

a. Remove hardware accessories, machined surfaces, plates, lighting fixtures and similar items in place and not to be finish-coated or provide surface applied protection prior to surface preparation and coating operations. Remove, of necessary, for complete coatings of items and adjacent surfaces. Following completion of coating of each area, reinstall removed

items.

b. All surfaces shall be sound and clean prior to application of primer and coatings.
Such surface contaminants as dust, dirt, mildew, form oils, loose substrate, etc., shall be removed by water-blasting. Excessive form oils, release agents and curing compounds may require light sandblasting.

c. Mask all glass, shrubbery and asphalt surfaces.

d. Over a clean and sound surface apply manufacturer recommended Primer per manufacturer's printed instructions.

1) Curing Time: Twenty-four (24) hours minimum

E. Materials Preparation:

1. Mix and prepare coating materials in accordance with manufacturer's directions.
2. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of coatings in a clean condition, free of foreign materials and residue.
3. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film, and if necessary, strain material before using.

F. Application:

1. Apply coating in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
2. Concrete System:
   a. Over primed, clean and sound surface, apply product at standard coverage rate in desired texture and color with recommended spray equipment.
   b. Apply a uniform film thickness over the entire surface being covered. Minimum dry film thickness is approximately 15 mils.
   c. A wet edge shall be maintained to prevent lap-marks.

G. Avoid starting and stopping midway on wall. Continue to a natural break such as a panel edge or corner.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. Clean-up: During progress of work, remove from site discarded coating materials, rubbish, cans and rags at end of each work day.

C. Upon completion of coating work, clean window glass and other coating-splattered surfaces. Protect work of other trades, whether to be coated or not, against damage by coating and finishing work. Correct any damage by cleaning, repairing or replacing, and recoating, as acceptable to Architect.

D. D. Provide "wet paint" signs as required protecting newly-coated finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of coating operations.

END OF SECTION

SECTION 10 14 00
SIGNAGE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install informational and directional signage.

1.2 RELATED SECTIONS

A. Section 01 50 00 - TEMPORARY FACILITIES AND CONTROLS: Temporary project sign and safety signage.

1.3 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Literature: Manufacturer's product data sheets, specifications, physical properties for each item furnished hereunder.
2. Schedule: The Architect will prepare and issue a schedule for all identification devices to be furnished hereunder, including character types, and colors. After receipt of the Architect's schedule, prepare and submit shop drawings and verification schedule.
3. Shop drawings:
   a. Plan drawing showing location of each interior [and exterior] sign. Coordinate plan with schedule.
   b. Elevation drawings showing full size elevations of each sign. Indicate for each sign: sign styles, lettering and locations, and overall dimensions.
   c. Large scale design details of signs, showing attachment clips and brackets; and complete installation details.

4. Selection samples:
   a. Sample plastic chips indicating Manufacturer's full range of colors available for initial selection by Architect.

5. Verification samples:
   a. Full size sign in specified finish and typeface. Approved sample may be used in finished Project.

1.4 REGULATORY REQUIREMENTS

A. Comply with all applicable federal, state and municipal codes, laws and regulations regarding signage for exits and handicapped barriers.

1.5 QUALITY ASSURANCE

A. Sign fabricator specializing in the work of this Section with a minimum of 3 years experience.

B. All signage must be ordered within two weeks of anticipated move-in and installation of signage must be completed within 45 days from the date of initial move-in.

1.6 DELIVERY, STORAGE AND HANDLING

A. Delivered packaged signs, labeled in name groups.

B. Store all materials in an elevated dry location, protected by waterproof coverings. Store adhesive tape at ambient room temperature.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Signage shall be based on Digital Realty Trust standards and furnished Desk and Door USA, Frankfort, IL, Contact Jay Burriter / (815) 806-8670 - www.deskanddoorusa.com/dlr.pdf.

2.2 SIGNAGE - GENERAL

A. General: Provide sign copy to comply with the requirements indicated in the Drawings, for sizes, styles, spacing, content, positions, materials, finishes and colors of letters.

1. All Signs shall conform to United States “Americans with Disabilities Act”.
2. Final placing and sizing of lettering shall be done as part of the shop drawing approval process, at which time the manufacturer shall make recommendations for Architect’s review. Lettering shall have stroke width to height ratio and width to height ratio in accordance with the Americans with Disabilities Act.

B. Installation of all signs shall be done by vandal-proof method, fully described on the shop drawings.

2.3 SIGNAGE TYPES

A. Suite Signage:

1. A suite number sign is required for each datacenter within a facility.
2. Each sign must be made of a brushed silver aluminum frame with a black phenolic polymer insert with satin silver text. The suite number must also be included on the sign in Braille.
3. The logo and/or name of a suite occupant may only be included with their written permission.
4. Each suite sign shall be 12-1/2 inches x 12 inches.

B. Utility Room Signage:

1. Utility room signs are required for each room whose function does not change including electrical, battery, and generator rooms. Each sign shall be of brushed silver aluminum frame with a black phenolic polymer insert inlaid with satin silver text.
2. Each utility room sign shall be 7 inches x 11 inches.

C. Building Signage/Cage Signs:

1. Cage signs may be used by data center tenants to denote the location of their space.
2. All cage signs must be ordered from the www.deskndoorusa.com/dlr.pdf website and meet the following criteria:
   a. Size: 18 inches tall x 24 inches wide
   b. Color: Silver plate
   c. Text color: PMS 285 Blue
   d. Text height: 3 inches-4 inches as designed.
3. Tenant names may be displayed only with the written authorization of the tenant.

D. At each alarmed exit door: Provide sign, 9 inches high by 18 inches wide, having 3 inch high raised letters identifying “EMERGENCY EXIT ONLY” followed by 1 inch high raised letters identifying “ALARM WILL SOUND”. Provide with Grade 2 Braille strip.

E. At each corridor door to egress stairs: 8 by 10 inch size, having 3 inch high raised letters identifying “FIRE EXIT”, and 1 inch high letter identifying “KEEP DOOR CLOSED”. Provide with Grade 2 Braille strip.

F. At data hall walls: cut vinyl lettering, white 12:” high Oracle 651 Gloss pressure sensitive vinyl calendared lettering in font: Gotham Medium. Refer to drawings for exact locations location.

G. Electrical equipment labeling: Oracle 751 cast pressure sensitive vinyl lettering in font: Gotham. 2 mil thickness with outdoor durability of more than 5 years.

2.4 INTERIOR PLAQUE SIGNAGE FABRICATION

A. Photopolymer plaque signage (general requirements): Identification signs with raised tactile graphics, text, and Grade 2 Braille. Signs shall consist of 1/32 inch thick synthetic light sensitive photo emulsion permanently bonded to a rigid phenolic substrate, aluminum or acrylic plaque.

1. Raised lettering: Minimum above the surface of the sign 1/32”, and be in compliance with Americans with Disabilities Act.
   a. Bond photopolymer permanently to sign plaque, with appropriate laminating film, as recommend by the photopolymer manufacturer.

2. Screenprinting: All screen printing graphics, including raised areas of tactile plaques except Braille, shall be screen printed in a contrasting color so as to meet the color contrast requirements of Americans with Disabilities Act.
   a. All non-tactile text shall be screen printed with catalyzed epoxy ink. Applied vinyl lettering and graphics is not acceptable.
   b. Apply screen printing inks evenly without pinholes, scratches or orange-peeling.

3. Graphics: All text, symbols and graphics shall be reproduced utilizing computer generated digital art. All screen printed graphics shall utilize photographically prepared screens and shall be printed in accordance with industry standards. Hand-cut screens are not acceptable.
   a. All edges and corners and letter forms shall be true and clean. Letterforms, color areas, or lines with rounded positive or negative corners, built-up edges, bleeding, spattering, etc., shall not be accepted.
   b. Prepare artwork from typesetters reproduction of the test specified, minimum 1200 dpi resolution, camera ready artwork. All camera ready artwork and typesetting shall be no less than 75 percent of actual finished size.

2.5 ACCESSORIES

A. Adhesive tape: Double sided tape, permanent adhesive.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

A. Locate sign units and accessories as required by the Owner’s standards, locations in accordance with the approved shop drawings. Use mounting methods of the type described and in compliance with manufacturer’s instructions.

B. Install signs plumb, level and true to height indicated, with sign surfaces free from distortion or other defects in appearance.

C. Shop fabricate signs where practical and deliver to site completely assembled. All joints of such fabricated work are completely smooth without apparent marks showing throughout the finish. All work “broken down” is erected so that all parts fit accurately with hairline joints, with all joints flush. Joints in lighted signs shall be light-proof.

D. Wall and door mounted signs: Attach to surfaces as follows:

1. Vinyl Tape Mounting: Use very high bond, double sided foam tape, of thickness indicated, to mount signs to smooth nonporous surface. Use construction adhesive in conjunction with foam tape.
2. Silicone Adhesive Mounting: Use appropriate liquid silicone adhesive to attach sign units to irregular, porous, or vinyl-covered surfaces. Use double-sided vinyl tape to hold the sign in place until the adhesive has fully cured.

3.2 CLEANING

A. Clean and polish installed signs.

B. Remove all names, stamps and decals of sign manufacturers, and installers. No visible advertising of any kind is permitted.

END OF SECTION

SECTION 10 26 00
WALL PROTECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install the following where indicated on Drawings.
   1. Stainless steel corner guards.
   2. Impact Resistant Wall protection.

1.2 RELATED SECTIONS

A. Section 05 50 00 - METAL FABRICATIONS: Concealed in wall anchors for attachment of work of this Section.

B. Section 06 10 00 - ROUGH CARPENTRY: Concealed blocking and nailers.

C. Section 09 29 00 - GYPSUM BOARD: Substrate for wall and corner guards.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES.
   1. ASTM A 167 - Stainless and Heat-resisting Chromium-nickel Steel Plate, Sheet and Strip.
   2. ASTM E 84 - Test Method for Surface Burning Characteristics of Building Materials.
   3. All applicable federal, state and municipal codes, laws and regulations regarding flammability and smoke generation of interior finishes.

1.4 PERFORMANCE REQUIREMENTS

A. Installed component assembly to support vertical live load of 100 pounds per lineal foot with deflection not to exceed 1/50 of span between supports.

B. Bumper rails, corridor handrails, and attachments to resist lateral force of 75 pounds at any point without damage or permanent set.

C. Corner guards to resist lateral impact force of 100 pounds at any point without damage.

1.5 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:
   1. Literature: Manufacturer's product data sheets, specifications for each item furnished hereunder.
   2. Installation instructions: Indicate installation rough-in measurements and instructions.
   3. Manufacturer’s certification: Certify that corner guards meet or exceed flame spread rating for surface finish.
   4. Shop drawings: Large scale details of flush corner guards showing attachment

clips and brackets; termination details, and complete installation details.

5. Selection samples:

   a. Sample card indicating Manufacturer's full range of colors available for selection by Architect.

   b. Provide samples as requested by Architect for initial selection of colors and finishes

6. Verification samples: 12 inch long samples, each, of flush corner guards, illustrating selected color and finish.

1.6 DELIVERY, STORAGE AND HANDLING

A. Do not deliver wall and corner guards to the project until all concrete, masonry, plaster and other wet work has been completed and dry.

B. Deliver materials in original packages, containers or bundles bearing brand name, identification of manufacturer or supplier.

C. Store materials inside, under cover, and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage from construction traffic and other causes.

1.7 FIELD MEASUREMENTS

A. Take field measurements before preparation of shop drawings and fabrication, where possible, to ensure proper fitting of Work.

B. Allow for adjustments within specified tolerances wherever taking of field measurements before fabrication might delay Work.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate the work with wall or partition Sections for installation of concealed blocking or anchor devices.

PART 2 - PRODUCTS

2.1 CORNER GUARDS

A. Stainless steel corner guard (surface-mounted-adhered type): Fabricated from 16 gage (0.059 inch thickness) type 304 stainless steel, polished to a Nº 4, brushed finish, 90 degree profile, 3-1/2 inch by 3-1/2 inch by heights indicated on Drawings, with 1/8 inch bend radius.
   1. Specified Product: Pawling Corporation, series CG-500 “Pro-Tek Wall Protection Systems”, model “CG-50.”

B. Mounting adhesive: Pawling Corporation product “ADH-50”.

2.2 IMPACT-RESISTANT WALL COVERINGS

A. Aluminum Diamond Plate Sheet Wall Covering: Fabricated from aluminum diamond plate sheet wall-covering material.
   1. Basis-of-Design Product
   2. <http://www.specagent.com/LookUp/?ulid=678&mf=04&src=wd>: Subject to compliance with requirements, provide: “WPAD-12” diamond plate wall protection by

ProTek Systems Inc., or approved equal.
3. Size: 48 by 96 inches (1219 by 2438 mm) for sheet.
4. Sheet Thickness: 0.125 inch (3.0 mm).
5. Color and Texture: Bright finish.
6. Height: +/- 4 feet
7. Base: Cove Base
8. Joint Moldings: aluminum diamond plate that matches sheet wall covering color.
9. Top Cap: Flexible vinyl strip in aluminum channel. EB-1 by ProTek.
10. Mounting: Adhesive.

2.3 FABRICATION

A. Fabricate components with tight joints, corners and seams.

B. Predrill holes for attachment.

C. Form end trim closure by capping and finishing smooth.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces and verify that they are in proper condition to receive the work of this Section.

B. Verify that field measurements are as indicated on Drawings.

C. Beginning of installation means acceptance of existing substrate and project conditions.

3.2 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position.

B. Position corner guard from finished floor.

3.3 TOLERANCES

A. Maximum variation from required height: 1/4 inch.

B. Maximum variation from level from visible length: 1/4 inch.

3.4 CLEANING

A. Upon completion of the work of this Section in any given area, remove tools, equipment and all rubbish and debris from the work area; leave area in broom-clean condition.

END OF SECTION

SECTION 10 40 00
SAFETY SPECIALTIES

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Furnish and install the following:

1. Fire extinguishers: Provide extinguishers at all fire extinguisher brackets and wall mount locations called out on Drawings.
2. Fire extinguisher cabinets.

1.2 RELATED SECTIONS

A. Section 06 10 00 - ROUGH CARPENTRY: Wood blocking.

B. Section 09 22 16 - NON-STRUCTURAL METAL FRAMING: Metal framed wall openings at gypsum board partitions.

C. Section 09 29 00 - GYPSUM BOARD: Wall openings in gypsum board partitions.

D. Section 09 91 00 - PAINTING: Field finishing.

1.3 REFERENCES

A. Comply with applicable requirements of the following standards and those others referenced in this Section, under the provisions of Section 01 42 00 - REFERENCES. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. NFPA 10 – Standard for Portable Fire Extinguishers, 2010 Edition.

1.4 SUBMITTALS

A. Submit the following under provisions of Section 01 33 00 - SUBMITTAL PROCEDURES:

1. Literature: Manufacturer's product data sheets, indicating: fabrication specifications, finishes, and dimensions of cabinet and rough opening, and installation instructions.
2. Shop drawings: Details showing unit dimensions, methods of construction, attachment clips and brackets; and complete installation details.

1.5 REGULATORY REQUIREMENTS

A. Obtain certificate of compliance from authority having jurisdiction indicating approval of fire extinguisher cabinets and their installed locations.

1.6 DELIVERY, STORAGE AND HANDLING

A. Do not deliver cabinets or extinguishers to the site, until all specified submittals have been submitted to, and approved by, the Architect.

B. Store cabinets and extinguishers inside, under cover, and in manner to keep them dry, protected from weather, direct sunlight, surface contamination, corrosion and damage

from construction traffic and other causes.

PART 2 - PRODUCTS

2.1 FIRE EXTINGUISHERS AND CABINETS

A. Manufacturers: Subject to compliance with the requirements specified herein, manufacturers offering products which may be incorporated in the work include the following, or equal:

1. J.L. Industries, Bloomington, MN.
2. Larsen Manufacturing Co., Minneapolis, MN.
3. Potter-Roemer, Union, NJ.

B. Wall mounting bracket: 16 gage steel surface mounted bracket, with red glossy polyester thermo-set coating, equal to the following. Provide with red letter decals spelling “FIRE EXTINGUISHER” applied to wall surface, letter size, style as required by code, location as selected by Architect.

1. JL Industries, model number “MB-810”.
2. Larsen model number 864.
3. Potter-Roemer, model number 3903.

C. Extinguishers:

1. Type 1 - Non-toxic Multi-purpose dry chemical type (mono amonium phosphate),10 pound capacity, multi-purpose rated ‘4A, 80B:C’; Heavy Duty DOT Steel Cylinder Extinguisher with metal valves and siphon tubes, replaceable molded valve stem seals, corrosion and impact resistant polyester/epoxy paint finish, pull pin- upright squeeze grip operation, and pressure gauges.
2. Type 2: Halotron-1 agent, EPA approved clean agent, 11 pound capacity, multi-purpose rated 2A minimum, capacity to comply with NFPA10, 10 B:C’; with metal valves and siphon tubes, replaceable molded valve stem seals, pressure gauges and hose discharge.
3. Type 3: FE-36, Clean-Agent, EPA accepted (SNAP), with zero Ozone Depletion Potential (ODP). 13.25 pound capacity, mult-purpose rated 2-A: 10-B:C to comply with NFPA10, with metal valves and siphon tubes, replaceable molded valve stem seals, pressure gauges and hose discharge.

D. Fire extinguisher cabinets:

1. Cabinet trim style: Square trim, semi-recessed cabinet.
   a. Protruding from wall: 1-1/2 inches.
2. Door and trim: Cold-rolled steel with factory applied white thermally fused polyester coating, acceptable to receive a field applied recoating.
   a. Horizontal duo design with tempered glazing.
   b. Handles: Red door handles having raised letters “FIRE”.
3. Cabinet construction: 18 gage cold-rolled steel with factory applied white baked acrylic enamel finish.
   a. Cabinet for 5 pound capacity extinguishers:
      1) JL Industries “Ambassador Series”, model number 1816.
      2) Larsen “Architectural Series”, model number 2409-5R
      3) Potter-Roemer, “Alta Series”, model number 7012
   b. Cabinet for 10 pound capacity extinguishers:
      1) JL Industries “Ambassador Series”, model number 2016.

2) Larsen “Architectural Series”, model number 2712-RK
3) Potter-Roemer, “Alta Series”, model number 7025

PART 3 - EXECUTION

3.1 EXAMINATION

A. Inspect all surfaces and verify that they are in proper condition to receive the work of this Section.

B. Verify that prepared openings are ready to receive extinguisher cabinets.

C. Beginning of installation means acceptance of project conditions.

3.2 INSTALLATION

A. Install fire extinguisher brackets and cabinets in accordance with manufacturer’s instructions in locations indicated.

B. Do not commence installation of fire extinguisher brackets and cabinets until immediately adjacent surfaces have been completely installed and finished.

3.3 CLEANING AND ADJUSTMENT

A. Upon completion of the work of this Section in any given area, remove tools, and all packaging and debris from the work area; leave area in broom-clean condition.

END OF SECTION

SECTION 21 00 10
BASIC FIRE PROTECTION REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Contract and General and Supplementary Conditions and Division 1 Specifications are hereby made a part of this Division as fully as if repeated herein. Where provisions of Division 1 conflict, the greater or stricter shall prevail.

B. Provide a code compliant and FM Global approved fire sprinkler system.

C. This Section includes general administrative and procedural requirements for fire protection installations. The requirements included in this Section expand the requirements specified in Division 1.

D. Examine all Divisions of the specifications and drawings to determine the complete Scope of the Work. Fire protection work shall comply with the requirements indicated in all sections of this Division.

E. The work to be done under this Division of the Specifications shall include the furnishing of all labor, material, equipment, tools and appurtenances and performing all operations necessary to provide complete, fully functional systems in accordance with the Specifications, the Drawings and requirements of the applicable codes and standards listed herein. Where the specifications, drawings and applicable codes and standards conflict provide the greater or stricter requirement.

F. Visit areas of construction where Work is to take place, and examine the construction site carefully, noting locations and conditions under which the Work will be performed and accepting the responsibility for performing the Work under the existing conditions.

G. The work shall include the following specification sections:

Division 21 – Fire Protection

21 00 10 Basic Fire Protection Requirements

21 01 00 Sprinkler Systems

H. The work shall include, but not be limited to, providing equipment and items listed below and installing items furnished under other Divisions of these specifications.

1. Receiving, handling, storing, and protecting equipment, material, and tools required to complete the work of this Division. This includes equipment and materials furnished by the Owner, as well as equipment and materials furnished by the Contractor. Store equipment and materials off site until ready for installation, and coordinate location of on-site storage and staging area with Construction Manager.
2. Hoisting and rigging required for completing the work of this Division. In general, hoisting and rigging will be required for all equipment to be installed in the building and moving equipment within the building. Furnish, erect, maintain, relocate, and remove all hoisting, rigging, staging and scaffolding required to perform the work of this Section of the specifications.
3. Coordination with Construction Manager and General Contractor for controlled environmental conditions for stored and installed equipment in compliance with NFPA 13 and the manufacturer/vendor's requirements. This includes equipment furnished by others and stored or installed under this Section.

4. Coordination with the General Contractor and other Installers for installation of piping to avoid conflict with duct, cable tray, conduit, and loose cable in the same space. Prepare and provide coordination drawings as specified herein.
5. Supplementary steel, channel and supports.
6. All materials and appurtenances that can reasonably be inferred to be a part of the fire protection systems and necessary to its proper operation, but not specifically mentioned or indicated on the drawings, shall be furnished and installed without additional charge.
7. Identification and signage as required herein and by code and local authorities.
8. Touch-up painting of prefinished equipment furnished or damaged.
9. Firestopping, smoke, acoustical and environmental seals.
10. Provide cutting and patching under provisions of Division 1.
11. Provide core drilling through concrete; provide steel reinforcement and metal decking; provide required sleeves. Coordinate and set sleeves and watertight fittings in construction as it progresses so as not to impede the work of other trades.
12. Coordinate with the building trades:
    d. Structural members, pads, and building openings for fire protection equipment, ducts, piping, fans, etc., for use by the fire protection contractor shown on the architectural and structural plans are the coordination responsibility of the fire protection contractor. Any changes in the above requirements after letting and accepting the fire protection contract will be paid for by the fire protection contractor.
    e. Provide full time superintendent who shall oversee and coordinate the work with other trades and the A/E.
13. Coordinate with General Contractor's equipment and piping systems:
    d. This fire protection contractor shall coordinate the layout of his work with the General Contractor to avoid conflict with the installation of the General Contractor's equipment and/or piping systems.
14. Coordinate with electrical work:
    d. All motor starters, relays, contactors, etc. for packaged equipment shall be provided by this Contractor and shall meet the requirements of Division 26 Specifications.
    e. All other motor starters shall be provided by the Division 26, unless otherwise indicated in Division 26 specifications or as indicated on the electrical drawings.
    f. All control wiring for control devices, magnetic coils, etc. shall not exceed 120 volts. Where power voltage for equipment is over 120 volts, a control transformer shall be provided and wired.
    g. 24 volt power wiring to solenoid and control valves, etc. is to be done under this Division 22, unless shown on the Electrical Drawings.
    h. 120 volt power source will be made available, under Division 26, at the distribution breaker panels as indicated on the electrical drawings.
15. Provide compliance with construction requirements and procedures to qualify for LEED points.
16. Start up and acceptance testing for all systems provided or installed under this section. Include all requirements indicated herein, recommended by manufacturer or system vendor, and as required by the Owner or Commissioning Authority. Submit written documentation of all inspections and testing.
17. Commissioning of building systems – provide assistance and coordination with Owner and Commissioning Authority. Attend and support Integrated Testing of all systems, as required.

1.2 RELATED WORK

A. The following items of labor and material incidental and/or related to the installation of the Fire protection Work are specified under other Divisions of these Specifications unless specifically indicated otherwise. Provide and assist and coordinate work to meet requirements indicated in the Specifications and on the Drawings.

1. Cutting and patching in accordance with the requirements under Division 1.

2. Controlled environmental conditions for fire protection equipment per the manufacturer's recommendations or as specified in this Division is to be provided by the General Contractor.
3. Concrete work including forms for housekeeping pads for equipment, Division 3.
4. Reinforcing steel, Division 5.
5. Flashing and caulking, Division 7.
6. Setting of frames for access panels, Division 8.
7. Painting of all equipment and material other than touch up of pre-finished fixtures, equipment and other Fire protection components, Division 9.
8. Tamper switches, pressure switches and flow switches are provided under this Division and wired under Division 26 and 28.
9. Utility (water, gas, steam) by the General Contractor. Utility (water, fire alarm) backcharges will be paid by the General Contractor with no additional markups allowed. Refer to Division 1 for utility backcharges.
10. Communications cabling and equipment are by Owner.
11. Connection of Owner's Equipment, unless otherwise indicated on the Drawings or in the Specifications.

B. Furnish the following items for installation by others and provide coordination, cooperation, assistance and wiring as required:

1. Furnish access panels as required for fire protection work behind finished surfaces or otherwise concealed for installation under Division 8.

C. Install items purchased by others, coordinate delivery and be responsible for unloading from delivery vehicles, rigging, and for safe handling and field storage up to the time of installation. This Section shall be responsible for:

1. Coordination of delivery and shipping splits for size and weight restrictions of the project site.
2. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
3. Connection to building systems including the purchase and installation of all terminating fittings, lugs, etc. necessary to adapt and connect them to the building systems.
4. Provide all work indicated in the specifications and on the drawings related to the pre-purchased items that are not specifically indicated as pre-purchased.
5. Carefully examine such items upon delivery, and advise the General Contractor and General Contractor of any damages or defects noted, as well as the shipper.
6. Installation, testing, coordination of vendor's work and responsibilities and compliance with warranty coverage, requirements and support.

D. Work by General Contractor:

1. Refer to Division 1 for additional requirements and information.
2. Accommodate concurrent work provided by General Contractor.

E. Existing Materials:

1. All existing equipment and materials to be reused is assumed to be in good operating condition.
2. Guarantee all replacement work, equipment or materials for a period of one year from date of acceptance by the General Contractor.

1.3 COORDINATION OF THE WORK

A. Refer to Division 1 for additional requirements for coordination of the Work.

B. Before submitting bid examine all Drawings and Specification, including other Divisions, for requirements that affect work of this Division and include it in the scope of work for this section whether or not such work is specifically mentioned in this Division. Be responsible, under this

Division of the Specifications, for the proper coordination of the fire protection work with the installations under other Divisions, including proper clearances. Any changes required to avoid interferences shall be submitted to the General Contractor.

C. Coordinate work with that of all other trades affecting or affected by work of this Division. Cooperate with such trades to ensure the steady progress of work under the contract.

D. Coordinate work with the General Contractor and the project schedule. Provide manpower and materials as required to meet the schedule and not to interfere with or impede the progress of or increase the cost of work by others. Submit shop drawings and order equipment in a timely manner. Expedite deliveries and manufacturing as required.

E. Deliver products to the project in a timely manner to meet all schedule requirements, properly identified with names, model numbers, compliance labels and other information needed for identification.

F. Install materials and apparatus as fast as conditions of the building will permit. Materials and apparatus must be installed when directed and in the fashion specified. Examine the Architectural Drawings for the location of suitable openings and aisles for the passage of equipment to be installed under this Section. The installer shall be responsible for having suitable openings and aisles left open until his equipment has been properly installed. If necessary, request the vendor to ship equipment in sections sized to permit passage. Provide sleeves, pockets, supports and incidentals.

G. Examine the drawings, the building construction, and vertical transportation for weight and size restrictions. Provide equipment and installation methods to comply with restrictions including shipping split sizes, weights, and disassembled components as required. Obtain manufacturer's approval and assurance warranty will be honored.

H. Prepare and submit coordination drawings in conjunction with the other Trades, on common drawings of at least 1/8"=1'-0", as directed by the General Contractor. Each system shall be color-coded, and for cad drawings, each system shall be on a different layer. Meet to resolve conflicts between the various Installers prior to submission to the General Contractor for review. Identify conflicts resolved that include changes to the design. Note on coordination drawings submitted to the General Contractor any conflicts that the trades could not resolve. The General Contractor will provide direction that all Installers will comply with, at no additional cost to the project. In general, distribution systems which require pitch or slope such as plumbing drains, steam and condensate piping shall have the right of way over those which do not. Lighting fixtures have minimal flexibility and should not be moved without prior approval. Install work to avoid interferences and to allow proper clearance around all trades' work for access, maintenance and as required by code. Prepare coordination drawings in the following order (subject to above): HVAC (with lighting fixtures indicated), fire protection, plumbing, electrical and telecommunications systems. Work installed prior to complete and reviewed coordination drawings must be corrected as required at no additional expense to the project.

I. Coordination Drawings:

1. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by A/E for Contractor's use in preparing coordination drawings.
   d. A/E makes no representations as to the accuracy or completeness of CAD Drawings as they relate to the Contract Drawings.
   e. Installer is responsible for accuracy of coordination drawings. Do not resubmit original design drawings without verifying accuracy.
2. Prepare and submit coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.

d. Show the interrelationship of components shown on separate Shop Drawings.
e. Indicate required installation sequences.
f. Comply with requirements contained in Section "Submittals."

3. Work installed prior to complete and reviewed coordination drawings must be corrected as required at no additional expense to the project.
4. Prepare coordination drawings to a scale of 1/8"=1'-0" or larger; detailing major elements, components, and systems of fire protection 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:
   d. Indicate the proposed locations of piping, risers, backflow prevention, piping, fixtures, drains, equipment, and materials. Include the following:
      1) Clearances for installing and maintaining insulation.
      2) Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
      3) Equipment connections and support details.
      4) Exterior wall and foundation penetrations.
      5) Fire-rated wall and floor penetrations.
      6) Sizes and location of required concrete pads and bases.
      7) Valve stem movement.
5. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.
6. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
7. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.
8. Submit one set of CAD Coordination Drawings, and three sets of Color CAD Coordination Drawing plots.

J. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated request information from Architect.

K. Check Contract Drawings as well as Shop Drawings of all Installers and vendors to verify and coordinate space in which work of this section will be installed.

L. Obtain from manufacturers the proper method of installation and connection of the equipment that is to be furnished, installed or wired. Obtain all information that is necessary to facilitate the work and to complete the project.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Refer to Division 1 for additional requirements for quality assurance and control of the installation.

B. Receive, handle, house, and protect equipment required for installation under this specification. Replace damaged equipment with new equipment. Provide environmental requirements per NFPA 13 and manufacturer's requirements during shipping, storage and installation.

C. Review submittals of equipment furnished under other Divisions prior to installation and fire protection rough-in. Verify location, size, and required connections. Coordinate details of equipment connections with supplier and installer.

D. Utilize installers with at least five years of experience and properly trained, licensed or certified in the type of work to be performed.

E. Manufacturers shall be companies experienced and properly trained, licensed or certified in manufacturing products specified for a minimum of five years.

F. Be responsible for the care and protection of all work included in this Section until it has been tested and accepted.

G. Protect all equipment and materials from damage from all causes including theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment.

H. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen and make good any damage caused.

I. Provide workmanship in accordance with the best accepted practices. Rework installations judged by the Architect as unacceptable.

J. Fire Protection Components, Devices, and Accessories: Listed and labeled as defined in UL and/or FM, by a qualified testing agency, and marked for intended location and application.

1.5 REGULATORY REQUIREMENTS

A. Refer to Division 1 for additional regulatory or reference requirements.

B. Arrange and pay for permits, licenses, inspections and certificates. Give the proper Authorities all requisite notices or information required relating to the work under this Section. Request inspections from Authorities Having Jurisdiction. At the conclusion of the work, deliver certificates of inspection from Authorities Having Jurisdiction to the Owner's Representative.

C. Provide products listed and classified by an OSHA certified Nationally Recognized Testing Laboratory (NRTL) as suitable for purpose specified and indicated. Provide NRTL-listed material and equipment where standards are available. Notify Architect of any material or equipment that is not NRTL listed when submitting information.

D. Perform work in strict accordance with the rules, regulations, listing or labeling requirements, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities having legal jurisdiction over the site. No additional compensation shall be granted for work that must be changed as a result of the work not originally complying with the codes, standards, local requirements, etc.

E. Equipment and installation shall be suitable for the wind, snow, ice, flood, and earthquake requirements indicated in the Building Code and ASCE 7 for the location and usage.

1. Building occupancy classification per ASCE 7: Category II
2. Spectral Acceleration Parameters:
   d. S_S (0.25 sec) = 0.125
   e. S_1 (1 sec) = 0.052
3. Seismic Design Category: A
4. Site Class as defined in the IBC: C
5. Component importance factor: 1.5
6. Wind Load: 90 MPH
7. Snow Load: 5 PSF

F. Manufacturer Seismic Qualification Certification - Submit certification equipment will withstand seismic forces defined alone. Include the following:

1. Basis for Certification - Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
2. 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.

G. Materials and equipment shall be manufactured, installed and tested as specified in the latest and required editions of applicable parts of the following publications, standards and rulings of:

1. State and local codes and ordinances
2. Local utility company requirements and standards
3. AADAG Americans with Disabilities Act Guidelines
4. AGA American Gas Association
5. AISC American Institute of Steel Construction
6. AISI American Iron and Steel Institute
7. ANSI American National Standards Institute
8. ASCE7 American Society of Civil Engineers – Minimum Design Loads for Buildings and Other Structures
9. ASHRAE American Society of Heating, Refrigerating, and Air-Conditioning Engineers
10. ASPE American Society of Plumbing Engineers
11. ASSE American Society of Sanitary Engineering
12. ASTM American Society for Testing and Materials
13. AWS American Welding Society
14. AWWA American Water Works Association
15. BICSI Building Industry Consulting Service International, Inc.
16. CAGI Compressed Air and Gas Institute
17. CGA Compressed Gas Association
18. CISPI Cast Iron Soil Pipe Institute
19. EIA/TIA Electronics Industry Association / Telecom Industry Association
20. ETL ETL Testing Laboratories, Inc.
21. FM FM Global (Factory Mutual)
22. ICEA Insulated Cable Engineers Association
23. IEEE Institute of Electrical and Electronic Engineers
24. IMSA International Municipal Signal Association
25. ISA Instrument Society of America
26. MCAA Mechanical Contractors Association of America
27. MSS Manufacturers Standardization Society of the Valve and Fittings Industry
28. NBFU National Board of Fire Underwiters
29. NEC National Electrical Code (NFPA 70)
30. NEMA National Electrical Manufacturers Association
31. NFPA National Fire Protection Association
32. NRTL Nationally Recognized Testing Laboratory (OSHA Certified)
33. NSF National Sanitation Foundation
34. OSHA Occupational Safety and Health Act
35. PDI Plumbing and Drainage Institute
36. SFPE Society of Fire Protection Engineers
37. SMACNA Sheet Metal and Air Conditioning Contractors National Association
38. UL Underwriters Laboratories
39. WSC Water Systems Council

H. Where conflicts occur among the codes, ordinances, standards, Drawings or Specifications, the more restrictive requirements shall govern.

I. The Drawings and Specifications do not undertake to repeat requirements written or all work required in the above codes, ordinances and standards.

J. Comply with applicable codes and regulations regarding toxicity of combustion products of materials used.

K. Legally dispose of all material. Adhere to all regulations regarding disposal of hazardous material. Recycle hazardous material where recycling is possible. Submit certificates of legal recycling or disposal to the General Contractor. Include copy in the General Contractor and Maintenance Manual.

L. Public utility back charges will be paid for by the General Contractor and are not to be included in the base bid. Submit charges to General Contractor without markups, for General Contractor to process directly or as a change order to the Contract. Markups on utility back charges will not be allowed.

M. Nothing in these Contract Documents shall be construed to permit work not conforming with applicable codes and regulations. When conflicts occur the more restrictive requirements shall govern.

N. Should the Facility have established building standards, rules or regulations, obtain a copy from the General Contractor and comply with them.

1.6 SUBMITTALS

A. Refer to Section 01 33 00 – Submittal Procedures.

B. Submit at time of bid any equipment or materials that have lead times that will affect the construction schedule. Provide alternate costs to expedite delivery and manufacturing so that the project schedule can be accomplished.

C. Submit at time of bid, any proposed substitutions. List reasons the Owner should accept substitutions including improved performance or equal performance and improved delivery time. Acceptance of substitutions is subject to acceptance by the Architect, whose decision will be final. A substitution is considered to be any manufacturer or product not specifically identified in the specifications or drawings. If only performance requirements are indicated, and no specific manufacturer is indicated, then a manufacturer meeting the Contract Document requirements is not considered a substitute.

D. Substitutions of specifically indicated items will be reviewed only if identified at time of bid, otherwise submittals will be returned rejected. It is the proposer's responsibility to submit the first time all information required to prove equality and a written letter on the proposer's letterhead indicating that the item is in full compliance with the Contract Documents and will fit in the designated location. Include in bid, coordination of all work and all costs for all trades for any work that may be required, including any architectural or engineering fees, to accommodate the substitution. Acceptance of the proposed substitution is up to the General Contractor and is not assured. Review will include, but is not limited to, quality, life cycle costs, size, appearance, construction, manufacturer, service record, efficiency, dependability, performance, etc.

E. Submit for review, within 10 days after being given Notice to Proceed and prior to the submission of any shop drawings, an itemized list of manufacturer's of material and equipment and of firms or subcontractors proposed to be used to perform the work. Include a list of submissions and the proposed schedule to submit them, so that based on the approval times and procedures indicated below, the proposed project schedule will be accomplished. FAILURE TO SUBMIT WITHIN THE TIME LIMIT OF 10 DAYS WILL BE CONSIDERED A CONTRACT VIOLATION and will require that all items will be provided in a timely manner to maintain the schedule and all costs required to meet the schedule are included to expedite delivery and manufacturing.

F. After approval of the list and schedule, submit one (1) electronic and three (3) bound hard sets of detailed Shop Drawings and product Data per the submission schedule or within 30 days or sooner if required to meet the construction schedule. Substitutions will not be accepted for failure to comply with the schedule above. Electronic Submissions shall match the requirements for hard copy submissions.

G. Submit related shop drawings at one time. SUBMIT ALL ITEMS IN A SPECIFICATION SECTION AT THE SAME TIME. Incomplete submittals will be held until a complete submittal is accumulated.

H. The review of systems, equipment and Shop Drawings is a general review subject to the Contract Drawings, specifications and verification of all measurements at the job. Review does not relieve the installer from the responsibility of Shop Drawing errors or complying with the Specifications and Drawings. Carefully check and correct all Shop Drawings prior to submission for approval. Regardless of any information included in the shop drawings submitted for review, the requirements of the Contract Documents shall not be superseded in any way by the Shop Drawing Review.

I. Mark submittals to clearly identify (including when photocopied) proposed equipment including their accessories, options, and modifications and exclude parts not applicable to the Project, otherwise the Architect will identify items and options to be provided at no additional cost to the project.

J. Each submittal shall be reviewed, stamped and certified prior to submission to the Architect. Such certification shall be made by a person duly authorized to sign binding Agreements for the Contractor. The certification shall state that the data and details contained on each Shop Drawing, layout drawing, catalog data and brochure has been reviewed by the Contractor for conformance to the contract documents and that it complies with the Contract Documents in all respects. Submittals will not be reviewed and will be returned to the Contractor unchecked unless they are certified.

K. It is intended that Submittals be complete and accurate at the first submission. If the Submittal is returned marked “Resubmit” only one additional submittal will be permitted. If the second Submission is not acceptable, the right of selection will be lost and the Architect will specify exactly what is required and the specified products shall be provided at no additional cost to the Project.

L. A minimum period of two weeks, exclusive of transmittal time, will be required by the General Contractor’s office each time Submittals are submitted or resubmitted for review. This time period shall be considered when scheduling the work, and any costs associated with expediting equipment delivery to meet the Schedule will be at no additional cost to the Owner. Submittals of numerous items at the same time may extend the time needed for review, so plan accordingly.

M. Provide submittals in a timely manner sufficiently in advance to give ample time for checking, correcting, resubmitting and rechecking if necessary. No claim for delay or additional costs will be granted for failure to comply with this requirement.

N. If proposed equipment deviates from the Specifications or Drawings, indicate those differences and provide sufficient data to justify acceptance. FAILURE TO INDICATE DEVIATIONS OR SUBSTITUTIONS IMPLIES FULL COMPLIANCE WITH DRAWINGS AND SPECIFICATIONS.

O. Indicate clearly all equipment, components or assemblies that are not NRTL listed or labeled. Failure to indicate otherwise implies NRTL listing or labeling.

P. Provide products of one manufacturer for each classification of equipment.

Q. Meet Project requirements including space, size and weight restrictions before submitting to Architect. Equipment shall be of proper size for its allocated space. Equipment may be disassembled so that it can be installed through available openings only if it will not invalidate manufacturer's warranties.

R. At the job site, maintain the latest equipment submittals showing the action taken by the Architect. Make these submittals available to General Contractor.

S. Any items with a tag number must be submitted for approval. Submittals shall provide all pertinent data and information necessary to evaluate each item. Certified Drawings and catalog data sheets shall show:

1. Applicable specification section number and equipment tag number.
2. Principal dimensions and details of construction.
3. Weights of principal parts and total weights with information required for the design of supports and foundations.
4. Sizes and locations of piping and connections.
5. Performance data, including pump curves; pressure loss curves; certified by the manufacturer for the equipment furnished.
6. Data on electric motors, including break HP of driven equipment, nameplate ratings and classes, and starting and running full load currents.
7. Approval stamp of Underwriters and other authorities having jurisdiction of drawings requiring such approval.

T. Submit Schedule of proposed piping fitting, valves, specialties, etc. along with manufacturer's catalog data.

U. Product Data: Submit catalog data sheets or other published materials showing appearances, electrical ratings characteristics and connection requirements, performance characteristics, dimensions, weights, installation methods, and space requirements of fire protection equipment and their accessories, as listed below and required by the individual sections.

V. Shop Drawings: Submit shop drawings, drawn to scale, indicating physical size and arrangement, (plans and elevations) construction details, provisions for conduits, access requirements for installation and maintenance, finishes, and materials used in fabrication. Supplement shop drawings with wiring diagrams and information as described under Product Data.

W. A complete copy of the specifications, reduced in size to allow a Comment Column, with each sub-paragraph noted with comment, "compliance," "deviation," or "alternate". In the case of non-primary, vendor-supplied items, the name of the sub-vendor supplying said item, including model number shall be indicated.

1. By noting the term "compliance" it shall be understood that the manufactures is in full compliance with the item specified and will provide exactly the same with no deviations.
2. By noting the term "deviation" it shall be understood that the proposer prefers to provide a different component that performs the same function in lieu of that specified. Indicate all deviations and indicate what is being proposed, with enough detail to determine equivalency.
3. By noting the term "alternate" it shall be understood that the proposer proposes to provide the same operating function but prefers to do it in a different manner. An alternate shall be fully described as to what the proposer proposes to provide. Indicate any function or feature that is not provided. Specification Comparison: In addition to the complete shop drawings required above provide.

X. Manufacturer's Instructions:

1. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.

2. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.
3. Include instructions on manufacturer's requirements for cable restraint in equipment.
4. Submit manufacturer's standard and recommended receiving, start up and acceptance testing checklists.

Y. In addition to copies of submittals as required under Operation and Maintenance Manuals, provide electronic copies on CDs or DVDs of all submittal information in PDF or Microsoft Word format with O&M manuals.

Z. Submit seismic qualification certification of materials, assemblies and components required by codes indicating that equipment will "withstand" seismic events suitable to the occupancy class rating of the space. Seismic forces defined on the Structural contract drawings. Include the following:

1. Basis of Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   d. In class 1-3 occupancies
      The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event."
   e. In class 4 occupancies
      The term "withstand" means "the unit will remain in place without separation of internal and external parts during a seismic event and the unit will be fully operational after the event."
2. Dimensioned Outline Drawings of Equipment: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
4. Where required by authorities having jurisdiction and or codes documentation must be stamped and signed by a licensed engineering professional. Copies of documentation are to include calculations, restraint, support and anchor design documents, and installation requirements, as well as seismic qualification certificates.

1.7 EXTRA MATERIALS

A. Provide extra materials as specified in each section.

B. Extra materials shall be turned over to the General Contractor prior to receiving final payment. Obtain itemized receipt properly signed and dated. Submit with request for final payment.

C. Extra materials shall be in original standard manufacturer's packaging.

1.8 PROJECT RECORD DOCUMENTS

A. Refer to Section 01 77 00 – Closeout Procedures.

B. Provide and submit the following:

1. Record Drawings
2. Specifications
3. Product Data
4. Operation and Maintenance Manual.
5. Equipment Warranties.
6. Certification of proper disposal of regulated materials.

C. Provide and maintain at the site a set of prints on which shall be accurately indicated the actual installation of all work under this Division, indicating any variation from Contract Drawings, including change orders, field conditions, Architect's direction and changes in sizes, locations

and dimensions. Changes in circuitry shall be clearly and completely indicated as the work progresses. Modify Schedules to reflect data consistent with that of the installed equipment.

D. Record Drawings shall be maintained in a clean, dry and legible condition and shall not be used for construction purposes.

E. These progress prints shall be available for inspection by the Architect and shall be used to determine the progress of electrical work. Indicate daily progress by color-coding materials and apparatus installed. Progress prints shall be reviewed weekly and shall be corrected immediately if found inaccurate or incomplete. Drawings will be used as a guide for determining the progress of the work installed. Requisitions for payment will not be approved until the Drawings are accurate and up-to-date.

F. At the completion of the work, provide a CAD set of record drawings, modify drawings to represent the work as actually noted on the marked-up prints, including the DIMENSIONED location of all underground pipe and conduit. Remove all superseded data to show only the completed installation. Mark all drawings as “Final Record Drawings” and date them.

G. Electronic files shall be AutoCad 2014 as a minimum.

H. Furnish these record documents to the Architect for review and transmission to the General Contractor.

I. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark new information that is important to the General Contractor, but was not shown on Contract Drawings or Shop Drawings.
2. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
3. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
4. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
5. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
6. Contract Modifications, actual equipment and materials installed.
7. Include all “Corrected For Record” shop drawings to reflect approvals received.
    a. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located to record the locations and invert elevations of underground installations.
    b. Mark Specifications to indicate approved substitutions and actual equipment and materials used.
    c. Number of Copies: Submit copies of Record Drawings as follows:
        1) Initial Submittal: Submit one set of plots from corrected Record CAD Drawings and one set of marked-up Record Prints. A/E will initial and date each plot and mark whether general scope of changes, additional information recorded, and

quality of drafting are acceptable. A/E will return plots for organizing into sets, printing, binding, and final submittal.

2) Final Submittal: Submit three sets of Record CAD Drawing files, and three sets of Record CAD Drawing plots. Plot each Drawing, whether or not changes and additional information were recorded.
3) Electronic Media: CD-ROM.
4) Format: Same CAD program, version, and operating system as the original Contract Drawings.
5) Refer instances of uncertainty to A/E for resolution.

1.9 OPERATING INSTRUCTIONS AND MAINTENANCE DATA

A. In addition to the requirements of Division 1, after completion of the work and prior to final completion, furnish and deliver six copies of a complete O&M manual. Each manual shall include one copy of each approved shop drawing, catalog pages, instruction sheets, operating instructions, installation, instructions and recommended maintenance procedures and intervals, and spare parts bulletins. Provide separate sections for each separate system, i.e., power system, lighting system, fire alarm system, sound system, security system, etc.

B. Give detailed instructions, using Operation and Maintenance (O&M) manuals, prior to final completion of work, to the responsible personnel designated by the Owner in the operation and maintenance of all work installed under this Division. All instructions shall be recorded on DVD with two copies of the DVD turned over to the General Contractor upon completion of the instruction period. Recording of the instructions shall include a description of the system as well as detailed operating and maintenance instructions. Recording sessions will be of professional quality and performed by a firm regularly employed in that business. A letter with two copies containing the name of the person or persons to whom the instructions were given and the dates of the instruction period shall be submitted to the General Contractor at the completion of the project. Provide instructions for the following in cooperation with the manufacturer:

1. Preaction sprinkler riser assemblies
2. Nitrogen generation equipment, including air compressors and AutoPurge devices

C. Prepare sets of manufacturer’s catalogs, and other similar data, including the necessary photographic equipment cuts, wiring diagrams covering all fire protection equipment and devices furnished and installed under this Section. These manuals shall provide complete instructions for the proper operation and use of the equipment, together with instructions for lubrication and periodic maintenance and trouble-shooting. Operating instructions shall be specific for each system and shall include copies of posted specific instructions. This manual shall contain only that information which specifically applies to this Project and all unrelated material shall be deleted. During the instruction period, this manual shall be used and explained. The material shall be bound in 3-ring binders, indexed and have a Table of Contents. On the edge of the binder, provide a clear, see-through plastic holder with a typed card indicating the Project name, the Architect's name, the Installer's name and the Volume number (e.g., Vol. No. 1 of 2).

D. Include a copy of all test reports and certifications in the O&M Manuals.

E. Include name, address and telephone number of the manufacturer’s representative and service company for each piece of equipment so that the source of replacement parts and service for each item of equipment can be readily obtained.

F. Provide copies of the O&M manual information on CD ROM or DVD. Files shall be in a readable format such as PDF or image files (TIF, etc). Record drawings shall be scanned in, and shall also include the AutoCad dwg files if Record Drawings are provided on CAD.

G. Furnish these manuals to the General Contractor for review and transmission to Owner.

1.10 WARRANTY

A. Refer to individual sections and Division 1 for additional warranty (guarantee) requirements.

B. Remedy work performed under this Division that is found not to comply with the Contract Documents, requires excessive service, or fails less than one year from the date of final acceptance.

C. Manufacturers shall provide their standard warranties for material and equipment furnished under this Division, unless otherwise indicated in each Section.

D. Materials, equipment and work furnished under this Division shall be guaranteed against all defects in materials and workmanship for a period of one year, commencing with the date of final acceptance by the General Contractor. Any failure due to defective material, equipment or workmanship shall be corrected as quickly as possible and at no expense to the Owner, including all damage to areas, materials and other systems resulting from such failures.

E. Upon receipt of notice from the Owner of failure of any part of the systems during the guarantee period, the affected parts shall be replaced as quickly as possible. Any equipment requiring excessive service (more than two unscheduled services) shall be considered defective and shall be replaced.

1.11 INTERPRETATION OF CONTRACT DOCUMENTS

A. Division 1, General and Supplementary Conditions are in addition to the requirements indicated in Division 21, Drawings and Specifications.

B. Where Drawings or Specifications conflict or are unclear, advise Architect in writing before Award of Contract. Otherwise, interpretations of Contract Documents by the Architect shall be final, and no additional compensation shall be permitted due to discrepancies or unclarities resolved according to the Architect's interpretation.

C. The intent of the Drawings and Specifications is to assist and guide and to establish minimum requirements.

D. Drawings and Specifications form complimentary requirements; provide work specified and not indicated, and work indicated and not specified as though explicitly required by both.

E. Should there be conflicts in Contract Documents, provide the greater quantity, the higher quality and the more restrictive of equipment and work.

F. Specifically stated requirements supersede general ones.

G. Fire Protection Drawings do not limit responsibility of determining full extent of work required by Contract Documents. Refer to Architectural, HVAC, Electrical, Telecommunications, Security, Plumbing, Fire Protection, Structural, specialty trades and other Drawings and other Divisions that indicate types of construction in which work shall be installed and work of other trades with which work of this Division must be coordinated.

H. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the Drawings or Specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

I. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

J. Where Drawings or Specifications do not coincide with manufacturer's recommendations, or with applicable Codes and Standards, alert Architect in writing before installation. Otherwise, make changes in installed work as Architect requires within Contract Price.

K. It is the intent of these Contract Documents to have systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component. In cases such as this, where the bidder has failed to notify the Architect of the situation prior to contract award, provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

L. In situations or where potential conflicts and Installer believes guidance is required, submit a sketch identifying a proposed solution and the Architect shall review, note if necessary, and return this sketch appropriately marked as required.

M. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Infer the omitted words or phrases such as “the Contractor shall,” “shall be,” “as indicated on the Drawings,” “in accordance with details,” “a,” “the,” and “all.”

N. “As permitted” means by Code, by Architect or by prevailing conditions.

O. “Acceptable,” “approved,” and “satisfactory” mean by Architect.

P. Work indicated on the Drawings is intended to be approximately correct to scale, but figures, dimensions, and detailed Drawings are to be followed. Take measurements at the building before fabrication commences.

Q. Size of pipes or conduits and methods of installing them are indicated, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered.

R. Drawings are generally diagrammatic and indicate the arrangement and approximate location of fixtures, equipment and piping. When necessary to deviate from the arrangement indicated, to meet structural conditions or to clear work of other Divisions, inform the General Contractor of proposed deviation before proceeding. Obtain in the field all information relevant to the placing of fire protection work.

S. Drawings and Specifications do not undertake to indicate every item required to produce a complete and properly operating installation. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a fully complete, secure and properly operating installation suitable for the intended use shall be provided.

T. The right is reserved to make reasonable changes in locations of equipment indicated in Drawings prior to installation without increase in contract cost.

U. Contract Documents indicate scope of work required. Jurisdictional assignment shall be a responsibility under this Section's contractual obligation.

V. The following definitions apply to the Drawings and Specifications:

Furnish: The term “furnish” is used to mean “supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.”

Install: The term “install” is used to describe operations at project site including the actual “unloading, unpacking, rigging in place, assembly, erection, placing, anchoring,

applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."

Provide: The term "provide" means to "furnish and install, complete and ready for the intended use."

Installer: An "Installer" is the Contractor or an entity engaged by the Contractor, either as an Employee, Subcontractor, or Sub-Subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1.12 GUARANTEE AND 24 HOUR SERVICE

A. Guarantee the Work of this Section in writing for one year following the date of Substantial Completion. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Owner's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

B. In addition to guarantee requirements of Division 1 and of Subparagraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.

C. Provide 24 hour service beginning on the date of Substantial Completion and lasting until the termination of the guarantee period. Service shall be at no cost to the Owner. Service can be provided by this contractor or a separate service organization. Choice of service organization shall be subject to Owner approval. Submit name and a phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

1.13 COMMISSIONING (LEVEL 4) AND INTEGRATED TESTING (LEVEL 5) OF EQUIPMENT AND SYSTEMS

A. Completion of start up and commissioning is a prerequisite for substantial completion and acceptance of project by the Owner. Operate and maintain systems and equipment until final acceptance by the owner. Provide testing, adjusting, and balancing as specified in Section 230800. Follow and provide all required paperwork for owner's Level 1, 2, 3, 4 testing procedures.

B. All guarantees and warranties shall not begin until final acceptance of the systems and equipment by the owner.

C. Include time for Owner's Level 5 Integrated Systems Testing to be scheduled after completion of Level 4 Acceptance Testing. Include time to assist in producing and providing Owner's required paperwork and documentation. Coordinate required time with General Contractor.

1.14 ITEMS FURNISHED BY OWNER

A. Where required to install items purchased by others, coordinate their delivery and be responsible for their unloading from delivery vehicles and for their safe handling and field storage up to the time of installation. This trade shall be responsible for:

1. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
2. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.

B. Carefully examine such items upon delivery, and advise the Owner of any damages or defects noted, as well as advising the shipper.

1.15 MATERIALS AND WORKMANSHIP

A. Work shall be neat and rectilinear. Install material and equipment as required by manufacturers. Installation shall operate safely and without leakage, undue wear, noise, vibration, corrosion or water hammer. Work shall be properly and effectively protected, and pipe and duct openings shall be temporarily closed to prevent obstruction and damage before completion.

B. Except as specified otherwise, material and equipment shall be new. Provide supplies, appliances and connections necessary for complete and operational installation. Provide components required or recommended by OSHA and applicable NFPA documents.

1.16 CONTINUITY OF SERVICES

A. Do not interrupt existing services without Owner’s approval.

B. Schedule interruptions in advance, according to Owner’s instructions. Submit, in writing, with request for interruption, methods proposed to minimize length of interruption.

C. Interruptions shall be scheduled at such times of day and work so that they have minimal impact on Owner's operations.

D. Include premium time work associated with shutdowns of systems

1.17 TEMPORARY HEATING AND COOLING

A. Work provided under Division 1.

1.18 UNIT PRICES

A. Refer to Division 1 for additional requirements.

1.19 ALTERNATES

A. Refer to Division 1 for additional requirements.

PART 2 - PRODUCTS

2.1 SPECIFIED PRODUCTS AND SUBSTITUTIONS

A. Provide new, unused, full weight, standard equipment that meets or exceeds Contract Document requirements to the satisfaction of the General Contractor. No equipment or material shall be used unless previously approved by the General Contractor.

B. The manufacturer's catalog number and description is the basis of the design and establishes quality and performance required for this project. Generality, the first manufacturer listed is the one the project design is based on.

C. Manufacturers of generally compatible products may also be listed, subject to compliance with requirements. Substitution of equal products or manufacturers of equal products are also acceptable when indicated in each section.

D. The description following a catalog number is basically to identify the item but may also call for accessories, options, or modifications that are beyond the cataloged item.

E. Zinc Whiskers:

1. Major data processing equipment suppliers have raised concerns over the potential for airborne zinc whiskers to damage their equipment. Zinc whiskers form on steel that is galvanized via a zinc electroplating process. Zinc whiskers do not form on steel that has been hot dipped galvanized. Do not use zinc-electroplated components in areas with raised access floors.
   a. Use materials under the raised access floors that are hot dipped galvanized steel or other material, but not zinc-electroplated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to beginning work in a particular area of the project visit the site and examine conditions under which work must be performed, including preparatory work done under other Divisions or Contracts or by the Owner. Report conditions that might affect work adversely in writing through Contractor to Architect. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

B. Arrangements shall be made to have the openings, inserts, sleeves and other such incidentals set in place ahead of the construction work, where practical to eliminate the need for cutting and patching. If cutting becomes necessary for the installation of the work, it shall be done under this Division in accordance with the requirements of Division 1 and other applicable Divisions. All openings shall be neatly patched and finished to match the adjoining work in a manner approved by the Architect. Penetrations in fire-rated walls or floors must be fire-stopped as indicated in Division 7. All cutting shall be performed in a manner not to weaken the structural parts. The cutting manner and method shall meet the approval of the Architect.

C. The equipment shall be kept upright at all times. If equipment has to be tilted for ease of passage through restricted areas, the manufacturer shall brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment. Comply with manufacturer's requirements.

3.2 INSTALLATION

A. Do not cut structural members without written acknowledgement from the General Contractor.

B. Do not attach equipment to metal roof decking or bottom of structural concrete members.

C. Arrange equipment so working parts are accessible for inspection, repair, and renewal.

D. Where not specified or indicated, mount equipment at heights directed by the Architect.

E. Locate equipment, control pushbuttons, terminal cabinets, safety switches and such other apparatus as may require periodic maintenance, operation, or inspection, so that they are easily accessible. If such items are shown on the plans in locations which are found to be inaccessible, advise the Architect of the situation before work is advanced to the point where extra costs will be involved.

F. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Architect, and no extra compensation will be allowed for making these changes.

G. Where installed in damp, wet and areas requiring washing down, all surface mounted equipment, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

H. All connections to equipment shall be made as required, and in accordance with the approved shop and setting drawings. Generally, the drawings do not show wiring. Provide wiring to best suit circuiting indicated on the drawings.

I. Unless otherwise approved by the Architect, pipe and conduit indicated exposed shall be installed exposed; piping indicated concealed shall be installed concealed.

J. Where exact locations are required for roughing in, stubbing-up and terminating pipe and conduit request Shop Drawings, equipment location drawings, foundation drawings, and any other data required to locate the concealed pipe or conduit before the floor slab is poured or wall or ceiling is installed.

K. Verify the ceiling type ceiling suspension system and clearance above hung ceilings prior to ordering grilles or diffusers. Notify the Architect of any discrepancies.

L. Fire ratings of enclosures, walls, ceilings, and floors shall be maintained. Penetrations for fire protection Work shall be fire-stopped as indicated in Division 7 or indicated in individual Sections on Drawings, or by General Contractor. Review Architectural drawings for fire ratings.

M. Smoke ratings, acoustical, and water tightness of enclosures, walls, ceilings, and floors shall be maintained. Provide necessary fittings, accessories and coordination as required.

N. Do not use powder actuated tools or anchors without written permission from the General Contractor or Construction Manager. Only allow personnel who are properly trained and licensed to use the power actuated tools.

3.3 TESTING AND INSPECTIONS

A. For additional requirements for starting, demonstration, and instructions of systems refer to Division 1.

B. Provide starting, demonstration, and instructions of systems as required in individual Sections.

C. Insure that the Owner's operating personnel are made entirely familiar with the nature, operation, and maintenance of the systems and equipment provided under this Division.

D. Provide acceptance testing as indicated in individual Division 21 sections. Submit written results.

3.4 SUBSTANTIAL COMPLETION

A. For additional requirements refer to Section 01 77 00 Closeout Procedures.

B. When Work under this Section (or designated portion of Work) is considered substantially complete, submit written notice through the General Contractor with a list of items remaining to be completed or corrected.

C. All systems shall be operational and tested. Submit test reports.

D. Submit local authority final sign off inspection reports.

E. Should Architect or General Contractor observe and find Work is not substantially complete, written notification will be provided listing observed deficiencies.

F. Remedy deficiencies and send a second written notice of substantial completion.

G. When Architect or General Contractor finds Work is substantially complete, a Certificate of Substantial Completion will be prepared in accordance with provisions of General Conditions.

H. Submit test reports for review prior to Architect's site visit.

3.5 FINAL COMPLETION

A. For additional requirements refer to Section 01 77 00 Closeout Procedures.

B. When Work under this Section is considered complete, submit through the General Contractor written certification that:

1. Contract documents have been reviewed.
2. Work has been inspected for compliance with Contract Documents.
3. Work has been completed in accordance with Contract Documents and deficiencies listed with Certificate of Substantial Completion have been corrected.
4. Equipment and systems have been tested, adjusted and balanced and are fully operational.
5. Work is complete and ready for final Architect review.

C. Upon completion of all work, and as a condition to receiving final payment, furnish to the Architect the following original, signed certificates and include copies of these certificates as part of the Operation and Maintenance manuals:

1. From the manufacturer's authorized representative, stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found same to be installed in accordance with the manufacturer's requirements and to be in satisfactory operating condition. This certification shall be provided for all major equipment and for all complete systems. It is not required for other components unless specifically requested by the Architect.
2. Certificates of inspections, letters and notices from the appropriate government-authorized inspectional authorities stating that all portions of the work (indicate trade and responsibility) have been inspected and are installed in conformance with the applicable codes, laws, ordinances and referenced standards. In nonconformance notices are received, include the reinspection certificate, letter of explanation, etc. as required to indicate complete conformance. Provide written evidence of all variations, exceptions, variances, etc. given by the inspectors.
3. Certificate from the installing firm responsible for the work (indicate trade and responsibility) signed by an authorized officer or General Contractor of the Firm and the Foreman or Project Manager in charge, stating that to the best of the signer's knowledge and belief that the project (indicate project name and address) has been installed in compliance with the Contract Plans, Specifications and Addenda, and all applicable codes and laws, ordinances and referenced standards. Where subcontractors perform a portion of the work of this Section, include certificates from them.

D. Should Architect or General Contractor observe and find Work incomplete, the review will be promptly suspended and written notification will be provided through the General Contractor.

E. Complete Work, remedy deficiencies and send a second certification of final completion.

F. Architect shall, upon receipt of a second certification of completion, make a second review and provide notification in writing through the General Contractor, listing observed deficiencies.

G. When Architect and General Contractor finds work complete, close-out submittals will be considered.

END OF SECTION

SECTION 21 01 00
SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Piping, fitting and joining methods and ratings
2. Fire protection valves
3. Sprinkler specialty pipe fittings
4. Sprinklers
5. Preaction valve assemblies
6. Air compressors
7. Nitrogen generator system
8. Alarm devices
9. Pressure gauges

B. Meet the following performance requirements:

1. Section 21 00 10 – Basic Fire Protection Requirements

1.2 SYSTEM DESCRIPTIONS

A. Wet Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device.

B. Double Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure monitoring gas (nitrogen). The actuation of the fire detection system only, or the loss of monitoring pressure in the sprinkler system piping (from a leak or an open sprinkler) only, will not permit water into the system piping. Both the actuation of a fire detection system (generally two smoke detectors) and the opening of at least one sprinkler in the same area opens the deluge valve permitting water to flow into the sprinkler piping. Then water will discharge from sprinklers that have opened. Sprinklers open when heat melts fusible link or destroys frangible device.

1.3 PERFORMANCE REQUIREMENTS

A. The sprinkler system design shall be per the applicable local codes and be approved by the authorities having jurisdiction as well as the Architect.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Standard Pressure Piping and System Components: Listed for 175-psig maximum working pressure.

D. Occupancy hazard classifications and protection strategies are based on NFPA 13.

1. Margin of Safety for Available Water Flow and Pressure:
   a. 10 percent or 10 psi (whichever is greater) including the losses through water service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:
   a. Electrical Equipment Rooms: Ordinary Hazard, Group 1.

b. Computer Rooms: Ordinary Hazard, Group 1.
c. General Storage Areas and Loading Dock: Ordinary Hazard, Group 1.
d. Long Term Storage Rooms: Ordinary Hazard, Group 2.
e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
f. Unoccupied Spaces: Ordinary Hazard, Group 1.
g. Offices, Corridors and Public Areas: Light Hazard.

3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Light Hazard Occupancy: 0.10 gpm/sq. ft. over 1,500 sq. ft.
   b. Ordinary Hazard, Group 1 Occupancy: 0.15 gpm/sq. ft. over 1,500 sq. ft.
   c. Ordinary Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over 1,500 sq. ft.
   d. Note: All double interlock preaction systems shall increase the area of operation as listed above by 30% without revising the density.
4. Maximum Protection Area per Sprinkler:
   a. Office, Corridors, Public Areas: 225 sq. ft. (standard coverage)
   b. Storage Areas: 130 sq. ft. (standard coverage) or 256 sq. ft. (16 ft. x 16 ft. extended coverage)
   c. Mechanical Equipment Rooms: 130 sq. ft. (standard coverage) or 256 sq. ft. (16 ft. x 16 ft. extended coverage)
   d. Electrical Equipment Rooms: 130 sq. ft. (standard coverage) or 256 sq. ft. (16 ft. x 16 ft. extended coverage)
   e. Unoccupied Shell or Flex Spaces: 130 sq. ft. (standard coverage) or 256 sq. ft. (16 ft. x 16 ft. extended coverage)
   f. Computer Room – Below Suspended Ceiling: 130 sq. ft. (standard coverage) or 256 sq. ft. (16 ft. x 16 ft. extended coverage)
   g. According to NFPA 13 recommendations unless otherwise indicated.
5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
   a. Light Hazard Occupancies: 250 gpm for 30 minutes (per FM Global).
   b. Ordinary Hazard Occupancies: 250 gpm for 60 minutes.

E. Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7. Conform to requirements indicated in Section 21 00 10.

1.4 SCOPE OF WORK

A. A current hydrant flow test performed on or near the project site shall be used as the basis of hydraulic design of the sprinkler system piping. Contact the local water authority for latest hydrant flow test results. Have test performed if available data is older than 12 months. Results of this test shall be used in the hydraulic calculations. Submit a copy of this test with the hydraulic calculations.

B. The work covered by this Specification is the modifying existing sprinkler systems to suit the new conditions. The existing space is protected with two dry pipe sprinkler systems and will be converted into three double interlock preaction sprinkler systems: two covering the Computer Room; one covering the Infrastructure Rooms. The South Corridor, Flex Spaces, Storage Rooms, and Preaction Closet will be protected by extending the existing wet pipe sprinkler system. The North Corridor and north PBB areas will be converted from dry pipe sprinkler systems to wet pipe systems at specific phases of tenant finish-out on the second floor, as indicated on the drawings.

C. Provide detail design of the piping systems in accordance with the referenced codes and standards, and submit the design to the Owner's Underwriter and to the local Fire Department for approval prior to fabrication or installation of any equipment or piping. The installation shall be made in accordance with the approved drawings, specifications, and applicable standards. All drawings shall be prepared and stamped by a Registered Fire Protection Engineer licensed in this State.

D. Sprinkler layout indicated on the drawings is a general arrangement only and shall not be used as a basis of bid. Contractor is responsible for a code compliant system. All contract documents must be reviewed for proper sprinkler placement relative to all other trades. Provide additional sprinklers and piping as required. Changes or modifications to the systems shall be submitted to the Architect for approval prior to pipe fabrication.

E. Provide and place into full operating condition a complete fire protection system as specified herein and indicated on the drawings. The systems shall include, but not be limited to, all piping, fittings, supports, hangers, valves, cabinets, sprinklers, system bracing, tamper and pressure switches, and all other accessories required to provide a complete and operable system. Division 28 shall provide detection devices and notification devices.

F. The work described hereinafter shall consist of installing piping, fittings, valves and appurtenances, sprinklers, supports and connections specified in this Section, including labor, materials, services, software, programming, and inspections and testing required providing a complete, operating system.

G. All devices shown on the plans shall be installed in accordance with the manufacturer's instructions. The plans provided with this specification are presented for construction planning. It is the responsibility of the Contractor to review these project drawings, visit the site, acquaint himself with existing conditions and proposed construction, and determine the required quantities of devices and specific optimum locations for same, consistent with the selected manufacturer's instructions and the code. As part of this project, the Contractor shall furnish and install all equipment indicated on the drawing set and described in this specification.

H. Furnish all labor and supervision, materials, equipment, and tools required for the design and installation of a complete automatic sprinkler system to serve the entire building. The sprinkler zones and piping layout shall take into consideration that the building will be occupied by several Data Center Users at a future date. The sprinkler system design needs to provide complete automatic sprinkler coverage that is easily converted to a preaction system as the building is occupied.

I. Piping network shall take into consideration future electrical gear installation and the future preaction zone requirements. Only sprinkler piping associated with a particular zone shall be installed over or within the limits of that particular zone.

J. Work shall include all necessary submittals for approval, securing of permits, installation, testing, and certification.

K. Provide bracing, anchors and supports for all sprinkler piping and equipment as required by the Building Code, local amendments, ASCE-7 and NFPA 13.

L. Design for sprinkler system shall be in accordance with NFPA 13 and the Owner's insurer: FM Global.

M. Sprinkler system design has been based on the Digital Engineering Guidelines (DEG). Changes or modifications to the system design shall be submitted to the Architect for approval prior to pipe fabrication and shall be prepared and stamped by a Registered Fire Protection Engineer licensed in this State.

N. Design for sprinkler system shall be in accordance with NFPA 13 Hydraulic Calculation Method.

O. Prepare all drawings, applications, and calculations as noted above, and obtain all approvals, permits, and tests, and shall pay all related fees.

P. Provide detailed design of the piping systems in accordance with the referenced codes and standards, and submit the design to the Architect, the Owner's Underwriter and to the local authorities having jurisdiction for approval prior to fabrication or installation of any equipment or piping. The installation shall be made in accordance with the approved drawings, specifications, and applicable standards.

Q. Be responsible for obtaining the approval of the sprinkler system design from all state and local authorities having jurisdiction, and from the Owner's insurance carrier, or the Owner's Safety Department.

R. Maintain a 10-psi safety factor between the sprinkler demand and the water supply.

S. All valves shall have supervisory switches that shall be connected to the Fire Alarm System under Division 28.

T. Service and maintenance in addition to warranty requirements:

1. Section 21 00 10 – Basic Fire Protection Requirements

1.5 RELATED SECTIONS

A. Section 21 00 10 – Basic Fire Protection Requirements

B. Section 28 31 12 – Digital, Addressable Fire Alarm System

1.6 REFERENCES

A. ANSI/ASME B16.1 Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, and 250.

B. ANSI/ASME B16.3 Malleable Iron Threaded Fittings, Class 150 and 300.

C. ANSI/ASME B16.5 Pipe Flanges and Flanged Fittings.

D. NFPA 13 Standard for the Installation of Sprinkler Systems.

E. FM Global Data Sheets.

F. Digital Realty Engineering Guidelines (DEG), latest edition.

1.7 SUBMITTALS

A. Refer to Section 01 33 00 – Submittal Procedures.

B. Submit design basis to Architect for approval prior to commencement of design. Submit shop drawings, product data, hydraulic calculations, and maintenance instructions to the local Fire Department and to the Owner's Underwriter prior to installation of system. Provide copy of approved submittal to Engineer.

1. Shop Drawings: Provide sprinkler piping drawings including connection to existing system, preaction valve installations, and distribution piping layout with sprinkler locations. Indicate pipe materials used, joining methods, supports, and wall penetration seals. Provide valve and control panel location, and any required field wiring details for installation.
2. Product Data: Provide manufacturer's catalog information for all equipment and materials to be used (pipe, sprinklers, preaction assemblies, hangers and accessories, etc).
3. All product data sheets shall indicate the system(s) for which the products are being submitted. Not all materials and joining methods are acceptable on all sprinkler system types. Cross out all options/sizes/accessories that are not included with the submittal. All

options not crossed out shall be deemed included without additional cost at the option of the Owner.

4. Calculations: Provide hydraulic calculations for each automatic sprinkler system. Include a copy of the water supply data used for the calculations.

C. Refer to Section 01 77 00 – Closeout Procedures.

D. Provide copy of completed and signed "Contractor's Material and Test Certificate for Aboveground Piping" (e.g., NFPA 13, 2010, Figure 24.1) to Engineer.

E. Submit Maintenance Instructions: Include installation instructions, spare parts lists, procedures, and treatment programs.

F. Submit record CAD drawings and final certification to the Owner and Engineer upon completion of installation and testing.

1.8 COORDINATION

A. Coordinate work under provisions indicated in Section 21 00 10.

B. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 21 00 10.

B. Perform all work in accordance with NFPA 13 and FM guidelines.

C. Valves shall bear FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.

D. Materials and details of the installation shall be UL listed and FM approved.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site. Store products elevated off the slab and protected from dirt and debris. Store valves in shipping containers with labeling in place. Products shall not be left exposed to the weather.

B. Provide temporary end caps and closures on piping and fittings, temporary protective coating on case iron and steel valves, and temporary protective caps or clips on sprinklers. Maintain in place until installation.

C. Ensure on-time delivery of all materials and equipment required for the Project. All materials furnished or incorporated in the Work shall be new, unused, of best quality, and especially adapted for the service required. Whenever the characteristics of any material are not particularly specified, such material shall be utilized as is customary in first class work of a nature for which the material is employed.

D. Provide necessary means to properly stage and store all materials and equipment until time of use or installation on the Project. Coordinate all requirements with General Contractor.

E. Provide proper handling, rigging, and installing of all materials and equipment for the Project.

F. Owner reserves the right to reject any materials or equipment that is not properly stored in accordance with these specifications or the manufacturers' requirements.

G. Refer to Division 1 for additional delivery and storage requirements.

1.11 REGULATORY REQUIREMENTS

A. Conform to requirements indicated in Section 21 00 10 in addition to following:

1. Design for sprinkler system shall be in accordance with NFPA 13, state and local requirements, and the Owner's insurer: FM Global.
2. Perform all work in accordance with NFPA 13, FM guidelines, and local jurisdictional requirements.
3. Valves shall bear FM label or marking. Manufacturer's name and pressure rating shall be marked on valve body.
4. Submit as required here in and under Section 21 00 10.

1.12 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 21 00 10

B. For each tenant, furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used.
2. Install Cabinets in tenant Preaction Closet.

1.13 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 21 00 10.

1.14 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 21 00 10.

1.15 WARRANTY

A. Provide under provisions indicated in Section 21 00 10.

1.16 LEED / SUSTAINABILITY

A. Conform to requirements indicated in Section 21 00 10.

1.17 PROJECT CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Schedule 40, Black Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Black Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard weight, seamless steel pipe with threaded ends.

C. Uncoated, Steel Couplings: ASTM A 865, threaded.

D. Uncoated, Gray Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable or Ductile Iron Unions: UL 860.

F. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

G. Grooved Joint, Steel Pipe Appurtenances:

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. Victaulic Company.
2. Pressure Rating: 175 psig minimum.
3. Uncoated, Grooved End Fittings for Steel Piping: ASTM A 47/A 47M, malleable iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel pipe dimensions. Include ferrous housing sections, EPDM rubber gasket, and bolts and nuts.

H. Steel Pressure-Seal Fittings: UL 213, FM approved, 175 psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Victaulic Company.

2.3 NITROGEN PIPING

A. Supply and Purity Sensing Tubing: Copper tubing complying with ASTM B 88, Type K ASTM B 88M, Type A.

B. Fittings: Cast-bronze solder fittings complying with ASME B16.18; or wrought-copper solder fittings complying with ASME B16.22, except forged-brass compression-type fittings at connections to equipment.

C. Joining Method: Soldered or brazed.

2.4 PIPING JOINING MATERIALS

A. Pipe Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast Iron and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast Iron and Class 300, Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.5 PRE-PIPED SPRINKLER SYSTEM CONTROL CABINETS

A. Basis of Design: FireFlex N_2-Blast Cabinet with integrated South-Tek N_2-Blast Nitrogen Generator.

B. Cabinet shall integrate a self-contained double interlock pre-action system, Electric/Pneu-Lectric release, and shall contain all hydraulic, pneumatic devices, and electrical components required for the control of a remote controlled preaction system. System shall include the following:

1. Sturdy free-standing 14 gauge steel cabinet measuring 54” x 31” x 77” for 4” & 6” systems.
2. Textured rust proof coating, inside and outside, fire red, oven baked polyester powder on phosphate base (powder coated).
3. Two locked access doors to reduce frontal clearance required for opening.
4. Individual access doors for the hydraulic section and the emergency release.
5. The cabinet shall have knock-outs for hydraulic and electrical connections.

C. Integrated Preaction System

1. Viking Deluge valve model F-1 for 1-1/2" (40 mm) through 6” (150mm) diameter c/w supervised butterfly control valve, releasing trim rated at 250 psi and all the necessary accessories. Trim shall include a mechanical latching device to prevent system from resetting in case of loss of power to the release solenoid. Systems provided with solenoid only, without this mechanical latching device, shall not be accepted. Every valve shall be clearly identified as to its operation with arrows indicating all positions to facilitate system operation.
2. Pressure gauges to indicate water supply, priming water of the system. Each pressure gauge must be provided with its own three-way valve.
3. Release trim with solenoid valve, and every supervisory and alarm device required shall be Schedule 40 galvanized steel. Black pipe will not be accepted.
4. Schedule 40 steel pipe header painted fire red, with grooved ends to be connected to supply water from either side.
5. Schedule 40 steel pipe drain manifold of 2" diameter painted fire red, with grooved ends for drain connections from either side.
6. Trim shall include properly identified contractor test ports factory mounted into the trim piping to facilitate system testing and commissioning.
7. Viking VFR-400 integrated control panel with emergency batteries factory-assembled inside the cabinet.
8. The system shall have an Integrated Releasing Circuit Disconnect Switch to allow the system to be tested without actuating the fire suppression system as required per NFPA 72. Operation of the Disconnect Switch shall cause a supervisory signal at the releasing service fire alarm control unit. The disconnect switch shall be a physical switch and not be accomplished by using software.
9. Field wiring terminal strips and junction box integrated with the cabinet for connection of field wiring. Standard factory-wired terminal strips to accept field installation of ARM-44 Relay Module, CA2Z Class initiating circuit module, RA-4410RC remote annunciator.

D. Nitrogen Generation System

1. Nitrogen Generation System shall include an integrated, oil-less air compressor complete with control panel located within the cabinet.
2. The N_2-Blast FPS - “Type 1” Nitrogen Generation System shall provide a minimum of 98% Nitrogen purity to the FPS. It shall include a Particulate and a Coalescing filter (internally mounted within the cabinet), sized properly for the required Compressed Air IN flow rates.
3. It shall provide a single (16) gallon Nitrogen Storage Tank which is DOT or ASME rated for 150 PSI and shall be provided with ASME rated 100 PSI Safety Relief valve, on/off valve and ¼” NPT I/O fitting.

4. A Viking D-2 Air Pressure Maintenance Device c/w trim shall be factory-installed and adjusted to regulate the nitrogen pressure in the FPS at the specified system pressure for a double interlock preaction system.
5. The Nitrogen Generation System shall be designed with an internal BlastOff™ - Leak Detection System and Fire Protection System Gas Purging Device.

E. Air Supply

1. Air compressor and supervisory trim shall be provided inside the cabinet and its pressure factory adjusted for the selected configuration. The air supply must be regulated and of the proper size to restore normal system air pressure within 30 minutes as per NFPA 13. This compressor shall be equipped with a factory-adjusted ON/OFF pressure switch tied into the sprinkler system piping. It shall be factory-set at 10 and 20 psi for the cut-in and cut-out pressures respectively.
2. If required by the size of the piping network, an accelerator device, Viking Model E-1 shall be factory installed in the air trim with its own pressure gauge and bypass valve, designed to increase the operating speed of the system.

F. AutoPurge System

1. Supply and install a N2 Blast AutoPurge System at a high point within the preaction system piping.
2. The AutoPurge System shall not require any electric connection AS or DC. The N2 Blast AutoPurge System shall have a connection allowing the Quick-Check Portable or Fixed Nitrogen Purity Sensor to attach within the FPS to ensure that proper Nitrogen purity levels have been attained.
3. The Sprinkler contractor shall adjust each N2 Blast AutoPurge System to purge the FPS per the manufacturer's specifications outlined within the sizing chart located on the device.

G. System drain

1. The single drain collector shall be connected to an open drain consisting of a vertical pipe with an air gap around the drain collector pipe.
2. The drain piping shall not be restricted or reduced and shall be of the same diameter as the drain collector.
3. Multiple drain collectors and open drain cups inside the cabinet will not be accepted.

H. System Options

1. Shut-off valve – Provide a Listed and Approved supervised butterfly valve installed on the system riser inside the cabinet for full flow test purposes. An integrated sight glass shall be part of this arrangement for visually confirming water flow through the main drain upon system actuation.
2. Semi flanged - Provide the system with a flanged inlet and riser connections and a threaded drain.
3. Use galvanized piping on water supply inlet manifold and riser outlet with galvanized pipe, cap and couplings.

I. Releasing Control Panel – Refer to Division 28

1. Preaction cabinet shall be remote controlled unit without integral control panel. Releasing control shall be by suite's Local Fire Alarm Control Panel (LFACP).

J. System Operation

1. The release control panel sequence of operation shall be programmed to perform the following:
   a. The activation of the detection condition <u>AND</u> the opening of an automatic sprinkler is necessary to cause the preaction valve actuation.
   b. The activation of the detection condition alone will sound an alarm and activate the alarm contacts connected to the fire alarm control panel but water <u>will not</u> enter the system piping.

c. The opening of an automatic sprinkler OR damage to system piping without the detection condition satisfied will activate the low air supervisory switch and supervisory contacts connected to the fire alarm control panel but will not cause the system piping to fill with water.
d. Activation of the detection condition AND the opening of an automatic sprinkler will activate the solenoid valve open causing the preaction valve to open and water to flow out of any open sprinklers. The water flow alarm pressure switch will activate.
e. Operation of the hydraulic emergency manual release will depressurize the priming chamber causing the preaction valve to open and allowing water to enter the system piping and water will discharge through any open sprinklers. The water flow alarm pressure switch will activate.

2. Detection condition:
   a. Detection of smoke at the full alarm level of the air aspirating fire detection system in the protected area is needed in order to get the "detection condition."

K. The cabinet assembly shall be pre-assembled, pre-wired and factory tested under ISO-9001 conditions.

L. The system shall be complete in all ways and shall incorporate all components required for complete system operation.

2.6 LISTED FIRE PROTECTION VALVES

A. General Requirements:
   1. Valves shall be UL listed or FM approved.
   2. Minimum Pressure Rating for Standard Pressure Piping: 175 psig.

B. Ball Valves:
   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. Anvil International, Inc.
      b. Victaulic Company.
   2. Standard: UL 1091 except with ball instead of disc.
   3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
   4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile iron body with grooved ends.
   5. Valves NPS 3: Ductile iron body with grooved ends.

C. Bronze Butterfly Valves:
   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. Fivalco Inc.
      b. Global Safety Products, Inc.
      c. Milwaukee Valve Company.
   2. Standard: UL 1091.
   3. Pressure Rating: 175 psig.
   4. Body Material: Bronze.
   5. End Connections: Threaded.

D. Check Valves:
   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. AFAC Inc.
      b. American Cast Iron Pipe Company; Waterous Company Subsidiary.

c. Anvil International, Inc.
d. Clow Valve Company; a division of McWane, Inc.
e. Crane Co.; Crane Valve Group; Crane Valves.
f. Crane Co.; Crane Valve Group; Jenkins Valves.
g. Crane Co.; Crane Valve Group; Stockham Division.
h. Fire-End & Croker Corporation.
i. Fire Protection Products, Inc.
j. Fivalco Inc.
k. Globe Fire Sprinkler Corporation.
l. Groeniger & Company.
m. Kennedy Valve; a division of McWane, Inc.
n. Matco-Norca.
o. Metraflex, Inc.
p. Milwaukee Valve Company.
q. Mueller Co.; Water Products Division.
r. NIBCO INC.
s. Potter Roemer.
t. Reliable Automatic Sprinkler Co., Inc.
u. Shurjoint Piping Products.
v. Tyco Fire & Building Products LP.
w. United Brass Works, Inc.
x. Venus Fire Protection Ltd.
y. Victaulic Company.
z. Viking Corporation.
aa. Watts Water Technologies, Inc.

2. Standard: UL 312
3. Pressure Rating: 250 psig minimum.
4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

E. Bronze OS&Y Gate Valves:

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. Crane Co.; Crane Valve Group; Crane Valves.
   b. Crane Co.; Crane Valve Group; Stockham Division.
   c. Milwaukee Valve Company.
   d. NIBCO INC.
   e. United Brass Works, Inc.
2. Standard: UL 262.
3. Pressure Rating: 175 psig.
4. Body Material: Bronze.
5. End Connections: Threaded.

F. Iron OS&Y Gate Valves:

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. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Crane Valves.
   e. Crane Co.; Crane Valve Group; Jenkins Valves.
   f. Crane Co.; Crane Valve Group; Stockham Division.
   g. Hammond Valve.

h. Milwaukee Valve Company.
i. Mueller Co.; Water Products Division.
j. NIBCO INC.
k. Shurjoint Piping Products.
l. Tyco Fire & Building Products LP.
m. United Brass Works, Inc.
n. Watts Water Technologies, Inc.

2. Standard: UL 262.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

G. Indicating-Type Butterfly Valves:

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. Anvil International, Inc.
   b. Fivalco Inc.
   c. Global Safety Products, Inc.
   d. Kennedy Valve; a division of McWane, Inc.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Shurjoint Piping Products.
   h. Tyco Fire & Building Products LP.
   i. Victaulic Company.
2. Standard: UL 1091.
3. Pressure Rating: 175 psig minimum.
4. Valves NPS 2-1/2 and Larger:
   a. Valve Type: Butterfly.
   b. Body Material: Cast or ductile iron.
   c. End Connections: Flanged or grooved.
5. Valve Operation: Integral electrical, 115 VAC, prewired, two-circuit, supervisory switch visual indicating device.

2.7 TRIM AND DRAIN VALVES

A. General Requirements:

1. Standard: UL “Fire Protection Equipment Directory” listing or FM Global “Approval Guide.”
2. Pressure Rating: 175 psig minimum.
3. Inspector’s test connection valves shall be lockable in the closed position.

B. Angle Valves:

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. Fire Protection Products, Inc.
   b. United Brass Works, Inc.

C. Ball Valves:

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. Affiliated Distributors.
   b. Anvil International, Inc.
   c. Barnett.

d. Conbraco Industries, Inc.; Apollo Valves.
e. Fire-End & Croker Corporation.
f. Fire Protection Products, Inc.
g. Flowserve.
h. FNW.
i. Jomar International, Ltd.
j. Kennedy Valve; a division of McWane, Inc.
k. Kitz Corporation.
l. Legend Valve.
m. Metso Automation USA Inc.
n. Milwaukee Valve Company.
o. NIBCO INC.
p. Potter Roemer.
q. Red-White Valve Corporation.
r. Southern Manufacturing Group.
s. Stewart, M. A. and Sons Ltd.
t. Tyco Fire & Building Products LP.
u. Victaulic Company.
v. Watts Water Technologies, Inc.

D. Globe Valves:

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. Fire Protection Products, Inc.
   b. United Brass Works, Inc.

E. Plug Valves:

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. Southern Manufacturing Group.

2.8 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
   a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:

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. AFAC Inc.
   b. Globe Fire Sprinkler Corporation.
   c. Reliable Automatic Sprinkler Co., Inc.
   d. Tyco Fire & Building Products LP.
   e. Venus Fire Protection Ltd.
   f. Victaulic Company.
   g. Viking Corporation.
2. Standard: UL 193.

3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.

C. Automatic (Ball Drip) Drain Valves:

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. AFAC Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.
7. Finish: Polished brass

2.9 SPRINKLER SPECIALTY PIPE FITTINGS

A. General Requirements for System Fittings: UL listed for fire protection service.

B. Sprinkler Inspector's Test Fittings:

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. AGF Manufacturing Inc.
   b. Triple R Specialty.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.
2. Standard: UL "Fire Protection Equipment Directory" listing or FM Global "Approval Guide."
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.
7. Provide with lockable capabilities.

C. Adjustable Drop Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. CECA, LLC.
   b. Corcoran Piping System Co.
   c. Merit Manufacturing; a division of Anvil International, Inc.
2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

2.10 SPRINKLERS

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. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc.
3. Tyco Fire & Building Products LP.
4. Victaulic Company.
5. Viking Corporation.

B. General Requirements:

1. Standard: UL "Fire Protection Equipment Directory" listing or FM Global "Approval Guide."
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Office Areas, Corridors, Common Spaces: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" (165°F) temperature classification rating unless otherwise indicated or required by application.
3. Computer Rooms, MEP Galleries, UPS Rooms, MCS Closets, MMR Rooms, POP Rooms: Nominal 3/4-inch orifice with discharge coefficient K of 8.0 or 14.0 as indicated on drawings, and for "Intermediate" (200°F) temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Upright – Finished Area: Chrome.
2. Upright – Unfinished Area: Brass.
3. Pendent: White, or as otherwise indicated on the drawings.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for recessed pendent sprinklers are specified with sprinklers.

1. Ceiling Mounted (Extended Coverage) – Computer Room: Recessed (Tyco Style 60), white finish to match ceiling, unless noted otherwise.
2. Ceiling Mounted (Standard): Concealed, white finish to match ceiling, unless noted otherwise.

F. Sprinkler Guards:

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. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.
2. Standard: UL 199.
3. Type: Wire cage with fastening device for attaching to sprinkler.

2.11 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm Bell:

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. Fire-Lite Alarms; a Honeywell company.
b. Notifier; a Honeywell company.
c. Potter Electric Signal Company.

2. Standard: UL 464.
3. Type: Vibrating, metal alarm bell.
4. Size: 6-inch minimum diameter.
5. Finish: Red-enamel factory finish, suitable for outdoor use.

C. Pressure Switches:

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. AFAC Inc.
   b. Barksdale, Inc.
   c. Detroit Switch, Inc.
   d. Potter Electric Signal Company.
   e. System Sensor; a Honeywell company.
   f. Tyco Fire & Building Products LP.
   g. United Electric Controls Co.
   h. Viking Corporation.
2. Standard: UL 346.
3. Type: Electrically supervised water-flow switch with retard feature.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design Operation: Rising pressure signals water flow.

D. Valve Supervisory Switches:

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. Fire-Lite Alarms; a Honeywell company.
   b. Kennedy Valve; a division of McWane, Inc.
   c. Potter Electric Signal Company.
   d. System Sensor; a Honeywell company.
2. Standard: UL 346.
3. Type: Electrically supervised.
4. Components: Single-pole, double-throw switch with normally closed contacts.
5. Design: Signals that controlled valve is in other than fully open position.

2.12 PRESSURE GAUGES

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. AMETEK, Inc.; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gauge Range: 0 to 250 psig minimum.

E. Water System Piping Gauge: Include “WATER” or “AIR/WATER” label on dial face.

F. Air System Piping Gauge: Include retard feature and “AIR” or “AIR/WATER” label on dial face.

2.13 WALL ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One-Piece, Cast Brass Escutcheons: Polished chrome plated finish with set screws.

C. One-Piece, Deep Pattern Escutcheons: Deep drawn, box shaped brass with chrome plated finish.

D. One-Piece, Stamped Steel Escutcheons: Chrome plated finish with set screw or spring clips.

E. Split Casting, Cast Brass Escutcheons: Polished chrome plated finish with concealed hinge and set screw.

F. Split Plate, Stamped Steel Escutcheons: Chrome plated finish with concealed hinge, set screw or spring clips.

2.14 SLEEVES

A. Cast Iron Wall Pipe Sleeves: Cast or fabricated of cast iron and equivalent to ductile iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Galvanized Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, standard weight, zinc coated, plain ends.

2.15 GROUT

A. Standard: ASTM C 1107, Grade B, posthardening and volume adjusting, dry, hydraulic cement grout.

B. Characteristics: Nonshrink, and recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.16 PIPE HANGERS AND SUPPORTS

A. Reference manufacturer's requirements.

B. Provide in accordance with referenced standards.

C. All pipe, fittings, hangers and supports shall meet the seismic requirements as referenced in this standard under Part 1, Seismic Performance.

1. C-clamps shall have a restraining strap when used for supporting dead loads. Lock nuts not approved for restraint
2. C-type clamps (with or without restraining straps) shall not be used to attach braces to the building structure
3. Hanger rods less than 3/8 inch diameter are not permitted.

2.17 ACCESS DOORS

A. Furnish access doors for concealed valves, cleanouts, and to concealed parts of the plumbing system that require accessibility for proper operation, maintenance, and repair. Doors are not required for suspended acoustical ceilings with lift-out panels.

B. Access doors shall be of the proper size for respective concealed items, with minimum size exclusive of other requirements, 18" x 18". Access door shall be flush type, with No. 16 U.S. Standard Gauge Steel door and trim, concealed hinges and screwdriver operated stainless steel cam lock. Access door shall be shop painted with one coat of zinc chromate primer.

2.18 SPRINKLER SYSTEM IDENTIFICATION SIGNS

A. A coordinated system of piping and equipment identification shall be provided which includes the following:

1. Framed and plastic protective diagrammatic layout of all piping systems, identifying and locating piping, equipment, and valves.
2. Metal tag identified major valves, piping system components and equipment.
3. Metal identification plate at controlling alarm valve identifying system and area protected.
4. Service labeled piping.

B. Diagrams:

1. Chart listing of equipment shall be by designation number and shall show pertinent data. Diagrams shall be neat, mechanical drawings mounted in extruded aluminum frames, will 1/8 inch thick acrylic plastic protection.
2. Location shall be as directed by the Owner's Representative. Typical location shall be in the sprinkler riser room.
3. A minimum of one mounted chart and diagram, plus one extra copy of each, shall be provided for each fire protection system.

C. Metal Tags:

1. Valve identification shall be a minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gauge steel or .024 inch aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not limited to "MAIN DRAIN," "AUXILIARY DRAIN," "INSPECTOR'S TEST," "ALARM TEST," ALARM LINE," and similar wording as required to identify operational components.
2. Identify the overall system, such as "Double Interlock Preaction System" or "Wet Sprinkler System". Identification shall be a minimum 6 inches wide by 2 inches high with enamel baked finish on minimum 18 gauge steel or .024 inch aluminum with red letters on a white background or white letters on red background.
3. Risers shall be provided with a stamped metal tag containing the hydraulic design data.

D. Service Labeling:

1. Piping, including that concealed in accessible spaces, shall be labeled to designate service. Each label shall include an arrow or arrows to indicate flow direction. Labels or tag designation shall be as follows:

Service	Label or Tag Designation
Main sprinkler supply	MAIN SPRINKLER SUPPLY
Sprinkler riser number	SPRINKLER RISER NO.
Sprinkler Branch	SPRINKLER BRANCH
Standpipe	STANDPIPE

2. Piping shall be labeled and arrowed in accordance with the following:
   a. Each point of entry and exit through walls
   b. Each change of direction
   c. In congested or hidden areas, at each point required to clarify service or indicate hazard.
   d. In long straight runs, labels shall be located at a distance visible to each other, but in no case shall the distance between labels exceed 40 feet.
3. Label lettering shall be approximately 1-1/2 to 2 inches high based on outside pipe diameter. Labels shall be legible from the primary service and operating level.

4. Pipe Markers cylindrically coiled printed plastic sheets that snap around pipes with OD up to 5.875". Use flat strap-around markers are designed for pipes with OD of 6" to 10" and are fastened onto the pipes heavy duty nylon ties.
5. Labels shall have red letters on white background.

E. Label and valve tag schedule above shall not be construed as defining or limiting the work. All piping systems shall be labeled.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in “Quality Assurance” Article.

B. Report test results promptly and in writing.

3.2 WATER SUPPLY CONNECTIONS

A. Connect sprinkler piping to building's interior water-distribution piping.

B. Install shutoff valve, pressure gauge, drain, and other accessories indicated at connection to water distribution piping.

3.3 SPRINKLER SCHEDULE

A. Use sprinkler types for the following applications:

1. Common areas with suspended ceiling – standard spray concealed with matching flat cover plate escutcheon.
2. Common areas without ceiling – standard spray upright
3. Computer Rooms – extended coverage recessed pendent (16’-0”x16’-0” maximum spacing) on return bends, white with matching escutcheon
4. Infrastructure Rooms - extended coverage upright
5. Storage Rooms – extended coverage upright

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass with custom factory-painted white cover plate, unless noted otherwise. Color to be selected by the Architect.
2. Recessed Sprinklers (Computer Room): White with matching white recessed escutcheon, intermediate temperature (200°F) rating.
3. Upright Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

3.4 PIPING INSTALLATION

A. General:

1. All equipment, distribution piping and fittings shall be installed in strict accordance with the manufacturer's requirements, NFPA 13 and approved piping standards and guidelines.
2. All distribution piping shall be installed by qualified individuals using good, accepted practices and quality workmanship procedures.
3. All piping shall be adequately supported and anchored at all directional changes.
4. All piping shall be reamed, blown clear and swabbed with suitable solvents to remove burrs, mill varnish and cutting oils before assembly.
5. All male pipe threads shall be sealed with Teflon tape pipe sealant applied in accordance with the manufacturer's requirements and good piping practices.

6. All piping shall be positively sloped to the riser or low point drain as indicated on the drawings.
7. Each zone shall consist of a completely separate riser (after main entry inside sprinkler riser room) with separate automatic sprinkler valve and trim.
8. Piping serving each zone shall be completely independent of the other zones.
9. No piping shall pass above “other sprinkler zones” unless specifically indicated on the drawings.

B. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Slope piping and arrange systems to drain at low points.

C. Install exposed sprinkler system mains and branch lines as high as possible.

D. Install sleeves for piping penetrations of walls, ceilings, and floors.

E. Install escutcheons for piping penetrations of walls, ceilings, and floors.

F. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13 for hanger materials.

G. Install valves with stems upright or horizontal, not inverted. Remove protective coatings after installation.

H. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval, revised piping plans and hydraulic calculations with Architect before deviating from approved working plans.

I. Install capped or plugged tee outlet connections on Shell space branch lines as indicated on plans for future sprinkler installation with suite build out.

J. Piping Standard: Comply with requirements in NFPA 13 for installation of sprinkler piping.

K. Install seismic restraints on piping. Comply with requirements for seismic restraint device materials and installation in NFPA 13.

L. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

M. Install unions adjacent to each valve in pipes NPS 2 and smaller.

N. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

O. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13. Inspector’s test discharge shall be piped to the exterior.

P. Install sprinkler piping with drains for complete system drainage. Main drains shall be piped to the exterior.

Q. Drain preaction sprinkler piping systems.

R. Pressurize and check preaction sprinkler system piping, air pressure maintenance devices and air compressors.

3.5 PIPING SCHEDULE

A. Wet Pipe Sprinkler Systems:

1. Standard pressure, wet pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
   a. Schedule 40, black steel pipe with threaded ends; uncoated, gray iron threaded fittings; and threaded joints.
2. Standard pressure, wet pipe sprinkler system, NPS 2-1/2 to NPS 8, shall be one of the following:
   a. Schedule 40, black steel pipe with threaded ends; uncoated, gray iron threaded fittings; and threaded joints.
   b. Schedule 40, black steel pipe with roll grooved ends; uncoated, grooved end fittings for steel piping; grooved end pipe couplings for steel piping; and grooved joints.

B. Preaction Sprinkler System using Nitrogen:

1. Standard pressure, NPS 8 and smaller, shall be the following:
   a. Schedule 40, black steel piping with threaded ends. Uncoated gray iron threaded or welded fittings and joints.
   b. Schedule 40, black steel pipe with roll grooved ends; uncoated, grooved end fittings for steel piping; grooved end pipe couplings for steel piping; and grooved joints.

3.6 JOINT CONSTRUCTION

A. Refer to Pipe Schedule for applicable piping and joining methods for each system type.

B. Install couplings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

C. Install unions adjacent to each valve in pipes NPS 2 and smaller.

D. Install reducing fittings for reduction in pipe sizes. Avoid the use of bushings.

E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

G. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

H. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

I. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

J. Steel Piping, Roll Grooved Joints: Roll rounded edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved end fittings according to AWWA C606 for steel pipe grooved joints.

K. Dissimilar Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.7 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire protection shutoff valves supervised open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
2. Alarm Valves: Include bypass check valve and retarding chamber drain line connection.
3. Preaction and Dry Pipe Valves: Install in vertical position, in proper direction of flow, and in main supply to sprinkler system. Install trim sets for drain, priming level, alarm connections, ball drip valves, pressure gauges, priming chamber attachment, and fill-line attachment
   a. Install air compressor and compressed air supply piping.
   b. Air Pressure Maintenance Device: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.

3.8 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings centered in 24”x24” suspended ceiling tiles or centered in the quarter points of 24”x48” suspended ceiling tiles, unless indicated otherwise. Refer to drawings for details.

B. Install upright sprinklers on 1” outlets (to be converted to pendent mounted sprinklers in the future).

C. Where required install sprinklers above and below duct work as defined in NFPA 13

D. Upright and pendent sprinklers shall be installed as to avoid obstructions of the spray pattern and if required install additional sprinklers based on the obstructions as defined in NFPA 13.

3.9 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls and ceilings.

B. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece or split casting, cast brass with polished chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with polished chrome plated finish.
5. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw or spring clips.

3.10 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in partitions, roofs, and walls.

B. Sleeves are not required for core drilled holes.

C. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

D. Install sleeves in new partitions and walls as they are built.

E. For interior wall penetrations, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

F. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."

G. Seal space outside of sleeves in concrete slabs and walls with grout.

H. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe unless otherwise indicated.

I. Install sleeve materials according to the following applications:
   1. Sleeves for Piping Passing through Concrete Floor Slabs:
      a. Galvanized-steel pipe
   2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
      a. Extend sleeves 2 inches above finished floor level.
      b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 1.
   3. Sleeves for Piping Passing through Gypsum Board Partitions:
      a. Galvanized steel pipe sleeves for pipes smaller than NPS 6.
      b. Galvanized steel sheet sleeves for pipes NPS 6 and larger.
   4. Sleeves for Piping Passing through Exterior Concrete Walls:
      a. Galvanized steel pipe sleeves for pipes smaller than NPS 6.
      b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.
      c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe when sleeve seals are used.
   5. Sleeves for Piping Passing through Interior Concrete Walls:
      a. Galvanized steel pipe sleeves for pipes smaller than NPS 6.
      b. Galvanized steel sheet sleeves for pipes NPS 6 and larger.

J. Fire Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.11 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.12 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Final Acceptance Test shall begin only when the Preliminary Test Report has been approved.
2. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
5. Above ground piping shall be hydrostatically tested in accordance with NFPA 13. A two hour hydrostatic test is required at not less than 200 psi, but at least 50 psi above the maximum expected static pressure, with no pressure loss.
6. As specified in NFPA 13, an air pressure leakage test at 50 psi shall be conducted for 24 hours on dry and preaction systems. There shall be no drop in pressure in excess of 1.5 psi for 24 hours. The air pressure test is in addition to the required hydrostatic test.
7. Energize circuits to electrical equipment and devices.
8. Start and run air compressors.
9. Coordinate with fire-alarm tests. Operate as required. The detection and control system shall be subjected to functional and operational performance tests including test of each installed initiating device, system actuation device and notification device.
10. Each water control valve shall be independently trip-tested in accordance with the manufacture's published instructions.
11. As-Built Drawings and previous test results shall be available at the time of testing.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Upon acceptance by the Architect / Engineer and the Owner's Representative, the completed system(s) shall be placed into service.

3.14 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.15 DEMONSTRATION TRAINING & INTEGRATED TESTING

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

B. Include sufficient man-hours to assist in the Owner's Level 5 Integrated Systems Testing.

END OF SECTION

SECTION 22 00 10
BASIC PLUMBING REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Contract and General and Supplementary Conditions and Division 1 Specifications are hereby made a part of this Division as fully as if repeated herein. Where provisions of Division 1 conflict, the greater or stricter shall prevail.

B. This Section includes general administrative and procedural requirements for plumbing installations. The requirements included in this Section expand the requirements specified in Division 1.

C. Examine all Divisions of the specifications and drawings to determine the complete Scope of the work. Plumbing work shall comply with the requirements indicated in all sections of Division 22.

D. The work to be done under this Divisions of the Specifications shall include the furnishing of all labor, material, equipment, tools and appurtenances and performing all operations necessary to provide complete, fully functional systems in accordance with the Specifications, the Drawings and requirements of the applicable codes and standards listed herein. Where the specifications, drawings and applicable codes and standards conflict provide the greater or stricter requirement.

E. Visit areas of construction where Work is to take place, and examine the construction site carefully, noting locations and conditions under which the Work will be performed and accepting the responsibility for performing the Work under the existing conditions.

F. The work shall include the following specification sections:

Division 22 – Plumbing

22 00 10 Basic Plumbing Requirements

22 01 00 Plumbing Systems

G. The work shall include, but not be limited to, providing equipment and items listed below and installing items furnished under other Divisions of these specifications.

1. Receiving, handling, storing, and protecting equipment, material, and tools required to complete the work of this Division. This includes equipment and materials furnished by the Owner, as well as equipment and materials furnished by the Contractor. Store equipment and materials off site until ready for installation, and coordinate location of on-site storage and staging area with Construction Manager.
2. Hoisting and rigging required for completing the work of this Division. In general, hoisting and rigging will be required for all equipment to be installed in the building and moving equipment within the building.
3. Coordination with the General Contractor and other Installers for installation of piping to avoid conflict with duct, cable tray, conduit, and loose cable in the same space. Prepare and provide coordination drawings as specified herein.
4. Supplementary steel, channel and supports.
5. All materials and appurtenances that can reasonably be inferred to be a part of the plumbing systems and necessary to its proper operation, but not specifically mentioned or indicated on the drawings, shall be furnished and installed without additional charge.
6. Touch-up painting of pre-finished equipment furnished or damaged.
7. Firestopping, smoke, acoustical and environmental seals.

8. Furnish, erect, maintain, relocate, and remove all hoisting, rigging, staging and scaffolding required to perform the work of this Section of the specifications.
9. Provide core drilling through concrete; provide steel reinforcement and metal decking; provide required sleeves.
10. Attend and support the Integrated Testing of all systems. Include in bid time for 2 plumbers (including foreman) for 5 days.
11. Coordinate with the building trades:
    a. Structural members, pads, and building openings for plumbing equipment, ducts, piping, fans, etc., for use by this Contractor shown on the architectural and structural plans are the coordination responsibility of the plumbing contractor. Any changes in the above requirements after letting and accepting the plumbing contract will be paid for by this Contractor.
    b. Provide full time superintendent who shall oversee and coordinate the work with other trades and the A/E.
12. Coordinate with General Contractor's equipment and piping systems:
    a. This Contractor shall coordinate the layout of his work with the General Contractor to avoid conflict with the installation of the General Contractor's equipment and / or piping systems.
13. Coordinate with electrical work:
    a. All motor starters, relays, contactors, etc. for packaged equipment shall be provided by this Contractor and shall meet the requirements of Division 26 Specifications.
    b. All other motor starters shall be provided by the Division 26, unless otherwise indicated in Division 26 specifications or as indicated on the electrical drawings.
    c. All control wiring for control devices, magnetic coils, etc. shall not exceed 120-volts. Where power voltage for equipment is over 120-volts, a control transformer shall be provided and wired.
    d. 24-volt power wiring to solenoid and control valves, etc. is to be done under this Division 22, unless shown on the Electrical Drawings.
    e. 120-volt power source will be made available, under Division 26, at the distribution breaker panels as indicated on the electrical drawings.

1.2 RELATED WORK

A. The following items of labor and material incidental and/or related to the installation of the Plumbing Work are specified under other Divisions of these Specifications unless specifically indicated otherwise. Provide and assist and coordinate work to meet requirements indicated in the Specifications and on the Drawings.

1. Cutting and patching in accordance with the requirements under Division 1.
2. Controlled environmental conditions for plumbing equipment per the manufacturer's recommendations or as specified in this Division is to be provided by the General Contractor.
3. Excavation and backfilling, Division 2.
4. Concrete work including forms for housekeeping pads for equipment, Division 3.
5. Reinforcing steel, Division 5.
6. Watertight penetrations through roof, Division 7.
7. Flashing and caulking, Division 7.
8. Setting of frames for access panels, Division 8.
9. Painting of all equipment and material other than touch up of pre-finished fixtures, equipment and other Plumbing components, Division 9.
10. Utility (water, gas, steam) by the General Contractor

B. Furnish the following items for installation by others and provide coordination, cooperation, assistance and wiring as required:

1. Furnish access panels as required for plumbing work behind finished surfaces or otherwise concealed for installation under Division 8.

C. Install items purchased by others, coordinate delivery and be responsible for unloading from delivery vehicles, rigging, and for safe handling and field storage up to the time of installation. This Section shall be responsible for:

1. Coordination of delivery and shipping splits for size and weight restrictions of the project site.
2. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
3. Connection to building systems including the purchase and installation of all terminating fittings, lugs, etc. necessary to adapt and connect them to the building systems.
4. Provide all work indicated in the specifications and on the drawings related to the pre-purchased items that are not specifically indicated as pre-purchased.
5. Carefully examine such items upon delivery, and advise the General Contractor of any damages or defects noted, as well as the shipper.
6. Installation, testing, coordination of vendor's work and responsibilities and compliance with warranty coverage, requirements and support.

D. Work by General Contractor:

1. Refer to Division 1 for additional requirements and information.
2. Accommodate concurrent work provided by General Contractor.

E. Existing Materials:

1. All existing equipment and materials to be reused is assumed to be in good operating condition.
2. Guarantee all replacement work, equipment or materials for a period of one year from date of acceptance by the General Contractor.

1.3 COORDINATION OF THE WORK

A. Refer to Division 1 for additional requirements for coordination of the Work.

B. Before submitting bid examine all Drawings and Specification, including other Divisions, for requirements that affect work of this Division and include it in the scope of work for this section whether or not such work is specifically mentioned in this Division. Be responsible, under this Division of the Specifications, for the proper coordination of the plumbing work with the installations under other Divisions, including proper clearances. Any changes required to avoid interferences shall be submitted to the General Contractor.

C. Coordinate work with that of all other trades affecting or affected by work of this Division. Cooperate with such trades to ensure the steady progress of work under the contract.

D. Coordinate work with the General Contractor and the project schedule. Provide manpower and materials as required to meet the schedule and not to interfere with or impede the progress of or increase the cost of work by others. Submit shop drawings and order equipment in a timely manner. Expedite deliveries and manufacturing as required.

E. Deliver products to the project in a timely manner to meet all schedule requirements, properly identified with names, model numbers, compliance labels and other information needed for identification.

F. Install materials and apparatus as fast as conditions of the building will permit. Materials and apparatus must be installed when directed and in the fashion specified. Examine the Architectural Drawings for the location of suitable openings and aisles for the passage of equipment to be installed under this Section. The installer shall be responsible for having suitable openings and aisles left open until his equipment has been properly installed. If necessary, request the vendor to ship equipment in sections sized to permit passage. Provide sleeves, pockets, supports and incidentals.

G. Examine the drawings, the building construction, and vertical transportation for weight and size restrictions. Provide equipment and installation methods to comply with restrictions including shipping split sizes, weights, and disassembled components as required. Obtain manufacturer's approval and assurance warranty will be honored.

H. Prepare and submit coordination drawings in conjunction with the other Trades, on common drawings of at least 3/8"=1'-0", as directed by the General Contractor. Each system shall be color-coded, and for cad drawings, each system shall be on a different layer. Meet to resolve conflicts between the various Installers prior to submission to the General Contractor for review. Identify conflicts resolved that include changes to the design. Note on coordination drawings submitted to the General Contractor any conflicts that the trades could not resolve. The General Contractor will provide direction that all Installers will comply with, at no additional cost to the project. In general, distribution systems which require pitch or slope such as plumbing drains, steam and condensate piping shall have the right of way over those which do not. Lighting fixtures have minimal flexibility and should not be moved without prior approval. Install work to avoid interferences and to allow proper clearance around all trades' work for access, maintenance and as required by code. Prepare coordination drawings in the following order (subject to above): HVAC (with lighting fixtures indicated), fire protection, plumbing, electrical and telecommunications systems. Work installed prior to complete and reviewed coordination drawings must be corrected as required at no additional expense to the project.

I. Coordination Drawings:
   1. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by A/E for Contractor's use in preparing coordination drawings
      a. A/E makes no representations as to the accuracy or completeness of CAD Drawings as they relate to the Contract Drawings.
   2. Prepare and submit coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.
      a. Show the interrelationship of components shown on separate Shop Drawings.
      b. Indicate required installation sequences.
      c. Comply with requirements contained in Section "Submittals."
   3. Prepare coordination drawings to a scale of 1/8"=1'-0" or larger; detailing major elements, components, and systems of plumbing 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:
      a. Indicate the proposed locations of piping, risers, backflow prevention, fixtures, drains, equipment (including wall mounted and ceiling suspended equipment), and materials. Include the following:
         1) Clearances for installing and maintaining insulation.
         2) Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
         3) Equipment connections and support details.
         4) Exterior wall and foundation penetrations.
         5) Respective locations of plumbing elements to structural components such as columns and beams.
         6) Locations of structural slab penetrations.
         7) Fire-rated wall and floor penetrations.
         8) Sizes and location of required concrete pads and bases.
         9) Valve stem movement.
   4. Indicate scheduling, sequencing, movement, and positioning of large equipment into the building during construction.

5. Prepare floor plans, elevations, and details to indicate penetrations in floors, walls, and ceilings and their relationship to other penetrations and installations.
6. Prepare reflected ceiling plans to coordinate and integrate installations, air outlets and inlets, light fixtures, communication systems components, sprinklers, and other ceiling-mounted items.
7. Submit one set of CAD Coordination Drawings, and three sets of Color CAD Coordination Drawing plots.

J. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated request information from Architect.

K. Check Contract Drawings as well as Shop Drawings of all Installers and vendors to verify and coordinate space in which work of this section will be installed.

L. Obtain from manufacturers the proper method of installation and connection of the equipment that is to be furnished, installed or wired. Obtain all information that is necessary to facilitate the work and to complete the project.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Refer to Division 1 for additional requirements for quality assurance and control of the installation.

B. Receive, handle, house, and protect equipment required for installation under this specification. Replace damaged equipment with new equipment.

C. Review submittals of equipment furnished under other Divisions prior to installation and rough-in. Verify location, size, and required connections. Coordinate details of equipment connections with supplier and installer.

D. Utilize installers with at least five years experience in the type of work to be performed.

E. Manufacturers shall be companies experienced in manufacturing products specified for a minimum of five years.

F. Be responsible for the care and protection of all work included in this Section until it has been tested and accepted.

G. Protect all equipment and materials from damage from all causes including theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment.

H. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen and make good any damage caused.

I. Provide workmanship in accordance with the best accepted practices. Rework installations judged by the Engineer as unacceptable.

1.5 REGULATORY REQUIREMENTS

A. Refer to Division 1 for additional regulatory or reference requirements.

B. Provide products listed and classified by an OSHA certified Nationally Recognized Testing Laboratory (NRTL) as suitable for purpose specified and indicated. Provide NRTL-listed material and equipment where standards are available. Notify Engineer of any material or equipment that is not NRTL listed when submitting information.

C. Perform work in strict accordance with the rules, regulations, listing or labeling requirements, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities having legal jurisdiction over the site. No additional compensation shall be granted for work that must be changed as a result of the work not originally complying with the codes, standards, local requirements, etc.

D. Equipment and installation shall be suitable for the wind, snow, ice, flood, and earthquake requirements indicated in the Building Code and ASCE 7 for the location and usage.

1. Building occupancy classification per ASCE 7 = Category II
2. Seismic Design Category = A
3. Site Class as defined in the IBC = C

E. Materials and equipment shall be manufactured, installed and tested as specified in the latest and required editions of applicable parts of the following publications, standards and rulings of:

1. AGA American Gas Association
2. AISC American Institute of Steel Construction
3. AISI American Iron and Steel Institute
4. ANSI American National Standards Institute
5. ASHRAE American Society of Heating, Refrigerating, and Air-Conditioning Engineers
6. SFPE Society of Fire Protection Engineers
7. ASPE American Society of Plumbing Engineers
8. ASSE American Society of Sanitary Engineering
9. ASTM American Society for Testing and Materials
10. AWS American Welding Society
11. AWWA American Water Works Association
12. CAGI Compressed Air and Gas Institute
13. CGA Compressed Gas Association
14. CISPI Cast Iron Soil Pipe Institute
15. ETL ETL Testing Laboratories, Inc.
16. FM FM Global (Factory Mutual)
17. IEEE Institute of Electrical and Electronic Engineers
18. ISA Instrument Society of America
19. MCAA Mechanical Contractors Association of America
20. MSS Manufacturers Standardization Society of the Valve and Fittings Industry
21. NEC National Electrical Code (NFPA 70)
22. NEMA National Electrical Manufacturers Association
23. NFPA National Fire Protection Association
24. NSF National Sanitation Foundation
25. PDI Plumbing and Drainage Institute
26. SMACNA Sheet Metal and Air Conditioning Contractors National Association
27. UL Underwriters Laboratories
28. WSC Water Systems Council

F. Where conflicts occur among the codes, ordinances, standards, Drawings or Specifications, the more restrictive requirements shall govern.

G. The Drawings and Specifications do not undertake to repeat requirements written or all work required in the above codes, ordinances and standards.

H. Comply with applicable codes and regulations regarding toxicity of combustion products of materials used.

I. Legally dispose of all material. Adhere to all regulations regarding disposal of hazardous material. Recycle hazardous material where recycling is possible. Submit certificates of legal recycling or disposal to the General Contractor. Include copy in the General Contractor and Maintenance Manual.

J. Public utility back charges will be paid for by the General Contractor and are not to be included in the base bid. Submit charges to General Contractor without markups, for General Contractor to process directly or as a change order to the Contract. Markups on utility back charges will not be allowed.

K. Nothing in these Contract Documents shall be construed to permit work not conforming with applicable codes and regulations. When conflicts occur the more restrictive requirements shall govern.

L. Should the Facility have established building standards, rules or regulations, obtain a copy from the General Contractor and comply with them.

1.6 SUBMITTALS

A. Provide and submit under provisions of Division 1 and as indicated herein.

B. Submit at time of bid any equipment or materials that have lead times that will affect the construction schedule. Provide alternate costs to expedite delivery and manufacturing so that the project schedule can be accomplished.

C. Submit at time of bid, any proposed substitutions. List reasons the General Contractor should accept substitutions including improved performance or equal performance and improved delivery time. Acceptance of substitutions is subject to acceptance by the General Contractor, whose decision will be final. A substitution is considered to be any manufacturer or product not specifically identified in the specifications or drawings. If only performance requirements are indicated, and no specific manufacturer is indicated, then a manufacturer meeting the contract document requirements is not considered a substitute.

D. Substitutions of specifically indicated items will be reviewed only if identified at time of bid, otherwise submittals will be returned rejected. It is the proposer's responsibility to submit the first time, all information required to prove equality and a written letter on the proposer's letterhead indicating that the item is in full compliance with the Contract Documents and will fit in the designated location. Include in bid, coordination of all work and all costs for all trades for any work that may be required, including any architectural or engineering fees, to accommodate the substitution. Acceptance of the proposed substitution is up to the General Contractor and is not assured. Review will include, but is not limited to, quality, life cycle costs, size, appearance, construction, manufacturer, service record, efficiency, dependability, performance, etc.

E. Submit for review, within 10 days after being given Notice to Proceed and prior to the submission of any shop drawings, an itemized list of manufacturer's of material and equipment and of firms or subcontractors proposed to be used to perform the work. Include a list of submissions and the proposed schedule to submit them, so that based on the approval times and procedures indicated below, the proposed project schedule will be accomplished. FAILURE TO SUBMIT WITHIN THE TIME LIMIT OF 10 DAYS WILL BE CONSIDERED A CONTRACT VIOLATION and will require that all items will be provided in a timely manner to maintain the schedule and all costs required to meet the schedule are included to expedite delivery and manufacturing.

F. After approval of the list and schedule, submit 8 sets of detailed Shop Drawings and product Data per the submission schedule or within 30 days or sooner if required to meet the construction schedule. Substitutions will not be accepted for failure to comply with the schedule above.

G. Submit related shop drawings at one time. <u>SUBMIT ALL ITEMS IN A SPECIFICATION SECTION AT THE SAME TIME.</u> Incomplete submittals will be held until a complete submittal is accumulated.

H. The review of systems, equipment and Shop Drawings is a general review subject to the Contract Drawings, specifications and verification of all measurements at the job. Review does not relieve the installer from the responsibility of Shop Drawing errors or complying with the Specifications and Drawings. Carefully check and correct all Shop Drawings prior to submission for approval. Regardless of any information included in the shop drawings submitted for review, the requirements of the Contract Documents shall not be superseded in any way by the Shop Drawing Review.

I. Mark submittals to clearly identify (including when photocopied) proposed equipment including their accessories, options, and modifications and exclude parts not applicable to the Project, otherwise the Engineer will identify items and options to be provided at no additional cost to the project.

J. Each submittal shall be reviewed, stamped and certified prior to submission to the General Contractor. Such certification shall be made by a person duly authorized to sign binding Agreements for the Contractor. The certification shall state that the data and details contained on each Shop Drawing, layout drawing, catalog data and brochure has been reviewed by the Contractor for conformance to the contract documents and that it complies with the Contract Documents in all respects. Submittals will not be reviewed and will be returned to the Contractor unchecked unless they are certified.

K. It is intended that Submittals be complete and accurate at the first submission. If the Submittal is returned marked "Resubmit," only one additional submittal will be permitted. If the second Submission is not acceptable, the right of selection will be lost and the General Contractor will specify exactly what is required and the specified products shall be provided at no additional cost to the Project.

L. A minimum period of two weeks, exclusive of transmittal time, will be required by the General Contractor's office each time Submittals are submitted or resubmitted for review. This time period shall be considered when scheduling the work, and any costs associated with expediting equipment delivery to meet the Schedule will be at no additional cost to the General Contractor. Submittals of numerous items at the same time may extend the time needed for review, so plan accordingly.

M. Provide submittals in a timely manner sufficiently in advance to give ample time for checking, correcting, resubmitting and rechecking if necessary. No claim for delay or additional costs will be granted for failure to comply with this requirement.

N. If proposed equipment deviates from the Specifications or Drawings, indicate those differences and provide sufficient data to justify acceptance. FAILURE TO INDICATE DEVIATIONS OR SUBSTITUTIONS IMPLIES FULL COMPLIANCE WITH DRAWINGS AND SPECIFICATIONS.

O. Indicate clearly all equipment, components or assemblies that are not NRTL listed or labeled. Failure to indicate otherwise implies NRTL listing or labeling.

P. Provide products of one manufacturer for each classification of equipment.

Q. Meet Project requirements including space, size and weight restrictions before submitting to Engineer. Equipment shall be of proper size for its allocated space. Equipment may be disassembled so that it can be installed through available openings only if it will not invalidate manufacturer's warranties.

R. At the job site, maintain the latest equipment submittals showing the action taken by the Engineer. Make these submittals available to General Contractor.

S. Any items with a tag number must be submitted for approval. Submittals shall provide all pertinent data and information necessary to evaluate each item. Certified Drawings and catalog data sheets shall show:

1. Applicable specification section number and equipment tag number.
2. Principal dimensions and details of construction.
3. Weights of principal parts and total weights with information required for the design of supports and foundations.
4. Sizes and locations of piping and connections.
5. Performance data, including pump curves; pressure loss curves; certified by the manufacturer for the equipment furnished.
6. Data on electric motors, including break HP of driven equipment, nameplate ratings and classes, and starting and running full load currents.
7. Approval stamp of Underwriters and other authorities having jurisdiction of drawings requiring such approval.
8. Submit Schedule of proposed piping fitting, valves, specialties, etc. along with manufacturer's catalog data.
9. Product Data: Submit catalog data sheets or other published materials showing appearances, electrical ratings characteristics and connection requirements, performance characteristics, dimensions, weights, installation methods, and space requirements of plumbing equipment and their accessories, as listed below and required by the individual sections.

T. Shop Drawings: Submit shop drawings (drawn to scale) indicating physical size and arrangement, (plans and elevations) construction details, provisions for conduits, access requirements for installation and maintenance, finishes, and materials used in fabrication. Supplement shop drawings with wiring diagrams and information as described under Product Data.

U. <u>A complete copy of the specifications</u> (Reduced in size to allow a Comment Column), with each sub-paragraph noted with comment, "compliance," "deviation", or "alternate". In the case of non-primary, vendor-supplied items, the name of the sub-vendor supplying said item, including model number shall be indicated.

1. By noting the term "compliance", it shall be understood that the manufactures is in full compliance with the item specified and will provide exactly the same with no deviations.
2. By noting the term "deviation" it shall be understood that the proposer prefers to provide a different component that performs the same function in lieu of that specified. Indicate all deviations and indicate what is being proposed, with enough detail to determine equivalency.
3. By noting the term "alternate" it shall be understood that the proposer proposes to provide the same operating function but prefers to do it in a different manner. An alternate shall be fully described as to what the proposer proposes to provide. Indicate any function or feature that is not provided. Specification Comparison: In addition to the complete shop drawings required above provide.

V. Manufacturer's Instructions:

1. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
2. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.
3. Include instructions on manufacturer's requirements for cable restraint in equipment.
4. Submit manufacturer's standard and recommended receiving, start up and acceptance testing checklists.

W. In addition to copies of submittals as required under Operation and Maintenance Manuals, provide electronic copies on CDs or DVDs of all submittal information in PDF or Microsoft Word format with O&M manuals.

1.7 EXTRA MATERIALS

A. Provide extra materials as specified in each section.

B. Extra materials shall be turned over to the General Contractor prior to receiving final payment. Obtain itemized receipt properly signed and dated. Submit with request for final payment.

C. Extra materials shall be in original standard manufacturer's packaging.

1.8 PROJECT RECORD DOCUMENTS

A. Provide and submit under provisions of Division 1 and this Section the following:

1. Record Drawings
2. Specifications
3. Product Data
4. Operation and Maintenance Manual.
5. Equipment Warranties.
6. Certification of proper disposal of regulated materials.

B. Refer to Division 1 for additional Project record document requirements beyond those indicated herein.

C. Provide and maintain at the site a set of prints on which shall be accurately indicated the actual installation of all work under this Division, indicating any variation from Contract Drawings, including change orders, field conditions, Engineer's direction and changes in sizes, locations and dimensions. Changes in circuitry shall be clearly and completely indicated as the work progresses. Modify Schedules to reflect data consistent with that of the installed equipment.

D. Record Drawings shall be maintained in a clean, dry and legible condition and shall not be used for construction purposes.

E. These progress prints shall be available for inspection by the Engineer and shall be used to determine the progress of electrical work. Indicate daily progress by color-coding materials and apparatus installed. Progress prints shall be reviewed weekly and shall be corrected immediately if found inaccurate or incomplete. Drawings will be used as a guide for determining the progress of the work installed. Requisitions for payment will not be approved until the Drawings are accurate and up-to-date.

F. At the completion of the work, obtain and pay for a new set of 4-mil mylar washoff sepia reproducible record drawings, modify drawings to represent the work as actually noted on the marked-up prints, including the DIMENSIONED location of all underground pipe and conduit. Remove all superseded data to show only the completed installation. Mark all Drawings as "Final Record Drawings" and date them.

G. Electronic files shall be AutoCad 2004 as a minimum.

H. Furnish these record documents to the Engineer for review and transmission to the General Contractor.

I. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark new information that is important to the General Contractor, but was not shown on Contract Drawings or Shop Drawings.
2. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
3. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
4. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
5. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
6. Contract Modifications, actual equipment and materials installed.
7. Include all “Corrected For Record” shop drawings to reflect approvals received.
   a. Mark Specifications to indicate approved substitutions and actual equipment and materials used.
   b. Number of Copies: Submit copies of Record Drawings as follows:
      1) Initial Submittal: Submit one set of plots from corrected Record CAD Drawings and one set of marked-up Record Prints. A/E will initial and date each plot and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable. A/E will return plots for organizing into sets, printing, binding, and final submittal.
      2) Final Submittal: Submit three sets of Record CAD Drawing files, and three sets of Record CAD Drawing plots. Plot each Drawing, whether or not changes and additional information were recorded.
      3) Electronic Media: CD-ROM.
      4) Format: Same CAD program, version, and operating system as the original Contract Drawings.
      5) Refer instances of uncertainty to A/E for resolution.

1.9 OPERATING INSTRUCTIONS AND MAINTENANCE DATA

A. In addition to the requirements of Division 1 provide the following after completion of the work and prior to final completion, furnish and deliver six copies of a complete O&M manual. Each manual shall include one copy of each approved shop drawing, catalog pages, instruction sheets, operating instructions, installation, instructions and recommended maintenance procedures and intervals, and spare parts bulletins. Provide separate sections for each separate system, i.e., fire alarm system, sound system, security system, etc.

B. Give detailed instructions, using additional manuals, prior to final completion of work, to the responsible personnel designated by the General Contractor in the operation and maintenance of all work installed under this Division. All instructions shall be recorded on DVD with two copies of the DVD turned over to the General Contractor upon completion of the instruction period. Recording of the instructions shall include a description of the system as well as detailed operating and maintenance instructions. Recording sessions will be of professional quality and performed by a firm regularly employed in that business. A letter with two copies containing the name of the person or persons to whom the instructions were given and the dates of the instruction period shall be submitted to the General Contractor at the completion of the project.

C. Prepare sets of manufacturer's catalogs, and other similar data, including the necessary photographic equipment cuts, wiring diagrams covering all plumbing equipment and devices furnished and installed under this Section. These manuals shall provide complete instructions for the proper operation and use of the equipment, together with instructions for lubrication and periodic maintenance and trouble-shooting. Operating instructions shall be specific for each system and shall include copies of posted specific instructions. This manual shall contain only

that information which specifically applies to this Project and all unrelated material shall be deleted. During the instruction period, this manual shall be used and explained. The material shall be bound in 3-ring binders, indexed and have a Table of Contents. On the edge of the binder, provide a clear, see-through plastic holder with a typed card indicating the Project name, the Architect's name, the Installer's name and the Volume number (e.g., Vol. No. 1 of 2).

D. Include a copy of all test reports and certifications in the O&M Manuals.

E. Include name, address and telephone number of the manufacturer's representative and service company for each piece of equipment so that the source of replacement parts and service for each item of equipment can be readily obtained.

F. Provide four copies of the O&M manual information on CD ROM or DVD. Files shall be in a readable format such as PDF or image files (TIF, etc). Record drawings shall be scanned in, and shall also include the AutoCad dwg files if Record Drawings are provided on Cad.

G. Furnish these manuals to the General Contractor for review and transmission to General Contractor.

1.10 WARRANTY

A. Refer to individual sections and Division 1 for additional warranty (guarantee) requirements.

B. Remedy work performed under this Division that is found not to comply with the Contract Documents, requires excessive service, or fails less than one year from the date of final acceptance.

C. Manufacturers shall provide their standard warranties for material and equipment furnished under this Division, unless otherwise indicated in each Section.

D. Materials, equipment and work furnished under this Division shall be guaranteed against all defects in materials and workmanship for a period of one year, commencing with the date of final acceptance by the General Contractor. Any failure due to defective material, equipment or workmanship shall be corrected as quickly as possible and at no expense to the General Contractor, including all damage to areas, materials and other systems resulting from such failures.

E. Upon receipt of notice from the General Contractor of failure of any part of the systems during the guarantee period, the affected parts shall be replaced as quickly as possible. Any equipment requiring excessive service (more than two unscheduled services) shall be considered defective and shall be replaced.

1.11 INTERPRETATION OF CONTRACT DOCUMENTS

A. Division one, General and Supplementary Conditions are in addition to the requirements indicated in Division 21, Drawings and Specifications.

B. Where Drawings or Specifications conflict or are unclear, advise General Contractor in writing before Award of Contract. Otherwise, interpretations of Contract Documents by the General Contractor shall be final, and no additional compensation shall be permitted due to discrepancies or un-clarities resolved according to the General Contractor’s interpretation.

C. The intent of the Drawings and Specifications is to assist and guide and to establish minimum requirements.

D. Drawings and Specifications form complimentary requirements; provide work specified and not indicated, and work indicated and not specified as though explicitly required by both.

E. Should there be conflicts in Contract Documents, provide the greater quantity, the higher quality and the more restrictive of equipment and work.

F. Specifically stated requirements supersede general ones.

G. Plumbing Drawings do not limit responsibility of determining full extent of work required by Contract Documents. Refer to Architectural, HVAC, Electrical, Fire protection, Plumbing, Structural, specialty trades and other Drawings and other Divisions that indicate types of construction in which work shall be installed and work of other trades with which work of this Division must be coordinated.

H. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the Drawings or Specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

I. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

J. Where Drawings or Specifications do not coincide with manufacturer's recommendations, or with applicable Codes and Standards, alert General Contractor in writing before installation. Otherwise, make changes in installed work, as General Contractor requires within Contract Price.

K. It is the intent of these Contract Documents to have systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component. In cases such as this, where the bidder has failed to notify the General Contractor of the situation prior to contract award, provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

L. In situations or where potential conflicts and Installer believes guidance is required, submit a sketch identifying a proposed solution and the General Contractor shall review, note if necessary, and return this sketch appropriately marked as required.

M. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Infer the omitted words or phrases such as "the Contractor shall", "shall be", "as indicated on the Drawings", "in accordance with details", "a", "the", and "all".

N. "As permitted" means by Code, by Engineer or by prevailing conditions.

O. "Acceptable", "approved", and "satisfactory" means by General Contractor.

P. Work indicated on the Drawings is intended to be approximately correct to scale, but figures, dimensions, and detailed Drawings are to be followed. Take measurements at the building before fabrication commences.

Q. Size of pipes or conduits and methods of installing them are indicated, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered.

R. Drawings are generally diagrammatic and indicate the arrangement and approximate location of fixtures, equipment and piping. When necessary to deviate from the arrangement indicated,

to meet structural conditions or to clear work of other Divisions, inform the General Contractor of proposed deviation before proceeding. Obtain in the field all information relevant to the placing of plumbing work.

S. Drawings and Specifications do not undertake to indicate every item required to produce a complete and properly operating installation. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a fully complete, secure and properly operating installation suitable for the intended use shall be provided.

T. The right is reserved to make reasonable changes in locations of equipment indicated in Drawings prior to installation without increase in contract cost.

U. Contract Documents indicate scope of work required. Jurisdictional assignment shall be a responsibility under this Section's contractual obligation.

V. The following definitions apply to the Drawings and Specifications:

Furnish: The term “furnish” is used to mean “supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations.”

Install: The term “install” is used to describe operations at project site including the actual “unloading, unpacking, rigging in place, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”

Provide: The term “provide” means to “furnish and install, complete and ready for the intended use.”

Installer: An “Installer” is the Contractor or an entity engaged by the Contractor, either as an Employee, Subcontractor, or Sub-Subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1.12 GUARANTEE AND 24 HOUR SERVICE

A. Guarantee the Work of this Section in writing for one year following the date of Substantial Completion. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Owner's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

B. In addition to guarantee requirements of Division 1 and of Subparagraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.

C. Provide 24 hour service beginning on the date of Substantial Completion and lasting until the termination of the guarantee period. Service shall be at no cost to the Owner. Service can be provided by this contractor or a separate service organization. Choice of service organization shall be subject to Owner approval. Submit name and a phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

1.13 COMMISSIONING (LEVEL 4) AND INTEGRATED TESTING (LEVEL 5) OF EQUIPMENT AND SYSTEMS

A. Completion of start up and commissioning is a prerequisite for substantial completion and acceptance of project by the Owner. Operate and maintain systems and equipment until final

acceptance by the owner. Provide testing, adjusting, and balancing as specified in Section 230800. Follow and provide all required paperwork for owner's Level 1, 2, 3, 4 testing procedures.

B. All guarantees and warranties shall not begin until final acceptance of the systems and equipment by the owner.

C. Include time for owner's Level 5 Integrated testing Systems Testing to be scheduled after completion of Level 4 Acceptance Testing. Include time to assist in producing and providing owner's required paperwork and documentation plus the equivalent of five 12 hour days for a foreman and three senior installers/technicians to assist and operate equipment during testing.

1.14 ITEMS FURNISHED BY OWNER

A. Where required to install items purchased by others, coordinate their delivery and be responsible for their unloading from delivery vehicles and for their safe handling and field storage up to the time of installation. This trade shall be responsible for:

1. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
2. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.

B. Carefully examine such items upon delivery, and advise the Owner of any damages or defects noted, as well as advising the shipper.

1.15 MATERIALS AND WORKMANSHIP

A. Work shall be neat and rectilinear. Install material and equipment as required by manufacturers. Installation shall operate safely and without leakage, undue wear, noise, vibration, corrosion or water hammer. Work shall be properly and effectively protected, and pipe and duct openings shall be temporarily closed to prevent obstruction and damage before completion.

B. Except as specified otherwise, material and equipment shall be new. Provide supplies, appliances and connections necessary for complete and operational installation. Provide components required or recommended by OSHA and applicable NFPA documents.

1.16 CONTINUITY OF SERVICES

A. Do not interrupt existing services without Owner's approval.

B. Schedule interruptions in advance, according to Owner's instructions. Submit, in writing, with request for interruption, methods proposed to minimize length of interruption.

C. Interruptions shall be scheduled at such times of day and work so that they have minimal impact on Owner's operations.

D. Include premium time work associated with shutdowns of systems

1.17 TEMPORARY HEATING AND COOLING

A. Work provided under Division 1.

1.18 UNIT PRICES

A. Refer to Division 1 for additional requirements.

1.19 ALTERNATES

A. Refer to Division 1 for additional requirements.

PART 2 - PRODUCTS

2.1 SPECIFIED PRODUCTS AND SUBSTITUTIONS

A. Provide new, unused, full weight, standard equipment that meets or exceeds Contract Document requirements to the satisfaction of the General Contractor. No equipment or material shall be used unless previously approved by the General Contractor.

B. The manufacturer's catalog number and description is the basis of the design and establishes quality and performance required for this project. Generality, the first manufacturer listed is the one the project design is based on.

C. Manufacturers of generally compatible products may also be listed, subject to compliance with requirements. Substitution of equal products or manufacturers of equal products are also acceptable when indicated in each section.

D. The description following a catalog number is basically to identify the item but may also call for accessories, options, or modifications that are beyond the cataloged item.

E. Zinc Whiskers:

1. Major data processing equipment suppliers have raised concerns over the potential for airborne zinc whiskers to damage their equipment. Zinc whiskers form on steel that is galvanized via a zinc electroplating process. Zinc whiskers do not form on steel that has been hot dipped galvanized. Do not use zinc-electroplated components in areas with raised access floors.
   a. Use materials under the raised access floors that are hot dipped galvanized steel or other material, but not zinc-electroplated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to beginning work in a particular area of the project visit the site and examine conditions under which work must be performed, including preparatory work done under other Divisions or Contracts or by the General Contractor. Report conditions that might affect work adversely in writing through Contractor to General Contractor. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

B. Arrangements shall be made to have the openings, inserts, sleeves and other such incidentals set in place ahead of the construction work, where practical to eliminate the need for cutting and patching. If cutting becomes necessary for the installation of the work, it shall be done under this Division in accordance with the requirements of Division 1 and other applicable divisions. All openings shall be neatly patched and finished to match the adjoining work in a manner approved by the General Contractor, any penetration in fire-rated walls or floors must be fire-stopped as indicated in Division 7. All cutting shall be performed in a manner not to weaken the structural parts. The cutting manner and method shall meet the approval of the Architect.

C. The equipment shall be kept upright at all times. If equipment has to be tilted for ease of passage through restricted areas, the manufacturer shall brace the equipment to ensure that

the tilting does not impair the functional integrity of the equipment. Comply with manufacturer's requirements.

3.2 INSTALLATION

A. Do not cut structural members without written acknowledgement from the General Contractor.

B. Do not attach equipment to metal roof decking or bottom of structural concrete members.

C. Arrange equipment so working parts are accessible for inspection, repair, and renewal.

D. Where not specified or indicated, mount equipment at heights directed by the General Contractor.

E. Locate equipment, control pushbuttons, terminal cabinets, safety switches and such other apparatus as may require periodic maintenance, operation, or inspection, so that they are easily accessible. If such items are shown on the plans in locations which are found to be inaccessible, advise the General Contractor of the situation before work is advanced to the point where extra costs will be involved.

F. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.

G. Where installed in damp, wet and areas requiring washing down, all surface mounted equipment shall be supported by spacers to provide a clearance between wall and equipment.

H. All connections to equipment shall be made as required, and in accordance with the approved shop and setting drawings.

I. Unless otherwise approved by the General Contractor, piping indicated exposed shall be installed exposed; piping indicated concealed shall be installed concealed.

J. Where exact locations are required for roughing in, stubbing-up and terminating conduit request Shop Drawings, equipment location drawings, foundation drawings, and any other data required to locate the concealed conduit before the floor slab is poured or wall or ceiling is installed.

K. Verify the ceiling type ceiling suspension system and clearance above hung ceilings prior to ordering grilles or diffusers. Notify the General Contractor of any discrepancies.

L. Fire ratings of enclosures, walls, ceilings, and floors shall be maintained. Penetrations for plumbing Work shall be fire-stopped as indicated in Division 7 or indicated in individual Sections on Drawings, or by General Contractor. Review Architectural drawings for fire ratings.

M. Water tightness of enclosures, walls, ceilings, and floors shall be maintained. Provide necessary fittings, accessories and coordination as required.

N. Do not use powder-actuated anchors.

3.3 TESTING AND INSPECTIONS

A. For additional requirements for starting, demonstration, and instructions of systems refer to Division 1.

B. Provide starting, demonstration, and instructions of systems as required in individual Sections.

C. Insure that the General Contractor's operating personnel are made entirely familiar with the nature, operation, and maintenance of the systems and equipment provided under this Division.

D. Provide testing as indicated in individual Division 22 sections. Submit written results.

3.4 SUBSTANTIAL COMPLETION

A. For additional requirements refer to Section 017700 Closeout Procedures.

B. When Work under this Section (or designated portion of Work) is considered substantially complete, submit written notice through the General Contractor with a list of items remaining to be completed or corrected.

C. All systems shall be operational and tested. Submit test reports.

D. Submit local authority final sign off inspection reports.

E. Should General Contractor observe and find Work is not substantially complete, written notification will be provided listing observed deficiencies.

F. Remedy deficiencies and send a second written notice of substantial completion.

G. When General Contractor finds Work is substantially complete, a Certificate of Substantial Completion will be prepared in accordance with provisions of General Conditions.

H. Submit test reports for review prior to Architect's site visit.

3.5 FINAL COMPLETION

A. For additional requirements refer to Section 017700 Closeout Procedures.

B. When Work under this Section is considered complete, submit through the General Contractor written certification that:

1. Contract documents have been reviewed.
2. Work has been inspected for compliance with Contract Documents.
3. Work has been completed in accordance with Contract Documents (and deficiencies listed with Certificate of Substantial Completion have been corrected).
4. Equipment and systems have been tested, adjusted and balanced and are fully operational.
5. Work is complete and ready for final Engineer review.

C. Upon completion of all work, and as a condition to receiving final payment, furnish to the Architect the following original, signed certificates and include copies of these certificates as part of the Operation and Maintenance manuals:

1. From the manufacturer's authorized representative, stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found same to be installed in accordance with the manufacturer's requirements and to be in satisfactory operating condition. This certification shall be provided for all major equipment and for all complete systems. It is not required for other components unless specifically requested by the Engineer.
2. Certificates of inspections, letters and notices from the appropriate government-authorized inspectional authorities stating that all portions of the work (indicate trade and responsibility) have been inspected and are installed in conformance with the applicable codes, laws, ordinances and referenced standards. In non-conformance notices are received, include the re-inspection certificate, letter of explanation, etc. as required to

indicate complete conformance. Provide written evidence of all variations, exceptions, variances, etc. given by the inspectors.

3. Certificate from the installing firm responsible for the work (indicate trade and responsibility) signed by an authorized officer or General Contractor of the Firm and the Foreman or Project Manager in charge, stating that to the best of the signer's knowledge and belief that the project (indicate project name and address) has been installed in compliance with the Contract Plans, Specifications and Addenda, and all applicable codes and laws, ordinances and referenced standards. Where subcontractors perform a portion of the work of this Section, include certificates from them.

D. Should General Contractor observe and find Work incomplete, the review will be promptly suspended and written notification will be provided through the General Contractor.

E. Complete Work, remedy deficiencies and send a second certification of final completion.

F. General Contractor shall, upon receipt of a second certification of completion, make a second review and provide notification in writing through the General Contractor, listing observed deficiencies.

G. When General Contractor finds work complete, close-out submittals will be considered.

END OF SECTION

SECTION 22 01 00
PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provide the plumbing additions and alterations as shown on the drawings, as specified in this Section, and as needed for a complete installation including, but not necessarily limited to:

1. Applications and fees for all plumbing permits, services, and interim and final inspections.
2. Temporary water provisions as required for construction purposes
3. Cold and hot water piping additions and alterations
4. Drain, waste, and vent systems
5. Plumbing equipment and trim
6. Cathodic and dielectric protection
7. Accessory plumbing devices including but not necessarily limited to hangers, supports, inserts and valves
8. Access panels
9. Piping insulation
10. Cutting and patching
11. Painting of exposed piping
12. Sterilization of the potable water system
13. Piping materials and installation instructions common to most piping systems
14. Dielectric fittings
15. Mechanical sleeve seals
16. Sleeves
17. Escutcheons
18. Grout
19. Plumbing demolition
20. Equipment installation requirements common to equipment sections
21. Supports and anchorages
22. Testing, adjusting and balancing

B. Include the cost of applications and fees for all plumbing permits, services, and interim and final inspections in the Base Bid.

1.2 DEFINITIONS

A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 RELATED SECTIONS

A. Section 22 00 10 – Basic Plumbing Requirements

1.4 REFERENCES

A. International Plumbing Code.

B. State and local regulations.

1.5 SUBMITTALS

A. Submit in accordance with Section 22 00 10:

1. Shop Drawings: Provide piping drawings including connections to existing domestic water, sanitary drain, and vent risers. Indicate pipe materials used, joining methods, supports, and wall penetration seals.
2. Product Data: Provide manufacturers catalog information for purchased items. Indicate valve data and ratings, equipment dimensions and materials of construction.
3. Maintenance Instructions: Include installation instructions, spare parts lists, procedures, and treatment programs.

B. Welding certificates.

C. Field quality-control inspection and test reports.

D. Submit record drawings and final certification to the Owner and Engineer upon completion of installation and testing.

1.6 QUALITY ASSURANCE

A. Codes and Regulations

1. All materials, apparatus, and equipment and the installation thereof shall comply with all state and county ordinances and all other governmental and/or private authorities having jurisdiction, and shall comply with all county and state laws, rules, and regulations, as well as rules and regulations of the National Board of Fire Underwriters, and the Plumbing Code having jurisdiction.
2. In the event of conflict between or among specified requirements and pertinent regulations, the more stringent requirement will govern and shall be provided at no additional cost to the Owner.

B. Drawings and Coordination:

1. Construction drawings shall be considered as a part of the work, insofar as the drawings furnish information relating to design and construction of the building. Because of the scale of the mechanical drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required to meet such conditions.
2. The plumbing drawings show the general arrangements of all piping, ductwork, equipment, etc., and shall NOT BE SCALED. This work shall be coordinated with ALL trades. Critical locations are dimensioned on the drawings; if a conflict arises, the Engineer immediately for clarification.

C. Verify the dimensions governing the plumbing systems work in the building. No extra compensation shall be claimed or allowed on account of differences between actual dimensions and those indicated on the drawings. Examine adjoining work, on which mechanical work is dependent for proper operation, and shall report any work which must be corrected. No waiver of responsibility for defective work shall be claimed or allowed due to any failure to report unfavorable conditions affecting the plumbing systems work.

D. Piping materials shall bear label, stamp, or other markings of specified testing agency.

E. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

F. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

G. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site. Store fixtures and valves in shipping containers with labeling in place.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

1.8 WARRANTY

A. Manufacturer’s Warranty: Provide the manufacturer's standard product warranty.

B. Installer’s Warranty: Include a copy of the Subcontractor’s Warranty for all work provided under the contract for construction for a term of 1 year after the Date of Substantial Completion.

C. Warranties shall be included in the Building Maintenance Manuals submitted to the Owner after the Date of Final Completion.

1.9 CLOSEOUT DOCUMENTS

A. Project Record Drawings: Record all changes as the work progresses on a set of project record drawings kept at the job site, and shall provide record drawings to the Owner after the Date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL

A. The word piping shall mean pipe, fittings, nipples, valves, etc. completely assembled.

2.2 DOMESTIC AND NON-POTABLE WATER SYSTEMS

A. Water Lines: Copper: Type "L" hard drawn, per ASTM B88-7, for all water pipe above concrete or ground.

B. Fittings: Wrought copper, per ANSI B16.18 and B16.22.

C. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

D. Identification: Color identify pipe with size of pipe manufacturer's trademark, and conform to the following schedule:

1. Type "L" Copper – Blue

E. Soft rolled copper coil for trap priming lines installed below grade

2.3 JOINING MATERIALS

A. Refer to individual piping sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.

E. Welding Filler Metals: Comply with AWS D10.12.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric Couplings: Galvanized-steel coupling with inert and non-corrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

F. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressures at 225 deg F.

2.5 SANITARY AND STORM DRAINAGE SYSTEMS

A. Waste & Vent Lines: Cast Iron - Aboveground: Provide cast iron no-hub soil and vent pipe, coated inside and out, conforming to CISPI 301-69T Specifications, for all soil and waste lines above ground and for all vent lines with inside diameter 2 inches and larger. Standard weight soil and waste fittings will be accepted throughout. Pipe shall conform to CISPI Standard 301.

1. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
   a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
   b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.

B. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

1. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought-copper, solder-joint fittings.

2.6 ACCESS DOORS

A. The Plumbing Installer shall furnish access doors for the Contractor's installation in finished work for concealed valves, cleanouts, and to concealed parts of the plumbing system that

require accessibility for proper operation, maintenance, and repair. Doors are not required for suspended acoustical ceilings with lift-out panels.

B. Access doors shall be of the proper size for respective concealed items, with minimum size exclusive of other requirements, 18" x 18". Access door shall be flush type, with No. 13 U.S. Standard Gauge Steel door and trim, concealed hinges and screwdriver operated, stainless steel cam lock. Access door shall be shop painted with one coat of zinc chromate primer.

2.7 VALVES

A. Ball Valves: Nibco-Scott #T595, or #S595, 150# bronze body chrome plated ball, Teflon seats.

B. Valve Manufacturers: Provide as manufactured by Crane Jenkens, Walworth, Kennedy, Stockham, or Nibco-Scott.

2.8 PIPE HANGERS AND SUPPORTS

A. Adequately support piping against sagging, pocketing, swaying, and displacement. Properly space and apply hangers to achieve the result, and not farther apart than the following:

B. Copper Tubing:

1. 1-1/4" and smaller, 6 foot on center
2. 1-1/2" and larger, 10 foot on center

C. Size all hangers on insulated lines to fit around outside diameter of insulation specified with allowance for sheet metal shield. Pipe shield shall be 169A, 1/3 circumference of insulation of a length of not less than 3 x diameter of the insulation (maximum 24").

D. Manufacturer: Grinnell Company catalog numbers are indicated to simplify the description, however, hangers and supports shall be Grinnell, Grabler, Fee & Mason, Elcen or approved equal.

E. Overhead Supported: Each horizontal pipe shall be supported on adjustable wrought iron clevis hangers equal to Grinnell, Figure 260, except that groups of pipes shall be supported on trapeze hangers made up of steel rods and steel channels or angles. Pipe shall be "U" bolted to trapeze and trapeze spaced for the smallest pipe in the group.

F. Wall Supported: Horizontal piping mounted on walls shall be supported by cast iron bracket similar to Grinnell Figure 213, with Figure 260 Clevis type hanger attached.

G. Vertical Piping: Vertical piping shall be supported at floor level with Grinnell, Figure 261 supports, or equal.

H. Inserts: Inserts in concrete shall be similar to Grinnell, Figure 281 and shall be supplied and installed by this contractor.

2.9 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.10 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated and rough brass.

C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

2.11 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.12 PLUMBING SYSTEM INSULATION

A. All insulation shall be applied in a neat and workmanlike manner. Remove and replace all insulation not applied in strict accordance with manufacturer's specifications or not presenting a neat appearance. Insulation shall be continuous through wall and ceiling openings and sleeves.

B. Work Included: Pipe covering for non-potable & domestic hot and cold water piping. Condensate drainage piping below raised floors does not require insulation.

C. Materials and Installation: No pipe insulation shall be applied until piping has been pressure tested and approved. All insulation shall be applied strictly in accordance with the manufacturer's recommendations. Materials as manufactured by Johns Manville, Fiberglass, Phillip Carey, or Armstrong will be acceptable if equal to those specified. All insulation on indoor work shall have composite fire and smoke hazard ratings as tested by procedure NFPA 255 not exceeding: Flame Spread 25, Fuel Contributed 50, Smoke Developed 50. Accessories, such as adhesives, mastics, cements, tapes, and cloth for fitting, shall have the same component ratings as listed above. Insulation shall have an average thermal conductivity not to exceed 0.25 BTU/inch of thickness per square foot per 1 degree F. at a mean temperature of 75 degrees F.

D. Non-Potable Water and Potable Water: All water piping and similar piping as further referenced, shall be insulated with 1" thick fiberglass insulated with foil kraft laminated vapor barrier fastened with pressure sensitive tape and staples 1" O.C. All fittings, valves, strainers, flanges, etc. shall be covered with a PVC fitting cover, taped and tack fastened. Condensate drainage piping below raised floors does not require insulation.

2.13 PIPE MARKERS

A. Pipe markers shall be Setmark wrap-around markers by Seton Nameplate Corporation. Markers shall be cylindrically coiled plastic sheets for pipes up to 4” size, and flat plastic wrap-around markers with nylon ties for 6” size and above. Markers shall be rated for a service temperature of 32º to 150º F. Pipe markers shall have lettering size based on pipe diameter, to be easily readable without overlapping.

2.14 EQUIPMENT TAGS

A. Valve tags shall be stock brass valve tags as manufactured by Seton Nameplate Corporation. Tags shall be 19 gauge thickness, 1½"diameter, with ¼" black-filled legend and ½" black-filled number.

B. Equipment tags shall be laminated plastic, minimum 1½" high, white background with ½" black-filled lettering. Furnish tags for equipment in system:

1. Trap priming units
2. Eyewash units

2.15 TRAPS

A. All floor drains are to be separately trapped as near to the floor drain as possible. Traps shall be self-cleaning, water-sealed, and shall have a scouring action. Traps shall be set true with respect to water seal. Traps shall be of the same material and size as pipes or branches into which they discharge.

2.16 VENTS

A. Connect vent piping to new vent through roof as indicated on the drawings.

2.17 CLEANOUTS

A. Where indicated on the drawings and as required by local plumbing code. Make all cleanouts accessible by one of the following means:

1. End cleanout, above removable ceiling tiles, or
2. Extending to floor or grade above.

B. Size: Same as pipe on which installed.

C. Installation: Covers set flush with finished floor or grade, to be securely anchored by means of integral lugs or bolts. Where surfacing materials such as resilient floor covering is used, install the clean out with top so that finished surface is smooth and flush.

D. Manufacturers: Cleanout products shall be as manufactured by Zurn.

E. End Cleanouts: Model Z-1470 bronze cleanout plug.

2.18 TRAP PRIMING UNITS (TP)

A. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Precision Plumbing Products, Inc.
2. Approved equal

B. Pre-assembled electronic timed trap priming unit

1. Atmospheric vacuum breaker
2. 120-volt solenoid valve
3. Preset 24 hour clock
4. Manual over ride switch
5. ¾" FNPT connection
6. Calibrated manifold for equal water distribution
7. ½" outlet compression fittings
8. Surfaced mounted 16-ga. steel cabinet with prime coat
9. Cylinder lock

2.19 EMERGENCY EYEWASH

A. Fendall 2000, 15 minutes flow duration, 6.87 gallons reservoir, wall mounted, 100% sterile saline solution, meets ANSI Z358.1-2009 requirements. Provide with wall mounting bracket, integrated waste containment, audio alarm, and alarm silencing button. Install where noted on the plan in each battery room.

PART 3 - EXECUTION

3.1 EXISTING CONDITIONS

A. Examine the areas and conditions under which work of this section will be provided, shall correct conditions detrimental to the timely and proper completion of the work, and shall NOT proceed until unsatisfactory conditions are corrected.

3.2 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to General Contractor.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.3 PIPING APPLICATIONS

A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.

B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

C. Aboveground, soil, waste, and vent piping shall be any of the following:

1. Service class, hub-and-spigot, cast-iron soil pipe and fittings, gaskets and compression joints.
2. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless steel couplings and hubless-coupling joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Layout the plumbing system in careful coordination with the drawings, determining proper elevations for all components of the system and using only the minimum number of bends to produce a properly operating system.

B. Follow the general layout shown on the drawings in all cases except where other work may interfere. Layout pipe runs to fall within the partition, wall or roof cavities, with no additional furring other than as specifically shown on the drawings.

C. Drainage and Vent Piping Systems:

1. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
2. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
3. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
4. Building Sanitary Drain and Horizontal Sanitary Drainage Piping:
   a. 2 percent (1/4” per foot) downward in direction of flow for piping NPS 3 and smaller
   b. 1 percent (1/8” per foot) downward in direction of flow for piping NPS 4 and larger
5. Vent Piping:
   a. 1 percent (1/8” per foot) down toward vertical fixture vent or toward vent stack
6. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
7. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

D. Drainage Specialties:

1. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   a. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   b. Locate at each change in direction of piping greater than 45 degrees.
   c. Locate at minimum intervals of 50 feet for piping NPS 3 and smaller and 100 feet for larger piping.
   d. Locate at base of each vertical soil and waste stack.
2. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
3. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   a. Position floor drains for easy access and maintenance, as indicated on the drawings.
   b. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   c. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
4. Install deep-seal traps on floor drains and other waste outlets.
5. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
6. Install air-gap fittings on indirect-waste piping discharge into sanitary drainage system.
7. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

E. Water Piping Systems:

1. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

2. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
3. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
4. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
5. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
6. Install piping to permit valve servicing.
7. Install piping at indicated slopes.
8. Install piping free of sags and bends.
9. Install fittings for changes in direction and branch connections.
10. Install piping to allow application of insulation.
11. Select system components with pressure rating equal to or greater than system operating pressure.
12. Install escutcheons for penetrations of walls, ceilings, and floors.
13. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
14. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
15. Verify final equipment locations for roughing-in.
16. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.5 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
2. Hubless Joints: Make with rubber gasket and sleeve or clamp.

H. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.6 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

B. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

C. Install piping adjacent to equipment to allow service and maintenance.

3.7 INSTALLATION OF PIPING AND EQUIPMENT

A. General:

1. Make changes in directions with fittings; make changes in main sizes with eccentric reducing fittings. Unless otherwise noted, install water supply piping with straight side of eccentric fittings at top of the pipe.
2. Run horizontal sanitary drainage piping at a uniform grade of 1/8" per foot, unless otherwise noted. Run horizontal water piping with an adequate pitch upwards in direction of flow to allow complete drainage.
3. Provide sufficient swing joint, ball joints, expansion loops, and devices necessary for a flexible piping system, whether or not shown on the drawings.
4. Support piping independently at equipment, and similar locations, so that the weight of the pipe will not be supported by the equipment.
5. Securely bolt all equipment, isolators, hangers, and similar items in place.
6. Support each item independently from other pipes. Do not use wire for hanging or strapping pipes.
7. Provide complete dielectric isolation between ferrous and non-ferrous metals.
8. Provide union and shut-off valves suitably located to facilitate maintenance and removal of equipment and apparatus.
9. Install offsets, swing joints, expansion joints, pipe clamps, and anchors as required to permit expansion and contraction of piping system.
10. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
11. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
12. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.
13. Install equipment to allow right of way for piping installed at required slope.

B. Workmanship:

1. Install all work pertaining to water, and drainage system as close as possible to layout shown on the drawings. Drawings are generally diagrammatic and all fixtures, equipment, and specialty items are to be located as shown on the drawing.
2. Connection to Equipment: Provide all plumbing and piping connections to equipment as specified including P-traps, and valves. Install valved and capped connections where indicated for continuation by others. Provide valves, ahead of all capped outlets.
3. Inspections: No piping in any location shall be concealed until it has been inspected and approved. All concealed work shall remain uncovered until tests have been completed. The drainage system shall be tested and proved tight under a water pressure test with nipples, ferrules, and connections being in place. All tests shall be conducted in the presence of the authorities having jurisdiction. If leaks or defects develop, new tests shall be made and repeated until all defects are remedied. Pipes or joints which leak shall be taken apart and be remade. No caulking shall be permitted. All labor, materials, as well as all costs and apparatus necessary for all tests, shall be furnished.
   a. Water System: 150 psi hydrostatic pressure held for four (4) hours.
   b. Soil and Vent System: Test by filling with water to highest point in the system.
   c. The water shall be applied to the drainage system either in its entirety or in sections. If applied to the entire system, all openings shall be tightly plugged except at the highest point of the section under test. Each section shall be filled with water, but no section shall be tested at less than a 10 foot head of water. In testing successive sections, at least the upper 10 feet of the previously tested adjacent section shall be tested so that no joint or pipe in the building shall have been submitted to a test of less than a 10 ft. head of water. The water shall be kept in the system or in the portion under test for at least 15 minutes before the inspection starts. The system shall then be proved tight at all points.
   d. After all plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and watertight.
4. Flushing and draining of system and cleaning of piping. Fill all piping systems with water and drain these systems before they are placed in operation, in order to remove foreign materials that may have been left on or deposited in the piping system during installation.
5. Clean-Up: Before acceptance of the work, clean all fixtures, trim and exposed piping, flush out all lines and leave the system ready for operation.

3.8 PIPE SUPPORTS

A. Support suspended piping with clevis or trapeze hangers and rods in accordance with products section.

B. Provide sway bracing on hangers longer than 18".

C. Support vertical piping with riser clamps secured to the piping and resting on the building structure. Provide at each floor unless otherwise noted.

D. Provide insulation continuous through hangers and rollers. Protect insulation by galvanized steel shields.

E. Arrange pipe supports to prevent excessive deflection, and to avoid excessive bending stress.

F. Do not support piping from inserts or anchors in concrete slabs. Provide trapeze hangers supported from structural steel components where required.

G. Hubless Piping:

1. Provide hangers on the piping at each side of, and within 6" of, hubless pipe coupling so the coupling will bear no weight.
2. Do not provide hangers on couplings.
3. Provide hangers adequate to maintain alignment and to prevent sagging of the pipe.
4. Make adequate provision to prevent shearing and twisting of the pipe and the joint.

H. Pipe hangers and supports:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

I. Support vertical piping and tubing at base and at each floor.

J. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

K. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

L. Install supports for vertical cast-iron soil piping every 15 feet.

M. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 72 inches with 3/8-inch rod.
2. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
3. NPS 2-1/2: 108 inches with 1/2-inch rod.
4. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
5. NPS 6: 10 feet with 5/8-inch rod.

N. Install supports for vertical copper tubing every 10 feet.

O. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.9 SLEEVES AND OPENINGS

A. Provide sleeves for each pipe passing through walls, partitions, floors, roofs, and ceilings.

1. Set pipe sleeves in place as early as practicable.
2. For uninsulated pipe, provide sleeves two pipe sizes larger than the pipe passing through, or provide a minimum of 1/2" clearance between inside and outside of the pipe.
3. For insulated pipe, provide sleeves of adequate size to accommodate the full thickness of pipe covering, with clearance for packing and caulking.

B. Caulk the space between sleeve and pipe or pipe covering, with sealant as specified in the Sealants and Caulking Section, or pack with non-combustible packing material to within 1/2" of both wall faces and caulk.

C. Finish and Escutcheons:

1. Smooth up rough edges around sleeves with plaster or spackling compound.
2. Provide 1" wide chrome or nickel plated escutcheons on all pipes exposed to view where passing through walls, floors, partitions, ceilings, and similar locations. Size the escutcheons to fit pipe and covering. Hold escutcheons in place with set screw.

3.10 CLEANOUTS

A. Secure Architect approval of locations for cleanouts in finished areas prior to installation.

B. Provide cleanouts of same nominal size as the pipes they serve; except where cleanouts are required in pipes 4" and larger provide 4" cleanouts.

C. Make cleanouts accessible. After pressure tests are made and approved, thoroughly graphite the cleanout threads.

3.11 VALVES

A. Provide valves in water systems. Locate and arrange so as to give complete regulation of apparatus, equipment and fixtures.

B. Provide valves in at least the following locations:

1. In branches of water piping.
2. On both sides of apparatus and equipment.
3. For shutoff of risers and branch mains.
4. For flushing and sterilizing the system.
5. Where shown on the drawings.

C. Locate valves for easy accessibility and maintenance.

3.12 BACKFLOW PREVENTION

A. Protect other equipment having plumbing connection, against possible back siphonage.

B. Apply for permitting and arrange for testing of backflow devices as required by the local jurisdiction.

3.13 DISINFECTION OF WATER SYSTEMS

A. Disinfect cold water system additions and alterations:

1. Notify the Contractor at least 48 hours prior to start of the disinfection process.
2. Upon completion of disinfecting, secure and submit the Sterilization Certificate of Performance as part of the Closeout Documents specified elsewhere in this Section. The Sterilization Certificate of Performance must state capacity, disinfectant used, time and rate of disinfectant applied, and required residuals in ppm at completion.
3. Sterilization of Water Piping: After the domestic water piping has been pressure tested, the new portion system shall be thoroughly sterilized in accordance with the requirements of the health department having jurisdiction or, in the absence of such requirements, with a solution containing not less than 100 parts per million of available chlorine. The chlorinating materials shall be either liquid chlorine or U.S. Army Specifications 4-1, or calcium hypochlorite or chlorinated lime conforming to Federal Specifications O-C-114 and shall be introduced into the system in accordance with Federal Regulations. The sterilization solution shall be allowed to remain in the system for a period of 24 hours, during which time, all valve and faucets shall be opened and closed several times. After the sterilizing agent has been applied for 24 hours, test for residual chlorine at the ends of the lines. If less than 5 ppm is indicated, repeat the sterilization process. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million.

3.14 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

3.15 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.16 LABELING AND IDENTIFYING

A. Install equipment nameplates or equipment markers on fixtures and equipment signs on water-tempering equipment.

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each piece of equipment and valve.

C. General: Install pipe markers of one of the following types on each system and include arrows to show normal direction of flow:

1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

D. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
4. At access doors, manholes and similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 20' along each piping run. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

E. General: Provide valve tag on every valve, cock and control device in each piping system. List each tagged valve in a valve schedule for each piping system.

1. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room

3.17 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 23 00 10
GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Contract and General and Supplementary Conditions and Division 1 Specifications are hereby made a part of Division 23 as fully as if repeated herein. Where provisions of Division 1 conflict, the greater or more strict shall prevail.

B. This Section includes general administrative and procedural requirements for mechanical installations. The requirements included in this Section expand the requirements specified in Division 1.

C. Examine all Divisions of the specifications and drawings to determine the complete Scope of the mechanical work mechanical work shall comply with the requirements indicated in all sections of Division 23.

D. The work to be done under Divisions 23 of the Specifications shall include the furnishing of all labor, material, equipment, tools and appurtenances and performing all operations necessary to provide complete, fully functional systems in accordance with the Specifications, the Drawings and requirements of the applicable codes and standards listed herein. Where the specifications, drawings and applicable codes and standards conflict provide the greater or more strict requirement.

E. Visit areas of construction where Work is to take place, and examine the construction site carefully, noting locations and conditions under which the Work will be performed and accepting the responsibility for performing the Work under the existing conditions.

F. The work shall include the following specification sections:

Division 23 - Heating Ventilating and Air Conditioning

23 05 00 Common Work Results for HVAC

230513 Common Motor Requirements for HVAC Equipment

23 05 29 Supports and Anchors

23 05 53 Mechanical Systems Identification

23 07 00 Insulation

23 08 00 Mechanical General Commissioning Requirements

23 08 13 Testing, Adjusting and Balancing

23 09 00 Building Automation System

232300 Refrigerant Piping

23 30 00 Ductwork and Accessories

233600 Air Terminal Units

23 74 13 Packaged Rooftop Ventilation Units

238125 DLR Refrigerant Based Precision Cooling System

23 84 13 Humidifiers

G. The work shall include, but not be limited to, providing equipment and items listed below and installing items furnished under other Divisions of these specifications.

1. Supplementary steel, channel and supports.
2. All materials and appurtenances that can reasonably be inferred to be a part of the mechanical systems and necessary to its proper operation, but not specifically mentioned or indicated on the drawings, shall be furnished and installed without additional charge.
3. Touch-up painting of prefinished equipment furnished or damaged.
4. Fire stopping, smoke, acoustical and environmental seals.
5. Furnish, erect, maintain, relocate, and remove all hoisting, rigging, staging and scaffolding required to perform the work of this Section of the specifications.
6. Provide core drilling through concrete provide steel reinforcement and metal decking. Provide required sleeves.
7. Compliance with construction requirements and procedures to qualify for LEED points.
8. Attendance at and support of Integrated Testing of all systems. Include time for owner's Level 5 Integrated Systems Testing to be scheduled after completion of Level 4 Acceptance Testing. Include time to assist in producing and providing owner's required paperwork and documentation plus the equivalent of five 12-hour days for a foreman and three senior installers/technicians to assist and operate equipment during testing.
9. Coordinate with the building trades:
    1) Structural members, pads, and building openings for mechanical equipment, ducts, piping, fans, etc., for use by this Contractor shown on the architectural and structural plans are the coordination responsibility of the mechanical contractor. Any changes in the above requirements after letting and accepting the mechanical contract will be paid for by this Contractor.
    2) Provide full time superintendent who shall oversee and coordinate the work with other trades and the A/E.
10. Coordinate with Owners equipment and piping systems:
    1) This Contractor shall coordinate the layout of his work with the Owner to avoid conflict with the installation of the Owner's equipment and / or piping systems.
11. Coordinate with electrical work:
    1) All motor starters, relays, contactors, etc. for packaged equipment shall be provided by this Contractor and shall meet the requirements of Division 26 Specifications.
    2) All other motor starters shall be provided by the Division 26 as part of motor control centers, unless otherwise indicated in Division 26 specifications or as indicated on the electrical drawings.
    3) All control wiring for control devices, magnetic coils, damper operators, etc. shall not exceed 120 volts. Where power voltage for equipment is over 120 volts, a transformer shall be provided and wired for the controls.
    4) 120 volt power wiring to solenoid and control valves, variable air volume terminals, damper operators, etc. is to be done under this Division 23, work by the Automatic Control Contractor, unless shown on the Electrical Drawings.
    5) 120 volt power source will be made available, under Division 26, at the distribution breaker panels as indicated on the electrical drawings.

1.2 RELATED WORK

A. The following items of labor and material incidental and/or related to the installation of the Mechanical Work are specified under other Divisions of these Specifications unless specifically

indicated otherwise. Provide and assist and coordinate work to meet requirements indicated in the Specifications and on the Drawings.

1. Cutting and patching in accordance with the requirements under Division 1.
2. Temporary HVAC services including consumption fees are to be provided by the General Contractor in accordance with Division 1.
3. Controlled environmental conditions for mechanical equipment per the manufacturer's recommendations or as specified in this Division is to be provided by the General Contractor.
4. Excavation and backfilling, Division 2.
5. Concrete work including forms for housekeeping pads for equipment, Division 3.
6. Reinforcing steel, Division 5.
7. Sealing penetrations through fire or smoke rated partitions, Division 7.
8. Watertight penetrations through roof, Division 7.
9. Flashing and caulking, Division 7.
10. Setting of frames for access panels, Division 8.
11. Painting of all equipment and material other than touch up of prefinished fixtures, equipment and other Mechanical components, Division 9.
12. Utility (water, gas, steam) back charges will be paid by the General Contractor with no additional markups allowed. Refer to Section 01005 for Utility back charges.

B. The following items incidental and/or related to the installation of the mechanical work will be furnished by others and wired and/or installed under this Section.

1. Install duct smoke detectors in ductwork per NFPA 72 under Division 23. Division 28 shall furnish quantity required to meet the installation requirements of NFPA 72.

C. Furnish the following items for installation by others and provide coordination, cooperation, assistance and wiring as required:

1. Pitch pocket or approved roofing penetration material for piping penetrations for installation under Division 7.
2. Furnish access panels as required for mechanical work behind finished surfaces or otherwise concealed for installation under Division 8.

D. Install items purchased by others, coordinate delivery and be responsible for unloading from delivery vehicles, rigging, and for safe handling and field storage up to the time of installation. This Section shall be responsible for:

1. Coordination of delivery and shipping splits for size and weight restrictions of the project site.
2. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
3. Connection to building systems including the purchase and installation of all terminating fittings, lugs, etc. necessary to adapt and connect them to the building systems.
4. Provide all work indicated in the specifications and on the drawings related to the pre-purchased items that are not specifically indicated as pre-purchased.
5. Carefully examine such items upon delivery, and advise the General Contractor and Owner of any damages or defects noted, as well as the shipper.
6. Installation, testing, coordination of vendor’s work and responsibilities and compliance with warranty coverage, requirements and support.

E. Prepurchased equipment furnished by the owner:

1. Chillers
2. Computer Room Air Conditioners
3. Packaged Pumping System (PPS)

F. Work by Owner:

1. Refer to Division 1 for additional requirements and information.

2. Accommodate concurrent work provided by owner.

G. Existing Materials:

1. All existing equipment and materials to be reused is assumed to be in good operating condition.
2. Any existing mechanical equipment to be reused found to be defective, upon commencement of this contract, shall be reported to the Architect.
3. Guarantee all replacement work, equipment or materials for a period of one year from date of acceptance by the Engineer.

1.3 COORDINATION OF THE WORK

A. Refer to Division 1 for additional requirements for coordination of the Work including Section 013100 Project management and coordination.

B. Before submitting bid examine all Drawings and Specification, including other Divisions, for requirements that affect work of this Division and include it in the scope of work for this section whether or not such work is specifically mentioned in this Division. Be responsible, under this Division of the Specifications, for the proper coordination of the mechanical work with the installations under other Divisions, including proper clearances. Any changes required to avoid interferences shall be submitted to the Engineer for approval and shall be made as approved, without additional cost to the Owner.

C. Coordinate work with that of all other trades affecting or affected by work of this Division. Cooperate with such trades to ensure the steady progress of work under the contract.

D. Coordinate work with the General Contractor and the project schedule. Provide manpower and materials as required to meet the schedule and not to interfere with or impede the progress of or increase the cost of work by others. Submit shop drawings and order equipment in a timely manner. Expedite deliveries and manufacturing as required.

E. Deliver products to the project in a timely manner to meet all schedule requirements, properly identified with names, model numbers, compliance labels and other information needed for identification.

F. Install materials and apparatus as fast as conditions of the building will permit. Materials and apparatus must be installed when directed and in the fashion specified. Examine the Architectural Drawings for the location of suitable openings and aisles for the passage of equipment to be installed under this Section. The installer shall be responsible for having suitable openings and aisles left open until his equipment has been properly installed. If necessary, request the vendor to ship equipment in sections sized to permit passage. Provide sleeves, pockets, supports and incidentals.

G. Examine the drawings and the building construction for weight and size restrictions. Provide equipment and installation methods to comply with restrictions including shipping split sizes, weights, and disassembled components as required. Obtain manufacturer's approval and assurance warranty will be honored.

H. Prepare and submit coordination drawings in conjunction with the other Trades, on common drawings of at least 3/8"=1'-0", as directed by the General Contractor. Each system shall be color-coded, and for CAD drawings, each system shall be on a different layer. Meet to resolve conflicts between the various Installers prior to submission to the Engineer for review. Identify conflicts resolved that include changes to the design. Note on coordination drawings submitted to the Engineer any conflicts that the trades could not resolve. The Engineer will provide direction that all Installers will comply with, at no additional cost to the project. In general, distribution systems which require pitch or slope such as plumbing drains, steam and condensate piping shall have the right of way over those which do not. Lighting fixtures have minimal flexibility and should not be moved without prior approval. Install work to avoid

interferences and to allow proper clearance around all trades' work for access, maintenance and as required by code. Prepare coordination drawings in the following order (subject to above): HVAC (with lighting fixtures indicated), plumbing, fire protection, electrical and telecommunications systems. Work installed prior to complete and reviewed coordination drawings must be corrected as required at no additional expense to the project.

I. Coordination Drawings:

a. General: Electronic copies of CAD Drawings of the Contract Drawings will be provided by A/E for Contractor's use in preparing coordination drawings
   1) A/E makes no representations as to the accuracy or completeness of CAD Drawings as they relate to the Contract Drawings.

b. Prepare and submit coordination Drawings where close and careful coordination is required for installation of products and materials fabricated off-site by separate entities, and where limited space availability necessitates maximum utilization of space for efficient installation of different components.
   1) Show the interrelationship of components shown on separate Shop Drawings.
   2) Indicate required installation sequences.
   3) Comply with requirements contained in Section "Submittals."

c. Prepare coordination drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, ductwork, piping, conduits and systems of mechanical 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 piping, ductwork, equipment, and materials. Include the following:
      a) Clearances for installing and maintaining insulation.
      b) Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
      c) Equipment connections and support details.
      d) Exterior wall and foundation penetrations.
      e) Fire-rated wall and floor penetrations.
      f) Sizes and location of required concrete pads and bases.
      g) Valve stem movement.

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, communication systems components, sprinklers, and other ceiling-mounted items.

d. Submit one set of CAD Coordination Drawings, and three sets of CAD Coordination Drawing plots.

J. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated request information from Architect.

K. Check Contract Drawings as well as Shop Drawings of all Installers and vendors to verify and coordinate space in which work of this section will be installed.

L. Obtain from manufacturers the proper method of installation and connection of the equipment that is to be furnished, installed or wired. Obtain all information that is necessary to facilitate the work and to complete the project.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Refer to Division 1 for additional requirements for quality assurance and control of the installation.

B. Receive, handle, house, and protect equipment required for installation under this specification. Replace damaged equipment with new equipment. Provide environmental requirements per NFPA 70B and manufacturer's requirements during shipping, storage and installation.

C. Review submittals of equipment furnished under other Divisions prior to installation and rough-in. Verify location, size, and required connections. Coordinate details of equipment connections with supplier and installer.

D. Utilize installers with at least five years experience in the type of work to be performed.

E. Manufacturers shall be companies experienced in manufacturing products specified for a minimum of five years.

F. Be responsible for the care and protection of all work included in this Section until it has been tested and accepted.

G. Protect all equipment and materials from damage from all causes including theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment.

H. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen and make good any damage caused.

I. Provide workmanship in accordance with the best accepted practices. Rework installations judged by the Engineer as unacceptable.

1.5 REGULATORY REQUIREMENTS

A. Refer to Division 1 for additional regulatory or reference requirements.

B. Arrange and pay for permits, licenses, inspections and certificates. Give the proper Authorities all requisite notices or information required relating to the work under this Section. Request inspections from Authorities having jurisdiction. At the conclusion of the work, deliver certificates of inspection from authorities having jurisdiction to the Owner's Representative.

C. Provide products listed and classified by an OSHA certified Nationally Recognized Testing Laboratory (NRTL) as suitable for purpose specified and indicated. Provide NRTL-listed material and equipment where standards are available. Notify Engineer of any material or equipment that is not NRTL listed when submitting information.

D. Perform work in strict accordance with the rules, regulations, listing or labeling requirements, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities having legal jurisdiction over the site. No additional compensation shall be granted for work that must be changed as a result of the work not originally complying with the codes, standards, local requirements, etc.

E. Equipment and installation shall be suitable for the Seismic requirements indicated in the Building Code for the location and usage.

1. Component Importance factor is 1.0
2. Seismic Design Category is A
3. Site Class is C

4. Building Classification (Occupancy Category) per ASCE 9- category II

F. Materials and equipment shall be manufactured, installed and tested as specified in the latest and required editions of applicable parts of the following publications, standards and rulings of:

1. AABC Associated Air Balance Council
2. AASHTO American Association of State Highway and Transportation Officials
3. ACPA American Concrete Pipe Association
4. ADC Air Diffusion Council
5. AFBMA Anti-Friction Bearing Manufacturers Association
6. AGA American Gas Association
7. AIHA American Industrial Hygiene Association
8. AISC American Institute of Steel Construction
9. AISI American Iron and Steel Institute
10. AMCA Air Movement and Control Association
11. ANSI American National Standards Institute
12. API American Petroleum Institute
13. ARI Air Conditioning and Refrigeration Institute
14. ASA Acoustical Society of America
15. ASC Adhesive and Sealant Council
16. ASHRAE American Society of Heating, Refrigerating
17. ASME American Society of Mechanical Engineers
18. ASPE American Society of Plumbing Engineers
19. ASSE American Society of Sanitary Engineering
20. ASTM American Society for Testing and Materials
21. AWS American Welding Society
22. AWWA American Water Works Association
23. CAGI Compressed Air and Gas Institute
24. CGA Compressed Gas Association
25. CISPI Cast Iron Soil Pipe Institute
26. CRSI Concrete Reinforcing Steel Institute
27. ETL ETL Testing Laboratories, Inc.
28. FM Factory Mutual Engineering and Research Organization
29. IEEE Institute of Electrical and Electronic Engineers
30. ISA Instrument Society of America
31. MCAA Mechanical Contractors Association of America
32. MSS Manufacturers Standardization Society of the Valve and Fittings Industry
33. NEC National Electric Code (Now NFPA)
34. NEMA National Electrical Manufacturers Association
35. NFPA National Fire Protection Association
36. NSF National Sanitation Foundation
37. PCA Portland Cement Association
38. PDI Plumbing and Drainage Institute
39. SMACNA Sheet Metal and Air Conditioning Contractors National Association
40. SSPMA Sump and Sewage Pump Manufacturers Association
41. SWPA Submersible Wastewater Pump Association
42. TIMA Thermal Insulation Manufacturers Association
43. UL Underwriters Laboratories
44. WSC Water Systems Council

G. Where conflicts occur among the codes, ordinances, standards, Drawings or Specifications, the more restrictive requirements shall govern.

H. The Drawings and Specifications do not undertake to repeat requirements written or all work required in the above codes, ordinances and standards.

I. Comply with applicable codes and regulations regarding toxicity of combustion products of materials used.

J. Legally dispose of all material. Adhere to all regulations regarding disposal of hazardous material. Recycle hazardous material where recycling is possible. Submit certificates of legal recycling or disposal to the Architect. Include copy in the Owner and Maintenance Manual.

K. Public utility back charges will be paid for by the Owner and are not to be included in the base bid. Submit charges to Owner without markups, for Owner to process directly or as a change order to the Contract. Markups on utility back charges will not be allowed.

L. Nothing in these Contract Documents shall be construed to permit work not conforming with applicable codes and regulations. When conflicts occur the more restrictive requirements shall govern.

M. Should the Facility have established building standards, rules or regulations, obtain a copy from the Building Owner and comply with them.

1.6 SUBMITTALS

A. Provide and submit under provisions of Division 1 and as indicated herein.

B. Submit at time of bid any equipment or materials that have lead times that will affect the construction schedule. Provide alternate costs to expedite delivery and manufacturing so that the project schedule can be accomplished.

C. Submit at time of bid, any proposed substitutions. List reasons the owner should accept substitutions including improved performance or equal performance and improved delivery time. Acceptance of substitutions is subject to acceptance by the Engineer, whose decision will be final. A substitution is considered to be any manufacturer or product not specifically identified in the specifications or drawings. If only performance requirements are indicated, and no specific manufacturer is indicated, then a manufacturer meeting the contract document requirements is not considered a substitute.

D. Substitutions of specifically indicated items will be reviewed only if identified at time of bid, otherwise submittals will be returned rejected. It is the proposer's responsibility to submit the first time, all information required to prove equality and a written letter on the proposer's letterhead indicating that the item is in full compliance with the Contract Documents and will fit in the designated location. Include in bid, coordination of all work and all costs for all trades for any work that may be required, including any architectural or engineering fees, to accommodate the substitution. Acceptance of the proposed substitution is up to the Engineer and is not assured. Review will include, but is not limited to, quality, life cycle costs, size, appearance, construction, manufacturer, service record, efficiency, dependability, performance, etc.

E. Submit for review, within 10 days after being given Notice to Proceed and prior to the submission of any shop drawings, an itemized list of manufacturer's of material and equipment and of firms or subcontractors proposed to be used to perform the work. Include a list of submissions and the proposed schedule to submit them, so that based on the approval times and procedures indicated below, the proposed project schedule will be accomplished. FAILURE TO SUBMIT WITHIN THE TIME LIMIT OF 10 DAYS WILL BE CONSIDERED A CONTRACT VIOLATION and will require that all items will be provided in a timely manner to maintain the schedule and all costs required to meet the schedule are included to expedite delivery and manufacturing.

F. After approval of the list and schedule, submit 8 sets of detailed Shop Drawings and product Data per the submission schedule or within 30 days or sooner if required to meet the construction schedule. Substitutions will not be accepted for failure to comply with the schedule above.

G. Submit related shop drawings at one time. SUBMIT ALL ITEMS IN A SPECIFICATION SECTION AT THE SAME TIME. Incomplete submittals will be held until a complete submittal is accumulated.

H. The review of systems, equipment and Shop Drawings is a general review subject to the Contract Drawings, specifications and verification of all measurements at the job. Review does not relieve the installer from the responsibility of Shop Drawing errors or complying with the Specifications and Drawings. Carefully check and correct all Shop Drawings prior to submission for approval. Regardless of any information included in the shop drawings submitted for review, the requirements of the Contract Documents shall not be superseded in any way by the Shop Drawing Review.

I. Mark submittals to clearly identify (including when photocopied) proposed equipment including their accessories, options, and modifications and exclude parts not applicable to the Project, otherwise the Engineer will identify items and options to be provided at no additional cost to the project.

J. Each submittal shall be reviewed, stamped and certified prior to submission to the Engineer. Such certification shall be made by a person duly authorized to sign binding Agreements for the Contractor. The certification shall state that the data and details contained on each Shop Drawing, layout drawing, catalog data and brochure has been reviewed by the Contractor for conformance to the contract documents and that it complies with the Contract Documents in all respects. Submittals will not be reviewed and will be returned to the Contractor unchecked unless they are certified.

K. It is intended that Submittals be complete and accurate at the first submission. If the Submittal is returned marked "Resubmit," only one additional submittal will be permitted. If the second Submission is not acceptable, the right of selection will be lost and the Engineer will specify exactly what is required and the specified products shall be provided at no additional cost to the Project.

L. A minimum period of two weeks, exclusive of transmittal time, will be required by the Engineer's office each time Submittals are submitted or resubmitted for review. This time period shall be considered when scheduling the work, and any costs associated with expediting equipment delivery to meet the Schedule will be at no additional cost to the Owner. Submittals of numerous items at the same time may extend the time needed for review, so plan accordingly.

M. Provide submittals in a timely manner sufficiently in advance to give ample time for checking, correcting, resubmitting and rechecking if necessary. No claim for delay or additional costs will be granted for failure to comply with this requirement.

N. If proposed equipment deviates from the Specifications or Drawings, indicate those differences and provide sufficient data to justify acceptance. FAILURE TO INDICATE DEVIATIONS OR SUBSTITUTIONS IMPLIES FULL COMPLIANCE WITH DRAWINGS AND SPECIFICATIONS.

O. Indicate clearly all equipment, components or assemblies that are not NRTL listed or labeled. Failure to indicate otherwise implies NRTL listing or labeling.

P. Provide products of one manufacturer for each classification of equipment.

Q. Meet Project requirements including space, size and weight restrictions before submitting to Engineer. Equipment shall be of proper size for its allocated space. Equipment may be disassembled so that it can be installed through available openings only if it will not invalidate manufacturer's warranties.

R. At the job site, maintain the latest equipment submittals showing the action taken by the Engineer. Make these submittals available to Engineer.

S. Any items with a tag number must be submitted for approval. Submittals shall provide all pertinent data and information necessary to evaluate each item. Certified Drawings and catalog data sheets shall show:

1. Applicable specification section number and equipment tag number.
2. Principal dimensions and details of construction.
3. Weights of principal parts and total weights with information required for the design of supports and foundations.
4. Sizes and locations of piping and connections.
5. Performance data, including pump and fan curves; fan discharge and inlet noise data; certified by the manufacturer for the equipment furnished.
6. Data on electric motors, including brake HP of driven equipment, nameplate ratings and classes, and starting and running full load currents.
7. Approval stamp of Underwriters and other authorities having jurisdiction of drawings requiring such approval.
8. Submit Schedule of proposed piping fitting, valves, specialties, etc. along with manufacturer's catalog data.
9. Automatic temperature control system including diagrammatic layout of piping, wiring, control devices, and equipment, and detailed descriptions of each item of equipment and its function in the system and system operation.
10. Refrigeration for field-assembled systems including description of specialties and pressure drops, layout of piping with lengths, fittings, and refrigerant specialties, and capacity curves for evaporator and compressor showing balance points.
11. Product Data: Submit catalog data sheets or other published materials showing appearances, electrical ratings characteristics and connection requirements, performance characteristics, dimensions, weights, installation methods, and space requirements of mechanical equipment and their accessories, as listed below and required by the individual sections.

T. Shop Drawings: Submit shop drawings (drawn to scale) indicating physical size and arrangement, (plans and elevations) construction details, provisions for conduits, access requirements for installation and maintenance, finishes, and materials used in fabrication. Supplement Shop Drawings with wiring diagrams and information as described under Product Data. Provide Shop Drawings for the following and as required by the individual sections:

Division 23 - Heating Ventilating and Air Conditioning

23 05 00 Common Work Results for HVAC

230513 Common Motor Requirements for HVAC Equipment

23 05 29 Supports and Anchors

23 05 53 Mechanical Systems Identification

23 07 00 Insulation

23 08 00 Mechanical General Commissioning Requirements

23 08 13 Testing, Adjusting and Balancing

23 09 00 Building Management System

232300 Refrigerant Piping

23 30 00 Ductwork and Accessories

233600 Air Terminal Units

23 74 13 Packaged Rooftop Ventilation Units

238125 DLR Refrigerant Based Precision Cooling System

23 84 13 Humidifiers

U. Specification Comparison: In addition to the complete Shop Drawings required above, provide:
   1. A complete copy of the specifications (Reduced in size to allow a Comment Column), with each sub-paragraph noted with comment, “compliance,” “deviation”, or “alternate”. In the case of non-primary, vendor-supplied items, the name of the sub-vendor supplying said item, including model number shall be indicated.
      a. By noting the term “compliance”, it shall be understood that the manufactures are in full compliance with the item specified and will provide exactly the same with no deviations.
      b. By noting the term “deviation” it shall be understood that the proposer prefers to provide a different component that performs the same function in lieu of that specified. Indicate all deviations and indicate what is being proposed, with enough detail to determine equivalency.
      c. By noting the term “alternate” it shall be understood that the proposer proposes to provide the same operating function but prefers to do it in a different manner. An alternate shall be fully described as to what the proposer proposes to provide. Indicate any function or feature that is not provided. Specification Comparison: In addition to the complete shop drawings required above provide
   2. Provide Specification reviews for the following:
      a. Chillers
      b. Computer Room Air Handlers
      c. PPS
      d. Building Automation System

V. Manufacturer's Instructions:
   1. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
   2. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.
   3. Include instructions on manufacturer’s requirements for cable restraint in equipment.
   4. Submit manufacturer’s standard and recommended receiving, start up and acceptance testing checklists.

W. In addition to copies of submittals as required under Operation and Maintenance Manuals, provide electronic copies on CDs or DVDs of all submittal information in PDF or Microsoft Word format with O&M manuals.

1.7 EXTRA MATERIALS

A. Provide extra materials as specified in each section.

B. Extra materials shall be turned over to the Owner prior to receiving final payment. Obtain itemized receipt properly signed and dated. Submit with request for final payment.

C. Extra materials shall be in original standard manufacturer's packaging.

1.8 PROJECT RECORD DOCUMENTS

A. Provide and submit under provisions of Division 1 and this Section the following:
   1. Record Drawings
   2. Specifications

3. Product Data
4. Operation and Maintenance Manual.
5. Equipment Warranties.
6. Certification of proper disposal of regulated materials.
7. Certificates and Start-up checklists.
8. Testing and Balancing reports.

B. Refer to Division 1 for additional Project record document requirements beyond those indicated herein.

C. Provide and maintain at the site a set of prints on which shall be accurately indicated the actual installation of all work under this Division, indicating any variation from Contract Drawings, including change orders, field conditions, Engineer's direction and changes in sizes, locations and dimensions. Changes in circuitry shall be clearly and completely indicated as the work progresses. Modify Schedules to reflect data consistent with that of the installed equipment.

D. Record Drawings shall be maintained in a clean, dry and legible condition and shall not be used for construction purposes.

E. These progress prints shall be available for inspection by the Engineer and shall be used to determine the progress of electrical work. Indicate daily progress by color-coding materials and apparatus installed. Progress prints shall be reviewed weekly and shall be corrected immediately if found inaccurate or incomplete. Drawings will be used as a guide for determining the progress of the work installed. Requisitions for payment will not be approved until the Drawings are accurate and up-to-date.

F. At the completion of the work, obtain and pay for a new set of 4-mil mylar washoff sepia reproducible record drawings, modify drawings to represent the work as actually noted on the marked-up prints, including the DIMENSIONED location of all underground conduit. Remove all superseded data to show only the completed installation. Mark all Drawings as "Final Record Drawings" and date them.

G. Electronic files shall be AutoCad 2008 as a minimum.

H. Furnish these record documents to the Engineer for review and transmission to the Owner.

I. Record Drawings: Maintain a clean, undamaged set of blue or black line white-prints of Contract Drawings and Shop Drawings. Mark the set to show the actual installation where the installation varies substantially from the Work as originally shown. Mark whichever drawing is most capable of showing conditions fully and accurately; where Shop Drawings are used, record a cross-reference at the corresponding location on the Contract Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.

1. Mark new information that is important to the Owner, but was not shown on Contract Drawings or Shop Drawings.
2. Organize record drawing sheets into manageable sets, bind with durable paper cover sheets, and print suitable titles, dates and other identification on the cover of each set.
3. Ductwork mains and branches, size and location, for both exterior and interior; locations of dampers and other control devices; filters, boxes, and terminal units requiring periodic maintenance or repair.
4. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Refer to Division 15 Section "Mechanical Identification." Indicate actual inverts and horizontal locations of underground piping.
5. Equipment locations (exposed and concealed), dimensioned from prominent building lines.

6. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
7. Contract Modifications, actual equipment and materials installed.
8. Include all "Corrected For Record" shop drawings to reflect approvals received.
   a. Engage the services of a Land Surveyor or Professional Engineer registered in the state in which the project is located to record the locations and invert elevations of underground installations.
   b. Mark Specifications to indicate approved substitutions and actual equipment and materials used.
   c. Number of Copies: Submit copies of Record Drawings as follows:
      1) Initial Submittal: Submit one set of plots from corrected Record CAD Drawings and one set of marked-up Record Prints. A/E will initial and date each plot and mark whether general scope of changes, additional information recorded, and quality of drafting are acceptable. A/E will return plots for organizing into sets, printing, binding, and final submittal.
      2) Final Submittal: Submit three sets of Record CAD Drawing files, and three sets of Record CAD Drawing plots. Plot each Drawing, whether or not changes and additional information were recorded.
      3) Electronic Media: CD-ROM.
      4) Format: Same CAD program, version, and operating system as the original Contract Drawings.
      5) Refer instances of uncertainty to A/E for resolution.

1.9 OPERATING INSTRUCTIONS AND MAINTENANCE DATA

A. In addition to the requirements of section 017823 provide the following after completion of the work and prior to final completion, furnish and deliver six copies of a complete O&M manual. Each manual shall include one copy of each approved shop drawing, catalog pages, instruction sheets, operating instructions, installation, instructions and recommended maintenance procedures and intervals, and spare parts bulletins. Provide separate sections for each separate system, i.e., fire alarm system, sound system, security system, etc.

B. Give detailed instructions, using additional manuals, prior to final completion of work, to the responsible personnel designated by the Owner in the operation and maintenance of all work installed under this Division. All instructions shall be recorded on DVD with two copies of the DVD turned over to the Owner upon completion of the instruction period. Recording of the instructions shall include a description of the system as well as detailed operating and maintenance instructions. Recording sessions will be of professional quality and performed by a firm regularly employed in that business. A letter with two copies containing the name of the person or persons to whom the instructions were given and the dates of the instruction period shall be submitted to the Engineer at the completion of the project. Provide recorded instructions for the following:

   1. Building Monitoring System
   2. Precision Cooling System CRAC / ACC
   3. RTUs
   4. MUAs

C. Prepare sets of manufacturer's catalogs, and other similar data, including the necessary photographic equipment cuts, wiring diagrams covering all mechanical equipment and devices furnished and installed under this Section. These manuals shall provide complete instructions for the proper operation and use of the equipment, together with instructions for lubrication and periodic maintenance and trouble-shooting. Operating instructions shall be specific for each system and shall include copies of posted specific instructions. This manual shall contain only that information which specifically applies to this Project and all unrelated material shall be deleted. During the instruction period, this manual shall be used and explained. The material shall be bound in 3-ring binders, indexed and have a Table of Contents. On the edge of the binder, provide a clear, see-through plastic holder with a typed card indicating the Project

name, the Architect's name, the Installer's name and the Volume number (e.g., Vol. No. 1 of 2).

D. Include a copy of all test reports and certifications in the O&M Manuals.

E. Include name, address and telephone number of the manufacturer's representative and service company for each piece of equipment so that the source of replacement parts and service for each item of equipment can be readily obtained.

F. Provide four copies of the O&M manual information on CD ROM or DVD. Files shall be in a readable format such as PDF or image files (TIF, etc). Record drawings shall be scanned in, and shall also include the AutoCad dwg files if Record Drawings are provided on Cad.

G. Furnish these manuals to the Architect for review and transmission to Owner.

1.10 WARRANTY

A. Refer to individual sections and Division 1 for additional warranty (guarantee) requirements.

B. Remedy work performed under this Division that is found not to comply with the Contract Documents, requires excessive service, or fails less than one year from the date of final acceptance.

C. Manufacturers shall provide their standard warranties for material and equipment furnished under this Division, unless otherwise indicated in each Section.

D. Materials, equipment and work furnished under this Division shall be guaranteed against all defects in materials and workmanship for a period of one year, commencing with the date of final acceptance by the Owner. Any failure due to defective material, equipment or workmanship shall be corrected as quickly as possible and at no expense to the Owner, including all damage to areas, materials and other systems resulting from such failures.

E. Upon receipt of notice from the Owner of failure of any part of the systems during the guarantee period, the affected parts shall be replaced as quickly as possible. Any equipment requiring excessive service (more than two unscheduled services) shall be considered defective and shall be replaced.

1.11 LEED SUSTAINABILITY

A. Comply with the requirements of section 018113-Sustainable Design requirements.

B. Minimize packing materials delivered to the site to minimize waste and maximize opportunity for qualifying for LEED points.

1.12 INTERPRETATION OF CONTRACT DOCUMENTS

A. Division one, General and Supplementary Conditions are in addition to the requirements indicated in Division 23 and 28, Drawings and Specifications.

B. Where Drawings or Specifications conflict or are unclear, advise Engineer in writing before Award of Contract. Otherwise, interpretations of Contract Documents by the Engineer shall be final, and no additional compensation shall be permitted due to discrepancies or unclarities resolved according to the Engineer's interpretation.

C. The intent of the Drawings and Specifications is to assist and guide and to establish minimum requirements.

D. Drawings and Specifications form complimentary requirements; provide work specified and not indicated, and work indicated and not specified as though explicitly required by both.

E. Should there be conflicts in Contract Documents, provide the greater quantity, the higher quality and the more restrictive of equipment and work.

F. Specifically stated requirements supersede general ones.

G. Mechanical Drawings do not limit responsibility of determining full extent of work required by Contract Documents. Refer to Architectural, HVAC, Electrical, Plumbing, Fire Protection, Structural, specialty trades and other Drawings and other Divisions that indicate types of construction in which work shall be installed and work of other trades with which work of this Division must be coordinated.

H. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the Drawings or Specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

I. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

J. Where Drawings or Specifications do not coincide with manufacturer's recommendations, or with applicable Codes and Standards, alert Engineer in writing before installation. Otherwise, make changes in installed work as Engineer requires within Contract Price.

K. It is the intent of these Contract Documents to have systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component. In cases such as this, where the bidder has failed to notify the Engineer of the situation prior to contract award, provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

L. In situations or where potential conflicts and Installer believes guidance is required, submit a sketch identifying a proposed solution and the Engineer shall review, note if necessary, and return this sketch appropriately marked as required.

M. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Infer the omitted words or phrases such as "the Contractor shall", "shall be", "as indicated on the Drawings", "in accordance with details", "a", "the", and "all".

N. "As permitted" means by Code, by Engineer or by prevailing conditions.

O. "Acceptable", "approved", and "satisfactory" means by Engineer.

P. Work indicated on the Drawings is intended to be approximately correct to scale, but figures, dimensions, and detailed Drawings are to be followed. Take measurements at the building before fabrication commences.

Q. Size of pipes or conduits and methods of installing them are indicated, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered.

R. Drawings are generally diagrammatic and indicate the arrangement and approximate location of fixtures, equipment and piping. When necessary to deviate from the arrangement indicated, to meet structural conditions or to clear work of other Divisions, inform the Engineer of

proposed deviation before proceeding. Obtain in the field all information relevant to the placing of mechanical work.

S. Drawings and Specifications do not undertake to indicate every item required to produce a complete and properly operating installation. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a fully complete, secure and properly operating installation suitable for the intended use shall be provided.

T. The right is reserved to make reasonable changes in locations of equipment indicated in Drawings prior to installation without increase in contract cost.

U. Contract Documents indicate scope of work required. Jurisdictional assignment shall be a responsibility under this Section's contractural obligation.

V. The following definitions apply to the Drawings and Specifications:

Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."

Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, rigging in place, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations".

Provide: The term "provide" means to "furnish and install, complete and ready for the intended use".

Installer: An "Installer" is the Contractor or an entity engaged by the Contractor, either as an Employee, Subcontractor, or Sub-Subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1.13 TEMPORARY HEATING AND COOLING

A. Work provided under Division 1.

1.14 ALTERNATES

A. Refer to Division 1 and Section 01 23 00 for additional requirements.

PART 2 - PRODUCTS

2.1 SPECIFIED PRODUCTS AND SUBSTITUTIONS

A. Provide new, unused, full weight, standard equipment that meets or exceeds Contract Document requirements to the satisfaction of the Engineer. No equipment or material shall be used unless previously approved by the Engineer.

B. The manufacturer's catalog number and description is the basis of the design and establishes quality and performance required for this project. Generality, the first manufacturer listed is the one the project design is based on.

C. Manufacturers of generally compatible products may also be listed, subject to compliance with requirements. Substitution of equal products or manufacturers of equal products are also acceptable when indicated in each section.

D. The description following a catalog number is basically to identify the item but may also call for accessories, options, or modifications that are beyond the cataloged item.

E. Zinc Whiskers:

a. Major data processing equipment suppliers have raised concerns over the potential for airborne zinc whiskers to damage their equipment. Zinc whiskers form on steel that is galvanized via a zinc electroplating process. Zinc whiskers do not form on steel that has been hot dipped galvanized. Do not use zinc-electroplated components in areas with raised access floors.

1) Use materials under the raised access floors that are hot dipped galvanized steel or other material, but not zinc-electroplated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to beginning work in a particular area of the project visit the site and examine conditions under which work must be performed, including preparatory work done under other Divisions or Contracts or by the Owner. Report conditions that might affect work adversely in writing through Contractor to Engineer. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

B. Arrangements shall be made to have the openings, inserts, sleeves and other such incidentals set in place ahead of the construction work, where practical to eliminate the need for cutting and patching. If cutting becomes necessary for the installation of the work, it shall be done under this Division in accordance with the requirements of Division 1 and other applicable divisions. All openings shall be neatly patched and finished to match the adjoining work in a manner approved by the Architect, any penetration in fire-rated walls or floors must be fire-stopped as indicated in Division 7. All cutting shall be performed in a manner not to weaken the structural parts. The cutting manner and method shall meet the approval of the Architect.

C. The equipment shall be kept upright at all times. If equipment has to be tilted for ease of passage through restricted areas, the manufacturer shall brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment. Comply with manufacturer's requirements.

3.2 INSTALLATION

A. Do not cut structural members without written acknowledgement from the Architect.

B. Do not attach equipment to metal roof decking.

C. Arrange equipment so working parts are accessible for inspection, repair, and renewal.

D. Where not specified or indicated, mount equipment at heights directed by the Engineer.

E. Locate equipment, test switches, control pushbuttons, terminal cabinets, safety switches and such other apparatus as may require periodic maintenance, operation, or inspection, so that they are easily accessible. If such items are shown on the plans in locations that are found to be inaccessible, advise the Engineer of the situation before work is advanced to the point where extra costs will be involved.

F. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Engineer, and no extra compensation will be allowed for making these changes.

G. Where installed in damp, wet and areas requiring washing down, all surface mounted equipment shall be supported by spacers to provide a clearance between wall and equipment.

H. All connections to equipment shall be made as required, and in accordance with the approved shop and setting drawings.

I. Unless otherwise approved by the Engineer, piping indicated exposed shall be installed exposed; piping indicated concealed shall be installed concealed.

J. Where exact locations are required for roughing in, stubbing-up and terminating conduit request Shop Drawings, equipment location drawings, foundation drawings, and any other data required to locate the concealed conduit before the floor slab is poured or wall or ceiling is installed.

K. Verify the ceiling type ceiling suspension system and clearance above hung ceilings prior to ordering grilles or diffusers. Notify the Engineer of any discrepancies.

L. Fire ratings of enclosures, walls, ceilings, and floors shall be maintained. Penetrations for mechanical Work shall be fire-stopped as indicated in Division 7 or indicated in individual Sections on Drawings, or by Architect. Review Architectural drawings for fire ratings.

M. Water tightness of enclosures, walls, ceilings, and floors shall be maintained. Provide necessary fittings, accessories and coordination as required.

N. Do not use power actuated anchors.

3.3 TESTING AND INSPECTIONS

A. For additional requirements for starting, demonstration, and instructions of systems refer to Division 1.

B. Provide starting, demonstration, and instructions of systems as required in individual Sections.

C. Insure that the Owner's operating personnel are made entirely familiar with the nature, operation, and maintenance of the systems and equipment provided under this Division.

D. Provide testing as indicated in individual sections and in Section 260813. Submit written results.

3.4 SUBSTANTIAL COMPLETION

A. For additional requirements refer to Section 017700 Closeout Procedures.

B. When Work under this Section (or designated portion of Work) is considered substantially complete, submit written notice through the General Contractor with a list of items remaining to be completed or corrected.

C. All systems shall be operational and tested. Submit test reports.

D. Submit local authority final sign off inspection reports.

E. Should Engineer observe and find Work is not substantially complete, written notification will be provided listing observed deficiencies.

F. Remedy deficiencies and send a second written notice of substantial completion.

G. When Engineer finds Work is substantially complete, a Certificate of Substantial Completion will be prepared in accordance with provisions of General Conditions.

H. Submit test reports for review prior to Engineer's site visit.

3.5 FINAL COMPLETION

A. For additional requirements refer to Section 017700 Closeout Procedures.

B. When Work under this Section is considered complete, submit through the General Contractor written certification that:

1. Contract documents have been reviewed.
2. Work has been inspected for compliance with Contract Documents.
3. Work has been completed in accordance with Contract Documents (and deficiencies listed with Certificate of Substantial Completion have been corrected).
4. Equipment and systems have been tested, adjusted and balanced and are fully operational.
5. Work is complete and ready for final Engineer review.

C. Upon completion of all work, and as a condition to receiving final payment, furnish to the Engineer the following original, signed certificates and include copies of these certificates as part of the Operation and Maintenance manuals:

1. From the manufacturer's authorized representative, stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found same to be installed in accordance with the manufacturer's requirements and to be in satisfactory operating condition. This certification shall be provided for all major equipment and for all complete systems. It is not required for other components unless specifically requested by the Engineer.
2. Certificates of inspections, letters and notices from the appropriate government-authorized inspectional authorities stating that all portions of the work (indicate trade and responsibility) have been inspected and are installed in conformance with the applicable codes, laws, ordinances and referenced standards. In non-conformance notices are received, include the re-inspection certificate, letter of explanation, etc. as required to indicate complete conformance. Provide written evidence of all variations, exceptions, variances, etc. given by the inspectors.
3. Certificate from the installing firm responsible for the work (indicate trade and responsibility) signed by an authorized officer or owner of the Firm and the Foreman or Project Manager in charge, stating that to the best of the signer's knowledge and belief that the project (indicate project name and address) has been installed in compliance with the Contract Plans, Specifications and Addenda, and all applicable codes and laws, ordinances and referenced standards. Where subcontractors perform a portion of the work of this Section, include certificates from them.

D. Should Engineer observe and find Work incomplete, the review will be promptly suspended and written notification will be provided through the General Contractor.

E. Complete Work, remedy deficiencies and send a second certification of final completion.

F. Engineer shall, upon receipt of a second certification of completion, make a second review and provide notification in writing through the General Contractor, listing observed deficiencies.

G. When Engineer finds work complete, close-out submittals will be considered.

END OF SECTION

SECTION 23 05 00
COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Sleeves.
3. Escutcheons.
4. Equipment installation requirements common to equipment sections.
5. Painting and finishing.
6. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-dieneterpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 Refrigerant Piping section for pipe, tube, and fitting materials and joining methods.

2.2 JOINING MATERIALS

A. Refer to individual Division 23 piping section for special joining materials not listed below.

B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

C. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.3 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:
   a. Advance Products & Systems, Inc.

b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.4 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

E. PVC Pipe: ASTM D 1785, Schedule 40.

2.5 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated and rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated and rough brass.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Insulated Piping: One-piece, stamped-steel type with spring clips.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
      e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
      f. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
      g. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).

4. Seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

3.3 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

END OF SECTION

SECTION 23 05 13
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 RELATED SECTIONS

A. Section 23 00 10 – General Mechanical Requirements, is an integral part of this section. Requirements and work indicated in 23 00 10 are not repeated in this Section.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 23 00 10.

B. Features of motors, installed units, and accessory devices are to be coordinated with and be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 23 00 10.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements indicated in Section 23 00 10.

1.6 SUBMITTALS

A. Furnish under provisions indicated in Section 23 00 10.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 23 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 23 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 23 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 23 00 10.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation:Class

J. Code Letter Designation:

1. Motors 15 > HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers:

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 23 05 29
SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment, small tools, and supervision required to complete the installation of hangers, supports, anchors, and seismic bracing for equipment, piping and ductwork related to the mechanical systems shown on the drawings. Supports shall be furnished with all necessary inserts, bolts, nuts, rods, and other accessories.

B. In general, the drawings will not indicate supports and hangers explicitly; it is the contractor's responsibility to provide supports as required for all piping, ductwork, and equipment installed under this contract, including miscellaneous secondary support members as specified herein, based on the routing of services and the spacing of available support points within the building structure.

C. Seismic bracing shall be provided in accordance with the State Building Code for components and piping related to the wet and pre-action sprinkler systems. In accordance with this Code Section, and based on the occupancy of the building, seismic bracing is not required for the HVAC equipment, piping, or ductwork included in this contract.

D. Equipment supports to be furnished and installed under this contract shall include:

1. Miscellaneous structural steel for support of piping accessories as required.
2. Seismic bracing for fire protection piping as required by the State Building Code.
3. Vibration isolation supports as specified herein.
4. Piping supports shall include roller hangers, clevis hangers, stanchions, riser clamps, and strut-type supports for floor-mounted and wall-mounted piping and accessories, as specified in Part 2.

E. Ductwork supports shall include strap hangers and beam clamps as specified in Section 23 30 00.

1.2 REFERENCES

A. Pipe hangers and supports shall conform as applicable to ANSI B31.9 - Building Services Piping Standard, to NFPA 13 - Standard for the Installation of Sprinkler Systems, and to MSS-SP 58 and MSS-SP 69 - Manufacturers Standardization Society, Pipe Hangers and Supports.

B. Ductwork supports shall conform to SMACNA Standards.

C. Section 23 00 10 – General mechanical Requirements, is an integral part of this section. Requirements and work indicated in 23 00 10 are not repeated in this section.

D. Section 23 23 00 – Refrigerant Piping.

E. Section 23 81 23 – Refrigerant Based Precision Cooling System

1.3 QUALITY ASSURANCE

A. Hangers and supports used in fire protection piping systems shall be listed and labeled by Underwriters Laboratories.

B. Pipe hangers and supports shall have the manufacturer's name, part number, and applicable size stamped in the part for identification.

1.4 SUBMITTALS

A. Submit product data for all hanger and support devices, including shields and attachment methods. Product data shall include but not be limited to materials, finishes, approvals, load ratings, and dimensional data.

B. Submit product data for all vibration isolation mounts and products.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Acceptable manufacturers for pipe hangers and supports include Cooper B-Line, Carpenter & Patterson, ITT Grinnell, or other manufacturer only if submitted and approved at time of bid.

B. Basis of design for vibration isolation devices is Novia Associates Inc. Acceptable manufacturers are Mason and Vibration Eliminator.

C. Floor stands for CRAC units shall be furnished by the unit's manufacturer.

2.2 PIPE HANGERS AND SUPPORTS

A. For all piping 2½" and smaller, use adjustable clevis or band type hanger for suspended piping, and use strut-type base with split clamp for floor-mounted or wall-mounted piping. Provide copper plated or epoxy coated hangers for use with copper tubing.

B. Provide sleeves, fire-stopping, and escutcheons at each penetration as specified herein. Provide pipe hanger for horizontal piping within 6 ft of vertical pipe. Use resilient mounting of pipe clamps at any penetrations of the roof.

C. For all insulated piping, use oversized hangers to suit insulation thickness, and provide galvanized sheet metal shield for protection between hanger and pipe. For all piping 4" and larger, use either wood block or steel support saddle at base of pipe within insulation, or use rigid insulation with adequate compressive strength at each hanger location to fully support the pipe without crushing the insulation.

2.3 HANGER RODS

A. Hanger rods shall be threaded on both ends, or continuous threaded rods of circular cross-section. Use adjusting locknuts at upper attachments and hangers. No wire, chain, or perforated straps are allowed.

B. Shields shall be 180º galvanized sheet metal, 12-inch minimum length, 18-gauge minimum thickness, designed to match the outside diameter of the insulated pipe.

C. Pipe protection saddles shall be formed from carbon steel, 1/8" minimum thickness, sized for insulation thickness. Saddles for pipe sizes greater than 12 inch shall have a center support rib.

2.4 INSERTS, CLAMPS, AND BOLTS

A. Use clamps and/or inserts as appropriate for connection of pipe supports to the existing building structure. Do not drill or cut primary structural steel, and do not use drilled or power-driven inserts in existing concrete decks without written permission of the building owner and structural engineer. Provide secondary support steel to span between available support points as specified below.

B. Beam clamps shall be used where piping is to be suspended from building steel or fabricated pipe racks. Type of clamp shall be selected based on the weight and configuration of the load to be supported, and the type and shape of structural steel available. Use C-clamps or top flange C-clamps with locknuts and cup point set screws for supporting from sides of beams, and adjustable double-jaw clamps for loads to be supported directly beneath beams, or for loads requiring more support area. Provide retaining straps where needed to hold clamp position.

2.5 VIBRATION ISOLATION MOUNTS

A. Description

1. All vibration isolation devices described in this section shall be the product of a single supplier. NAI (Novia Associates, Inc.) is the preferred supplier. Products manufactured by Vibration Eliminator or Mason Industries may be acceptable provided their systems strictly comply with intent and submittal requirements of these specifications.

B. General

1. Hardware for outdoor applications shall be cadmium or zinc plated, all other outdoor metal parts shall be hot dipped galvanized or zinc electroplated.
2. All non-galvanized materials shall be prime paint finished. Review equipment sections of these specifications and contract drawings for additional requirements.
3. Operating height for support shall be as shown on the drawings.
4. Provide pre-drilled holes on all supports for attachment to the building structure.
5. Refer to Vibration Isolation Schedule at the end of this section for specific requirements.

C. Provide neoprene isolators for the pre-purchased air cooled condensers. Isolators shall be anchored to the steel grillage and installed in accordance with the manufacturer's instructions.

1. Neoprene mountings: Provide neoprene mountings consisting of neoprene element bonded between 2 steel plates that are neoprene-covered to prevent corrosion. Provide minimum rated deflection of 0.35". Provide threaded hole in upper plate and 2 holes in base plate for securing to equipment and to substrate.

D. Type A: Spring Isolator – Free Standing

1. Adjustment bolt counter bored and tapped with interlocking cap screw.
2. Model SM as manufactured by NAI.

E. Type F: Combination Spring/Elastomer Hanger Isolator

1. Molded 1-1/4" minimum thickness neoprene element in series with the spring, located inside a four sided steel box.
2. Model SNH as manufactured by NAI.

F. TYPE L: Elastomer Isolator

1. Non-skid top and bottom surfaces with drilled tie-down bolt holes. Threaded bolting sleeves shall be embedded in the isolator.
2. Model "FMD" by NAI.

2.6 SECONDARY STRUCTURAL STEEL

A. Secondary structural steel shall be provided where required to span available support points or to avoid the work of another trade. Steel angles and channels shall be sized to support the intended load within the allowable stress on the load and the building, with less than 1/8" deflection at mid-span, and secured to primary steel using clamps with locknuts.

B. All fabricated steel framework shall be cleaned and primed with a rustproof primer prior to installation, then touched-up after installation. All exposed structural steel shall be painted with two coats of gray machinery enamel after installation

2.7 FINISHES

A. Hangers and clamps for support of bare copper pipe shall be copper-plated, epoxy-coated, or plastic-coated to prevent contact of dissimilar metals.

B. Hangers for steel pipe located indoors shall be zinc-plated in accordance with ASTM B633-SC3, or shall have an epoxy finish. All hangers and supports located outdoors shall be hot-dip galvanized after fabrication in accordance with ASTM A123. All hanger hardware shall be hot-dip galvanized or stainless steel.

PART 3 - EXECUTION

3.1 PIPE HANGERS AND SUPPORTS

A. Pipe shall be adequately supported by pipe hanger and supports specified in Part 2 - Products. Hangers for insulated pipes shall be sized to accommodate insulation thickness.

B. Support piping from the building structure only, with secondary steel as required; do not support piping from other pipes, ductwork, or equipment.

C. Horizontal copper piping shall be supported in accordance with MSS SP-69 Tables 3 and 4, as noted below:

Nominal Pipe Size	Rod Diameter	Maximum Spacing
½" - 3/4"	3/8"	5'-0"
1"	3/8"	6'-0"
1-1/4"	3/8"	7'-0"
1-1/2" - 2"	3/8"	8'-0"
2-1/2"	½"	9'-0"

D. Provide means of preventing dissimilar metal contact such as plastic coated hangers, or copper plated hangers.

E. Install hangers to provide a minimum clearance of ½" between the finished pipe surface and adjacent work or structure.

F. Place a hanger within 12" of any horizontal elbow or tee. Support piping at each equipment connection to eliminate any stress on the equipment, and if flexible connections are used for expansion or vibration isolation, install support within 12" of the connector.

G. Install spring type hangers (Type F) on refrigerant piping within 50 ft of CRAC units.

H. Where several pipes can be installed in parallel, provide trapeze hangers as specified in Part 2, spaced according to the smallest pipe size, or use intermediate supports for small pipes.

I. Support vertical piping independently of connected horizontal piping, and support risers at every floor. Wherever possible, locate riser clamps directly below pipe couplings or shear lugs.

3.2 CLAMPS

A. Support hangers from building steel using C-clamps, top flange C-clamps, or adjustable double-jaw beam clamps as appropriate for the load and structure as indicated in Part 2. For open-web joists, support from top chord where possible, and as close to panel points as possible to minimize stress on the structure.

3.3 EQUIPMENT BASES AND SUPPORTS

A. Install floor stands for CRAC units specified in Section 238123, located as shown on the plans, and leveled to the height of the raised access floor.

B. Install neoprene mounts beneath air cooled condensers as noted above. All mounts shall be firmly bolted to the structural steel and to the equipment being supported in accordance with the manufacturer's recommendations.

C. Support piping on finished floor in the sub-floor plenum as shown in detail drawings. Coordinate elevation of piping in sub-floor plenum with installation of conduit and cable trays by others.

3.4 VIBRATION ISOLATION SCHEDULE

VIBRATION ISOLATION SCHEDULE						
TAG	**ISOLATION**	**DEFL**	**BASE**	**HGT**	**NOTES**	**MOUNTING TYPE**
CRAC-01 thru 32	INTERNAL COMPONENTS	-	MFG'S STAND	`		FLOOR
ACC-01 thru 32	INTERNAL COMPONENTS	-	TYPE L			STRUCT FRAME
H-01 thru 04	Type F	0.75"	-	-	-	-
FPTs	Type F	0.75"	-	-	-	-
In-Line EFs	Type F	0.75"	-	-	-	-
RTU-09	INTERNAL COMPONENTS	-	MFG'S CURB	-	-	MFG'S CURB
MUA-01, 02	INTERNAL COMPONENTS	-	MFG'S CURB	-	-	MFG'S CURB

END OF SECTION

SECTION 23 05 53
MECHANICAL SYSTEMS IDENTIFICATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish and install pipe and duct markers, valve tags, and equipment nameplates for systems installed under this contract, as specified herein.

B. Provide list of valves, and update list at end of project, to provide as-built valve list to Owner.

C. Provide graphic floor plan mounted in a frame in the Computer Room with all valves indicated under raised floor or above ceilings. Provide valve tag and raised floor grid numbering from the Engineer's drawings.

1.2 REFERENCES

A. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

A. Furnish samples or catalog cuts of pipe markers, valve tags, and equipment nameplates for approval by the Engineer.

PART 2 - PRODUCTS

2.1 PIPE MARKERS

A. Pipe markers shall be Setmark wrap-around markers by Seton Nameplate Corporation. Markers shall be cylindrically coiled plastic sheets for pipes to 4" size, and flat plastic wrap-around markers with nylon ties for 6" size and above. Markers shall be rated for a service temperature of 32º to 150º F. Pipe markers shall have lettering size based on pipe diameter, to be easily readable without overlapping.

2.2 PLASTIC DUCT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color coded duct markers. Conform to the following color code:

1. Yellow/Green: Supply air.

B. Nomenclature: Include the following:

1. Direction of airflow.
2. Duct service (supply, return, exhaust, etc.).
3. Duct origin (from).

2.3 VALVE & EQUIPMENT TAGS

A. Valve tags shall be stock brass valve tags as manufactured by Seton Nameplate Corporation. Tags shall be 19 gauge thickness, 1½ " diameter, with ¼" black-filled legend and ½" black-filled number.

B. Equipment tags shall be laminated plastic, minimum 1½" high, white background with ½" black-filled lettering. Furnish tags for CRAC units, RTUs, MUA, H, FPTs, EF, EUH and other major equipment in system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Prepare and degrease and clean surfaces to receive adhesive for identification materials.

B. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 DUCTWORK IDENTIFICATION

A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers; showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).

B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 20' spacings along exposed runs.

C. Access Doors: Provide duct markers on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

D. Concealed Doors: Where access doors are concealed above acoustical ceilings or similar concealment, plasticized tags may be installed for identification in lieu of specified signs, at Installer's option.

3.3 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of one of the following types on each system and include arrows to show normal direction of flow:

1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
4. At access doors, manholes and similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 20' along each piping run.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.4 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures,

HVAC terminal devices and similar rough-in connections of end-use fixtures and units. List each tagged valve in a valve schedule for each piping system.

B. Stencil valve tag number on insulation covering valve body so that the number can be observed from the floor of the pump room.

C. Mark all valve wheels with indication of status (open/closed) so that position is observable from the floor of the pump room. Add contrasting color marker to hand wheel and/or chain wheel that points in the direction of flow when the valve is open.

3.5 MECHANICAL EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. CRAC Units.
2. Condensers and economizer pumps.
3. Exhaust Fans.
4. Humidifiers.
5. Rooftop Units and Make up Air Units.
6. Fan Powered Terminals.

B. Equipment labels shall be 2” black letters on 6”x4” white background.

C. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

END OF SECTION

SECTION 23 07 00
INSULATION

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. The Contractor shall furnish all labor and supervision, materials, equipment, and tools required to insulate piping and ductwork installed under this contract as indicated on the plans and as specified herein. The scope of work includes coordination with the piping and ductwork installation contractors to ensure that hangers and supports, valve stems and damper operators, and other appurtenances are properly sized to allow for the thickness of insulation when they are installed.

B. Refrigerant suction, hot gas and liquid piping, domestic cold water, non-potable piping shall be covered with either pre-formed mineral fiber or closed cell elastomeric pipe insulation.

C. Humidifier and drain piping shall be covered with pre-formed mineral fiber insulation.

D. The insulation of all supply air ductwork systems, makeup air and return/ exhaust air system sections in contact with outside air shall be in accordance with the International Energy Conservation Code and local energy codes, with flexible or rigid mineral fiber blanket insulation as specified herein.

E. Exterior ductwork insulation and weatherproofing is by Section 07 72 00.

1.2 REFERENCES

A. ASTM C518, C534, C547, C553 and related standards for insulation performance

B. ASTM E96 – Water Vapor Transmission of Materials

C. ASTM E84/NFPA 255/UL 723 - Surface Burning Characteristics of Building Materials.

D. International Energy Conservation Code 2009

E. Section 23 00 10 – General Mechanical Requirements, is an integral part of this section. Requirements and work indicated in 23 00 10 are not repeated in this Section.

1.3 SUBMITTALS

A. Provide insulation schedule with product data descriptions and thickness for each service. Provide samples if requested by Engineer.

B. Provide product data for field applied jackets.

C. Provide manufacturer's installation instructions, which indicate procedures that ensure acceptable workmanship and installation standards will be achieved.

1.4 QUALITY ASSURANCE

A. Materials: Flame spread/smoke developed rating of 25/50 or less in accordance with UL 723.

B. Installers: Company specializing in the work of this section with a minimum of three years of experience.

C. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

D. Ensure that piping and ductwork is complete and tested, clean and dry before applying insulation.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Store insulation in original wrapping and protect from weather and construction traffic. Protect insulation against dirt, water, chemical, and mechanical damage.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mineral-Fiber Insulation:
   a. CertainTeed Manson.
   b. Johns Manville
   c. Knauf FiberGlass GmbH.
   d. Owens-Corning Fiberglas Corp.
   e. Schuller International, Inc.
2. Flexible Elastomeric Thermal Insulation:
   a. Armacell Company
   b. Armstrong World Industries, Inc.
   c. Rubatex Corp.

2.2 INSULATION MATERIALS

A. Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

B. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from kraft paper, reinforcing scrim, aluminum foil, and vinyl film.

C. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

2.3 PIPE INSULATION

A. Preformed closed cell elastomeric pipe insulation shall be equal to Armacell Company AP/Armaflex, conforming to ASTM C534, a preformed, self-seal pipe insulation consisting of elastomeric material with expanded closed-cell structure. Insulation shall be provided to match thickness as shown in the schedule, and shall have the following properties:

1. K-value not more than 0.27 Btu-in/hr-sf-ºF @ 75º F;
2. Rated for service temperatures between -20º and 180º F;
3. Maximum moisture absorption: 0.2% by volume;
4. Vapor barrier permeance: 0.08 perms maximum.

B. All exposed insulation located outdoors, and in any other areas subject to physical damage, shall be covered with aluminum or PVC jacketing and fitting covers.

C. Performed mineral fiber pipe insulation shall be equal to Johns Manville Micro-Lok, conforming to ASTM C547, consisting of preformed glass fibers bonded with a thermosetting resin, and jacketed with a reinforced vapor barrier facing and a factory-applied, longitudinal adhesive closure system. Insulation shall be provided to match thickness as specified, and shall have the following properties:

1. K-value not more than 0.24 Btu-in/hr-sf-°F@75°F;
2. Rated for service temperatures between 0° and 300°F;
3. Maximum moisture absorption: 0.2% by volume;
4. Vapor barrier permeance: 0.02 perms maximum.

2.4 DUCT INSULATION

A. Mineral fiber duct wrap insulation shall be equal to Johns Manville Microlite, EQ, Type 75, conforming to ASTM C553, consisting of flexible glass fibers bonded with a thermosetting resin, and jacketed with a U.L. rated foil-scrim-kraft vapor barrier covering. Insulation shall have the following properties:

1. Density: 0.75 lb/cf
2. K-value not more than 0.29 Btu-in/hr-sf-ºF @ 75º F ("out of package" R-value: 5.2 for 1½" thickness);
3. Rated for service temperatures between 40º and 250º F;
4. Maximum moisture absorption: 0.2% by volume;
5. Vapor barrier permeance: 0.02 perms maximum.

B. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB. For duct and plenum applications, provide insulation with factory-applied white FSK or ASJ jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corp.; Commercial Board.
   b. Fibrex Insulations Inc.; FBX.
   c. Johns Manville; 800 Series Spin-Glas.
   d. Knauf Insulation; Insulation Board.
   e. Manson Insulation Inc.; AK Board.
   f. Owens Corning; Fiberglas 700 Series.

2.5 FIELD-APPLIED JACKETS, PIPING

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. Foil and Paper Jacket: Laminated, glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.

C. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming, suitable for outdoor use.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Jacket Color: White.
3. For indoor use, use Zeston 300 series PVC.

D. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC, suitable for outdoor use.

1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.

2. Adhesive: As recommended by insulation material manufacturer.
3. For indoor use, use Zeston 300 series PVC.

E. Aluminum Jacket: Aluminum roll stock, factory cut and rolled or ready for shop or field cutting and forming to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper.

1. Finish and Thickness: Smooth finish, 0.010 inch thick.
2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.
3. Elbows: Preformed, 45- and 90-degree, short- and long-radius elbows; same material, finish, and thickness as jacket.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 INSTALLATION

A. Install materials in accordance with manufacturer's instructions. Insulate fittings, joints and valves with molded insulation of like material and thickness as adjacent pipe. Provide access for valves, unions, and strainers. Do not insulate flexible connections or expansion joints.

B. Continue insulation and covering through wall, roof "dog houses", sleeves, pipe hangers and other pipe penetrations. Finish insulation at supports, protrusions and interruptions.

C. Provide galvanized steel shields on all piping at hanger locations, and use inserts for piping 1½ inches diameter or larger, between the shield and the pipe. See Section 230529.

D. All indoor exposed water and drain piping located within ten feet of finished floor level in any occupied area, and any piping in other locations which are subject to physical damage shall be insulated as specified above, then covered with Zeston 300 PVC jacketing and fitting covers in 30 mil thickness.

E. Insulate ductwork after connections have been made to branch ducts and diffuser takeoffs. Use weld pins and staples on ducts over 18" wide.

F. Exterior supply and return ductwork insulation and weatherproofing is by Section 07 72 00.

G. RTU Curb Insulation:

1. Refer to drawing M201, detail #4 & 10 for RTU curb insulation requirements.

3.4 INSULATION SCHEDULE

A. Furnish and install ½" thick, preformed mineral-fiber or preformed self-seal closed cell elastomeric insulation on all domestic water and non-potable water piping and condensate drain piping located indoors.

B. Furnish and install 2" thick, flexible mineral-fiber duct wrap insulation on all concealed supply and outside air ductwork.

C. Furnish and install 2” thick, mineral-fiber duct board insulation on all exposed supply and outside air ductwork.

D. Furnish and install 2” thick, mineral-fiber duct board insulation on all exhaust air discharge and outside air intake sheet metal plenums.

E. Furnish and install 2” thick, flexible mineral-fiber duct board insulation on all exhaust air ductwork between exhaust fans and discharge plenums.

F. Furnish and install 1½” thick, preformed mineral-fiber pipe insulation on all humidifier steam supply and steam condensate piping.

G. Furnish and install ½” thick, pre-formed mineral-fiber or pre-formed self-seal closed cell urethane insulation on all non-potable water piping and condensate drain piping located indoors.

H. Furnish and install 1” thick, closed cell elastomeric insulation on refrigerant suction, hot gas and liquid piping. Install PVC or aluminum jacket on all outdoor piping.

I. Exterior supply and return ductwork insulation and weatherproofing is by Section 07 72 00

END OF SECTION

SECTION 23 08 00
MECHANICAL GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements that apply to implementation of the required commissioning process without regard to specific systems, assemblies, or components. This scope of work expands upon and is in addition to the scope of work and testing required and indicated on the contract drawings and individual specification sections.

B. Follow commissioning procedures and provide support throughout standard level 2, 3, 4 and 5 commissioning procedures as outlined in the contract documents.

C. Coordinate and provide appropriate technicians and manufacturer's representatives, including pre-purchased equipment, as required to meet the schedule and contract requirements.

D. Receive, inventory and check against shop drawings and contract drawings all material and equipment received on site including Owner pre-purchased equipment.

E. Complete required paperwork for each commissioning level in a timely manner and provide copies to the General Contractor and Commissioning Authority (CxA). Compliance and completeness of paper work will be reviewed regularly and a condition for approval of monthly requisitions.

F. Systems to be commissioned and performance benchmarked include all systems related to the data center including but not limited to:

1. Refrigerant Based Precision Cooling Systems
2. Make up Air Units
3. UPS Room Exhaust Fans and associated devices
4. Humidification System
5. BMS and associated devices.
6. PBB RTUs and FPTs
7. PBB Exhaust fans
8. Unit Heaters

G. Provide personnel, cooperate and assist with all testing and commissioning of project systems.

H. Provide certified qualified personnel to perform start up of equipment and systems and for testing required or specified.

I. Provide personnel to support full time, the level 5 testing schedule indicated in Section 019100. Personnel shall include the project foreman and additional personnel as required to operate equipment and support commissioning and integrated testing and the proposed schedule.

1.2 RELATED SECTIONS

A. Section 23 00 10 – Basic Mechanical Requirements is an integral part of this Section. Requirements and work indicated in Section 23 00 10 are not repeated in this Section.

B. Section 01 91 00 – General Data Center Commissioning Requirements, is an integral part of this section. Requirements and work indicated in 01 91 00 are not repeated in this Section.

C. Owner's Project Requirements (OPR) and Basis of Design (BOD) documentation are included by reference for information only.

1.3 DEFINITIONS

A. Refer to Section 01 91 00 – General Data Center Commissioning Requirements.

B. Levels of Commissioning

1. Level One – Factory Testing
2. Level Two – Component Verification
3. Level Three – System Installation Verification
4. Level Four – Individual System Operation Verification (Acceptance Testing to verify all contract requirements have been completed and the system operates as specified).
5. Level Five – Integrated System Testing – optional testing to verify and document system operation.

1.4 COMMISSIONING TEAM

A. Appoint Individual(s) to be part of the commissioning team, each having the authority to act on behalf of the entity he or she represents, and explicitly organized to implement the commissioning process through coordinated action with all of the project team.

B. These representatives shall review and comment where appropriate on all commissioning documents, attend all meetings and coordinate scopes of work with all team members.

1.5 OWNER'S RESPONSIBILITIES

A. Refer to Section 01 91 00 – General Data Center Commissioning Requirements.

1.6 THIS SECTION'S RESPONSIBILITIES

A. Assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Attend commissioning team meetings held on a weekly basis at the normal meetings and more frequently as level 4 and 5 commissioning get closer and daily during level 4 and 5 commissioning.
2. Integrate and coordinate commissioning process activities with the construction schedule.
3. Review and accept construction checklists provided by the Commissioning Agent (CxA).
4. Complete paper and electronic construction checklists as Work is completed and provide to the Design Team and the Commissioning Authority on a weekly basis.
5. Review, comment and accept commissioning process test procedures provided by the Commissioning Authority.
6. Complete commissioning process test procedures.
7. Assure compliance with the commissioning schedule by organizing and planning to have appropriate personnel, equipment and material available when required. Coordinate vendor's personnel for all furnished and assigned owner's pre-purchased equipment. Provide as much advanced notice to vendors as possible.
8. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
9. Cooperate with the CxA for resolution of issues recorded in the Issues Log.

1.7 COMMISSIONING AGENT'S (CxA'S) RESPONSIBILITIES

A. Refer to Section 01 91 00 – General Data Center Commissioning Requirements.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for cooling through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the HVAC&R Installer, testing and balancing vendor, and HVAC&R Instrumentation and BMS installer shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

END OF SECTION

SECTION 23 08 13
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Summary

1. Section Includes:
   a. Testing & Balancing Air Systems:
      1) CRAC Units
      2) Perforated tiles
      3) Makeup Air Units
      4) Humidifiers
      5) Exhaust Fans
      6) Supply Registers
      7) Rooftop Units
      8) Fan Powered Terminals

B. Provide qualified personnel, equipment, apparatus and services for start-up, testing and balancing of mechanical systems, to performance data shown on drawings, in schedules, and as specified, for the air and water distribution systems included herein. Note that some start-up procedures require the cooperation of the Balancing Vendor, the equipment manufacturer's representative and the BMS vendor. Ensure that all associated parties are present on site during the entire time that these procedures take place.

C. The Scope of Work includes adjustment of dampers, belt drives, and coupled shafts. The Mechanical Installer shall provide the services of the appropriate skilled trades for each phase of start up, testing, and balancing to ensure that work is done properly.

D. Start-up, testing and balancing shall not diminish guarantee requirements.

E. Coordinate work with Owner’s Commissioning Agent.

F. Notify Engineer and authorities involved at least two days before start up, testing and balancing begins.

G. Do not cover or conceal work before testing and inspection and obtaining approval.

H. Instruments for testing and balancing shall have been calibrated within one month prior to testing and balancing. Calibration shall be traceable to NBS Standards. Provide photocopy of certificate of calibration to Engineer with submittal of balancing report.

I. Leaks, damage and defects discovered or resulting from start up, testing and balancing shall be repaired or replaced to like-new condition with acceptable materials. Tests shall be continued until system operates without adjustments or repairs.

J. Provide reports for each testing and balancing procedure as specified below.

1.2 REFERENCES

A. Associated Air Balance Council (AABC): National Standards for Total System Balance

B. ASHRAE Standard 111-1988: Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems

C. National Environmental Balancing Bureau (NEBB): Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems

D. SMACNA: HVAC Systems Testing, Adjusting, and Balancing

E. ASME B31.9 – Building Services Piping Standard

1.3 RELATED SECTIONS

A. Section 23 00 10 – General Mechanical Requirements, is an integral part of this section. Requirements and work indicated in 23 00 10 are not repeated in this Section.

1.4 COORDINATION

A. Coordinate work under provisions indicated in Section 23 00 10:

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

1.5 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 23 00 10.

B. TAB Contractor Qualifications: Engage a TAB entity certified by AABC or NEBB.

1. TAB Field Supervisor and Technicians: Employees of the TAB contractor and certified by AABC or NEBB.

1.6 QUALITY ASSURANCE

A. The Contractor shall be an independent balancing vendor with not less than five years experience in balancing commercial or industrial HVAC system installations of greater than 10,000 sq. ft., and shall submit sample documentation for at least three reference projects involving data centers contracted within the last three years. The Contractor shall indicate whether certification has been granted by an independent agency such as AABC or NEBB.

1.7 SUBMITTALS

A. Submittals required here and under Section 23 00 10.

B. Prepare a test report form which includes space for all data required by these specifications, and submit the form to the Engineer for approval prior to use.

C. Submit complete testing and balancing reports, including system drawings, as specified below within two weeks of completion of the work for approval by the Engineer. Final acceptance of the project by the Owner shall be contingent upon receipt of approved testing and balancing reports.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 23 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 23 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 23 00 10.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EQUIPMENT START-UP

A. The precision cooling system technician, with any assistance required from the Balancing Vendor and the BMS Vendor, shall coordinate and perform the start-up of the refrigerant based precision cooling system, and all related control systems in strict accordance with equipment Manufacturer's instructions.

B. The precision cooling system technician shall check out all control sensors and devices for the system, including the, high temperature and low pressure devices and alarms, the alternating and sequencing controls, leak detection systems, and condensate pump overflow alarms, as well as monitoring of general operation of the CRAC units, heating, cooling, makeup air, and exhaust air systems controlled through the BMS to ensure that all sequences of operation called for in drawings and specifications operate properly. Ensure that all control components are properly calibrated in accordance with manufacturer's instructions. For further requirements see BMS section of these specifications (Section 23 09 00).

3.2 AIR BALANCING REQUIREMENTS

A. The Air Balance Vendor shall provide qualified personnel, equipment and services for balancing and adjusting of airside mechanical systems as specified herein. Submit procedures, recording forms, and test equipment calibration documentation for review by Engineer at least two weeks prior to scheduled start of balancing procedures.

B. Work shall be performed in accordance with practices recommended by ASHRAE and/or SMACNA. Forms may be obtained from SMACNA by its member contractors.

C. Prepare a drawing of the system, showing the location of all MAUs, CRACs. Electronic files will be made available by the Engineer for use as a background reference for the drawing. This drawing shall accompany the test report.

D. For each CRAC, verify the Mechanical installer has completed installation and start up by the equipment manufacturer is completed and documented.

1. Set EC fans to specified flow.
2. Check nameplate voltage and full load amps on each motor, compare to scheduled values. Notify Engineer immediately of any discrepancies. Measure and record actual voltage and current draw across all power leads. If there are marked discrepancies in amperage draws between legs, or if any motor draws more than its nameplate rating, shut down fan and notify Engineer immediately.
3. Measure and record fan and motor rpm. Check that motor rpm agrees with nameplate and scheduled rpm.
4. Measure and record intake, discharge, total and external static pressure.

E. Using a rotating vane or hot wire anemometer traverse of the top inlet area, measure the total airflow rate through each CRAC unit. Record total airflow rate for each unit on the drawing and in the report. Adjustment of airflow is not required, unless total airflow is more than 10% below

the rated airflow, or if fan is overloaded for any unit. If adjustment is necessary, advise Engineer.

F. Computer Room: Using a calibrated flow hood, after the raised access floor installation is complete and all unused cable openings are sealed off, measure air flow rate from each perforated floor tile diffuser in the computer room and record on the drawing and in the report. Adjustment of airflow is not required. Perform test:

1. All non-redundant CRACs (redundant units off) operating at 100% fan capacity. This may be accomplished by lowering room temperature set point, which will force operating CRAC fan drives to 100%. Measure and record static pressure at six locations under the floor evenly spread out through the white space and indicate locations in TAB report.
2. Calculate overall room airflow and leakage from floor plenum. Leakage shall be below 10% of the total CRAC unit airflow.

G. Electrical Infrastructure Spaces: Using a calibrated flow hood, after the raised access floor installation is complete and all unused cable openings are sealed off, measure air flow rate from each perforated floor tile diffuser in the rooms served and record on the drawing and in the report. Adjustment of airflow is not required. Perform test:

1. Suites 230 and 236
   a. Normal Operation: CRAC-29,30 & CRAC-31,32 operating at 100% fan capacity. This may be accomplished by lowering room temperature set point, which will force operating CRAC fan drives to 100%. Measure and record static pressure at locations under the floor as indicated on the floor plans.
   b. Calculate overall room airflow and leakage from floor plenum.
   c. Failure Mode 1: CRAC-31/32 operating and serving both UPS Room C & D with CRAC -31/32 shut off. Measure and record static pressure at locations under the floor as indicated on the floor plans. Confirm that under floor dampers are positioned correctly.
   d. Failure Mode 2: CRAC-29/30 operating and serving both UPS Rooms A & B with CRAC-29/30 shut off. Measure and record static pressure at locations under the floor as indicated on the floor plans. Confirm that under floor dampers are positioned correctly.
2. Suite 242
   a. Normal Operation: CRAC-21,22,23 operating at 100% fan capacity. This may be accomplished by lowering room temperature set point, which will force operating CRAC fan drives to 100%. Measure and record static pressure at locations under the floor as indicated on the floor plans.
   b. Calculate overall room airflow and leakage from floor plenum.
   c. Failure Mode 1: CRAC-21/22 operating and serving UPS Rooms A, B, & Cwith CRAC -23 shut off. Measure and record static pressure at locations under the floor as indicated on the floor plans. Confirm that under floor dampers are positioned correctly.
   d. Failure Mode 2: CRAC-21/23 operating and serving UPS Rooms A, B & C with CRAC-22 shut off. Measure and record static pressure at locations under the floor as indicated on the floor plans. Confirm that under floor dampers are positioned correctly.
   e. Failure Mode 3: CRAC-22/23 operating and serving UPS Rooms A, B & C with CRAC-21 shut off. Measure and record static pressure at locations under the floor as indicated on the floor plans. Confirm that under floor dampers are positioned correctly.

H. Balance the air distribution systems related to each MAU.

1. Using a calibrated flow hood, measure and adjust airflow rate from each supply register for the data center ventilation system and split systems to within +/- 10% of values shown on plan. Ensure that all equipment is in operation and under automatic control.

2. Measure and document total air flow and outdoor airflow rates for each MAU. Measure and document inlet and discharge static pressures and motor current draw, and notify the engineer immediately if the supply fan motor operates in excess of its nameplate rated amps.

I. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.
   a. Where sufficient duct space in is unavailable for Pitot-tube traverse measurements; measure airflow at terminal outlets and inlets and calculate the total airflow.
2. Measure fan static pressures as follows to determine actual static pressure:
   a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
   b. Measure static pressure directly at the fan outlet or through the flexible connection.
   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
3. Measure static pressure across each component that makes up the fan coil.
   a. Report the cleanliness status of filters and the time static pressures are measured.
4. Obtain approval from Architect, Construction Manager, and Commissioning Authority for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for MAUs for adjustment of fans, belts, and pulley sizes to achieve indicated MAU performance.
5. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

J. Adjust volume dampers for main duct and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow of submain and branch ducts.
   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Re-measure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

K. Measure air outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or by using outlet manufacturer's written instructions and calculating factors.

L. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.

1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.3 TESTING AND BALANCING REPORTS

A. Air balance reports shall include as a minimum, full nameplate data for each item of equipment balanced, including motor data, belt drive information, and operating limits. Verify that each motor matches the scheduled data.

B. Record all measurements taken, and all adjustments made to arrive at final values. Reference all air flow rates and static pressures to specific terminals or loads, and coordinate with locations on drawings which are specified to accompany the report.

C. Air balance reports shall be signed and certified by the responsible balancing technician, and six (6) copies shall be submitted to the Engineer for approval within two weeks of the completion of work.

D. Provide signed copies of start up reports completed by the respective equipment manufacturer's representative using their standard forms and procedures.

END OF SECTION

SECTION 23 09 00
BUILDING MONITORING SYSTEM

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish and install a complete direct digital control (DDC) Building Monitoring System (BMS) for automated building equipment control as manufactured by Schneider Electric, or other pre-qualified and Owner-approved vendor. All systems shall be provided directly by the manufacturer, or by a dealer licensed by the manufacturer. The manufacturer must provide full support to the licensed dealer throughout the guarantee period.

B. The BMS shall perform all sequences of operation, which may be listed in Part 3 of this specification and/or in the Appendix B & M801. The control system vendor shall provide all hardware, software, sensors and devices necessary to completely perform the specified sequences whether such devices are explicitly shown on the drawings, specified, or not shown or specified.

C. Provide the services of control vendor's representative to be on site during installation and during the entire time that the startup, testing and balancing procedures detailed in other sections, take place. Provide a full operational test of all systems and all sequences in the presence of the Owner and Engineer, and provide training for the Owner's maintenance personnel as specified herein. The representative shall be part of the manufacturer's service organization and shall be skilled in the adjustment and calibration of all control devices as well as being capable of modifying and checking system software.

D. Certify maintenance of local office within 50-mile radius of job site, staffed with factory-trained engineers capable of providing instructions to Owner's personnel, and performing routine and emergency maintenance on all system components. Provide service contract with 24-hour response time as specified below for first year of operation.

E. The scope of work includes, in general, monitoring and control of certain data center and Electric Room HVAC systems, including sequencing and monitoring of MAUs and Precision Cooling Systems, and support area equipment including exhaust fans and Humidifiers. In addition, the BMS shall interface with and monitor the operation of the electrical infrastructure systems, fire alarm, security, and power monitoring systems. See Part 3 - Control Sequences or the Appendix B for detailed descriptions of operating and safety controls, monitoring, and alarm functions for each system.

   1. Control of Ventilation MAU, Computer and Electric Room Precision Cooling System is, in general, by the respective vendor.
   2. Refer to Owner furnished document in Appendix A, DLR Data Center –- Liebert DSE Systems – Data Center and Electric Room - Sequence of Operation – Release Version 2.4 for specific and detailed sequences.
   3. Refer to Controls Responsibility Matrix on drawing M803 for installer/vendor/contractor requirements.
   4. Refer to Computer Room Design Criteria table on drawing M803 for indoor environmental requirements.

F. PBB RTUs, Fan Powered Terminals, PBB exhaust fans will also be in scope of work of this project. The PBB HVAC system will be incorporated into the existing PBB BMS.

G. Furnish and install all conduit and wiring to complete field-wired interconnection of sensors and control devices with packaged control systems for MAUs and exhaust fans as well as providing wiring for devices controlled by BMS. Provide network interface wiring between packaged unit control systems and the BMS for open communication of operating parameters and alarms.

H. The system shall provide for a specific allowance of I/O points as specified herein or on the drawings for monitoring of electrical equipment status and alarms, as well as providing virtual points and accepting communications from these systems through an open protocol. The system shall provide for future expansion of HVAC systems, and may also include monitoring of the, fire alarm systems, specified in other sections of the project specifications. Systems outside of the scope of HVAC systems are specified by others.

1.2 SYSTEM PERFORMANCE

A. The system shall operate continuously, and shall be provided with surge suppression and a minimum of 60-minutes of uninterrupted power supply, as well as with standby power from the data center generator system. The system shall remain in operation at all times, and shall provide an orderly start-up of controlled equipment after a power failure to avoid overloading the generator.

B. The performance of the system, with respect to minimum point scan rates, speed of command response, alarm response, etc. shall be adequate for the individual system response requirements, and every effort shall be made to minimize control response times through consolidation of points in a common building controller, and optimization of I/O signal routing. In any case, the maximum response time by any controlled device to act shall not exceed two seconds from the time the command is given (analog objects adjustment must start, but may not be complete, depending on the actuator). The object scan rate shall be such that any change of value or change of state data displayed on any operator interface shall be current to within the last six seconds.

C. Alarms shall be annunciated at the operator's workstation within 45 seconds of their occurrence, unless a software delay is included as part of the sequence of operation.

D. Controllers shall be able to execute PID control loops at a selectable frequency of at least once per second. The controller shall scan and update the process value and output generated by this calculation at this same frequency.

E. Graphic display pages shall be capable of loading and displaying data, or refreshing all points with current data within 10 seconds.

F. The system shall report all values with accuracy equal to the monitored sensor accuracies, which are specified in Part 2 - Products. Control loops shall maintain the measured variable at set point within the tolerances indicated in Part 3 - Control Sequences.

1.3 WARRANTY OF SYSTEM

A. The DDC system Vendor/Contractor shall guarantee the entire control system and its physical installation, including sensors and transmitters, actuators and other end devices, controllers and associated power supplies, transducers, transformers, and switches, and all wiring and pneumatic tubing to be free from defects in material and workmanship for a period of not less than one year from the acceptance of the system by the Owner. Only new equipment and devices shall be used on this project.

B. The Vendor/Contractor shall guarantee the performance of the entire control system, including accuracy of measurement and control outputs, speed of response, and applicability of device control capability and ranges to the controlled devices and the required tolerances around set point. The Vendor/Contractor shall provide the necessary labor to tune all control loops to an acceptable level of stability, and shall warrant that the control loops will function in a stable manner, free from defects in material and workmanship for a period of not less than one year from the acceptance of the system by the Owner.

C. Control system failures during the warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to the Owner. The Vendor/Contractor shall respond to the Owner's request for warranty service within 24 hours during normal business hours.

D. The Vendor/Contractor shall identify any deviations in his proposed warranty from the requirements noted above at the time of bid.

1.4 SUBMITTALS

A. The control systems installer shall provide full documentation on all equipment, hardware, software, and installation procedures for approval by the Owner and the Engineer. No work may begin on the installation of this project until the submittals have been reviewed and approved by the Owner and the Engineer. Submittals shall be provided as soon as possible after award of contract, and at least two weeks should be allowed for review and comments.

B. Submit six sets of the following shop drawings and device documentation for approval:

1. Control drawing for each system, with detailed piping and wiring diagrams, including bills of materials and written description of operation. All sensor and device points shall be labeled with I/O addresses corresponding to their BCU termination point. The sequence of operation shall not simply repeat the sequences specified on the contract document but shall provide full detail as to required interlocks, time delays, and calculation routines which are a part of each sequence.
2. System layout drawing showing DDC panels (BCUs and ASCs), central computer, paging and/or dial-up messaging equipment, and communication network. Indicate actual locations of equipment referenced to a floor plan.
3. Point List, listing every component to be sensed or controlled, including I/O device, signal type, control function, and associated alarms.
4. Damper schedules showing sizes, configurations, capacities, pressure drops and locations of equipment.
5. Data sheets and specifications for control system components, including sensors, transmitters, transducers, panels, controllers, and other devices.
6. Complete software information including names of software packages provided, control sequences performed including flow chart logic diagrams, complete information on user programmability (commands, language details, programming sequences, etc.), and complete description of operating system. Provide full description of central computer and color graphics system and accessories.

C. Within one month of contract award, furnish a schedule of the work, including intended sequence of work items, with start dates and durations, and critical path items. Provide a monthly written status report, including any revisions to the schedule. Work shall be completed as required by the overall construction scheduled and owner required completion date. Work shall be scheduled to be completed prior to system integrated testing.

1.5 VALIDATION REQUIREMENTS

A. Provide one hard copy and one electronic copy of as-built system documents to Owner's operating personnel, including as-built shop drawings and narrative descriptions of sequences of operation, including input and output signals (electronic and pneumatic), and performance and specification sheets for all sensors, controlled devices, controller units, and other hardware. Record drawings shall be furnished in AutoCad format on a CD.

B. Provide one hard copy and one electronic copy of operation and maintenance manuals, including as a minimum, procedures for operating the control systems, including logging on and off, alarm handling, producing point reports, trending data, overriding computer control and changing set points and other variables, and procedures for maintaining the system, including sensor and control device maintenance and calibration procedures.

C. Provide at least one hard and one electronic copies set of programming manuals with description of the programming language (including syntax), statement descriptions (including algorithms and calculations used), point database creation and modification, program creation and modification, and use of the editor. Provide building blocks for use in creating new graphics and new points for the system.

D. Provide testing and commissioning reports for calibration of sensors, loop tuning parameters, and start up of the system. Provide electronic backup files of all software, along with related licenses and warranties.

1.6 START UP AND PROGRAMMED MAINTENANCE

A. Start system and perform necessary testing and debugging. Perform acceptance test in presence of Owner's representative and Engineer. Provide 15 days notice before acceptance test. Notice shall certify that system is complete and operates as required by contract documents. When system performance is deemed satisfactory, system parts will be accepted for beneficial use and warranty shall begin.

B. Submit manufacturer's agreement to provide necessary programmed maintenance and to maintain systems for one year from date of final acceptance, within contract sum. Programmed maintenance agreement shall identify maintenance work to be performed and shall quote cost of work for two years subsequent to guarantee period. Update software free of charge during warranty as manufacturer's software is improved.

C. Provide a minimum of 24 hours of on-site instruction in operating DDC system, and provide at least six sets of training manuals for use by the operators.

1.7 COODINATION AND WORK BY OTHERS

A. The BMS Vendor/Contractor shall cooperate with other vendors/installers performing work on this project as needed to achieve a complete and working installation. Consult the drawings and specifications related to other trades to determine the nature and extent of others' work, and resolve potential conflicts by coordination with others through the construction manager.

B. The BMS Vendor/Contractor shall furnish all, control dampers, and similar instruments for installation by the Mechanical Installer, and shall provide field supervision for their installation.

C. The BMS Vendor/Contractor shall provide and install all control wiring to all sensors and devices included under this section, utilizing licensed electricians and working in accordance with the requirements of NEC and local building codes. Power wiring to motors and dedicated circuits for control wiring will be provided by the Electrical installer. Fire alarm system devices and panels will be furnished and installed by the Fire Alarm Installer, as will fan shutdown controls and power wiring to smoke dampers, however, wiring of alarm notifications specified herein shall be provided by the BMS Vendor/Contractor.

1.8 CODE COMPLIANCE

A. Provide BMS components and related equipment which are UL-916 Listed and labeled.

B. All equipment or piping located in conditioned air streams or plenums shall comply with NFPA 90A requirements for maximum flame spread/smoke developed/fuel contributed rating of 25/50/0.

C. All wiring shall conform to the Electric Code. Route all control wiring within rigid EMT or conduit.

D. All smoke dampers shall be rated in accordance with UL 555S.

E. Comply with FCC Rules, Part 15 regarding Class A radiation for computing devices and low power communication equipment operating in commercial environments. Comply with FCC Rules Part 68 for telephone modems and data sets.

1.9 ADDITIONAL REQUIREMENTS

A. This specification covers the requirements for the BMS to monitor and control the HVAC systems and the resulting environmental conditions for the building. Additional points and sequences for monitoring and/or controlling process equipment, and fire alarm controls, if any, shall be specified by others, in other Sections of the Project Specifications.

B. The scope of work, materials and products, programming and installation specified herein shall be considered the minimum scope of work and deliverables for this project. The BMS Vendor/Contractor may offer extra cost options for the integration of packaged equipment controls, or may offer "value engineering" deductions based on his standard practice, as long as the proposed additions, deletions, or substitutions are proposed at the time of bid, and each one is specifically identified with a cost benefit or penalty. The Vendor/Contractor shall clearly identify any deviations from this specification in his proposed scope of work and deliverables with his bid.

C. Section 23 00 10 – General Mechanical Requirements, is an integral part of this section. Requirements and work indicated in 23 00 10 are not repeated in this section.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All products used in this project installation shall be new and currently under manufacture and shall have been applied in similar installations for a minimum of two years. This installation shall not be used as a test site for any new products unless explicitly approved by the Owner and Engineer in writing.

B. Spare parts and/or equivalent replacement devices shall be available for at least five years after the completion of this project.

2.2 SYSTEM ARCHITECTURE

A. The BMS shall consist of a dedicated high speed network of stand-alone building control units (BCUs) and secondary level controllers designed to monitor and control the data center HVAC systems and to provide hard-point monitoring and alarm functions for the mechanical and electrical infrastructure systems. In addition, the BMS shall accept and display virtual points for all RTUs, Precision Cooling Systems, UPS systems, PDUs, generators, and other equipment via open protocol such as Modbus or BacNET, to allow monitoring of all equipment via their individual microprocessors as described by the control sequences and input/output lists specified herein and on the drawings. The system shall include an operator interface with capabilities for communication and access with external locations via separate local area network, telephone, and/or broadband cable systems.

B. The BMS network shall operate on a true token pass, peer to peer communication basis. The internal microprocessors which reside within each BCU shall provide for full exchange of system information between each BCU on the network communication trunk. The system shall not rely on the central computer interface to exchange system information. Failure of any one of the network BCUs shall not affect the operation of other BCUs residing on the same network. Each BCU shall be fully programmable, and shall have full capability for monitoring, control, point trend data collection, and alarm functions for the equipment it serves, and shall be equipped for local operator interface in addition to its network connection.

C. The system architecture may also include secondary level, or application specific controllers (ASCs), connected between the BCU and the equipment to be controlled. Such controllers may be used to control an individual AC unit, and are expected to communicate through the respective BCU. However, all complex systems in this project, and monitoring functions shall be served by fully programmable BCUs as specified below.

D. The system architecture may include gateways to interface the BMS with packaged equipment controllers, or with other building or process control systems. The specific communication gateways may be specified as line item options in Part 1, or in the control sequences listed in Part 3.

E. Network transmission shall occur at typical Ethernet speeds of 10/100 mb/sec. All transmission shall incorporate data integrity and validity check routines.

2.3 BUILDING CONTROL UNITS (BCUs)

A. Each BCU shall monitor and control the HVAC and utility system functions for the specific group of equipment it serves. The analog and digital inputs from sensors, transmitters, and switches shall be continuously used with the individually programmed logic sequences to control analog and digital outputs to valve and damper actuators, motor starters and variable frequency drives, switches and relays, and other controlled devices. All BCUs shall be connected directly to the transmission network, but shall operate independently in that individual BCU functions shall not be degraded by loss of the central computer or failure of the transmission network that connects the BCUs and the computer.

B. Each BCU shall include the necessary software and firmware to provide for its independent operation, and shall be capable of upgrade by the system manufacturer for future enhancements or improvements. The BCU shall have sufficient memory to support its operating system, database, and programming requirements. The BCU shall execute application programs, calculations and commands through its microprocessor, and shall communicate with other BCUs on the network, as well as the central operator interface. The microprocessor shall be capable of proportional plus integral and PID control loops, and shall permit independent floating point calculations for all arithmetic functions. The microprocessor shall provide analog/digital conversions, alarm recognition and generation, and communications. Provide real-time clock with external synchronization feature to enable the BCU to perform time-based scheduling functions automatically. All programming and operator-adjustable values shall be accessible through the individual BCU, although operator interface will generally be via the central computer.

C. Each BCU shall be provided with a minimum of 16 universal (software selectable analog/digital input/output) points, alphanumeric display and keypad, and communications port for local connection of terminal or printer. The configuration of each BCU shall allow for at least two spare input and two spare output points for each panel. In general, a separate BCU shall be used for each major system depending on point count, e.g. one for each group of RTUs and all control points associated with a given control loop shall be monitored or controlled from a single BCU to optimize response times and ensure that a unit failure will not affect other systems.

D. The BCU shall continuously check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode and generate an alarm notification. Provide diagnostic LEDs for power, communication, and processor. Provide battery backup capable of retaining full system memory for a minimum of 72 hours.

E. Each BCU shall be capable of operating in ambient conditions between 32°F and 120°F and up to 90% RH (non-condensing). Install each BCU in a control cabinet rated for the intended environment.

F. Provide surge transient protection to BCU to suppress induced voltage transients. The controller shall be able to operate at 90% to 110% of its nominal voltage rating, and shall perform an orderly shutdown below 80% of nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz, and from keyed radios up to 5 watts at 3 ft distance.

G. The system shall be designed for phased start-up by providing all wiring terminals on the panel backplate with a plug-in microprocessor chassis. Installed BCUs shall be capable of communicating properly with I/O devices and with the central computer while remaining BCUs are being installed.

H. Each BCU shall be UL-916 listed and approved, FCC and CSA certified.

2.4 CENTRAL OPERATOR AND GRAPHIC DISPLAY INTERFACE

A. An operator's interface to the control system shall be provided.

B. The software shall be graphically oriented. The system shall allow display of up to ten graphic screens at once for comparison and monitoring of system status. Provide a method for the operator to easily move between graphic displays and to change the size and location of graphic displays on the screen. The displays shall consist of full color graphic flow diagrams of the systems involved. Each graphic shall include all major HVAC components, control sensors and controlled devices, flow paths, alarms, and other pertinent information.

1. For each Precision Cooling System and MAU the graphic shall include a schematic drawing of the unit with filters, coils, fan(s), and ductwork or flow paths directly related to the unit. The graphic display shall indicate differential pressure across filters, along with alarm point and status, output signal or position of damper actuators, on-off command and status of fans, set points and real-time measured values for temperature, humidity or dew point, pressure and/or differential pressure, alarm points, and other data indicated in the control sequence descriptions which are related to the unit and to its respective system.
2. For each damper specified to have proof of position, the graphic display shall indicate the end switch or proximity switch closure as part of the valve or damper graphic image.
3. For each fan, or other motor-driven equipment item, the graphic display shall indicate the commanded state and the actual status, including speed reference and feedback for motors driven by VSDs. The graphic image shall include a means of determining normal vs. alarm status for each motor. For multiple units, such as the redundant exhaust fans, which are specified to be alternated periodically, the graphic display shall indicate total run-time hours, lead-lag position or active-standby status, and the date and time of the next scheduled unit alternation. The date and time shall be automatically indexed by the programmed schedule at the completion of each alternation event.

C. Graphic display screens, or pages, shall be arranged in a logical hierarchy, and shall be accessible either directly from a text-based menu or from a "control panel" graphic with icons for selecting each page, or through a progression from a basic building "overview" page to individual building areas and system pages, to individual room or equipment pages. The BMS vendor shall propose a list of graphic screens with their associated points, graphic images, and access hierarchy with his system submittal for approval. However, for this project, the following may serve as a guideline:

1. At the building "overview" level, the screen may show the complete building floor plan, including first floor and roof, with major areas and major systems indicated on each floor plan. Selection of a floor or system from the graphic screen via mouse click shall access the next level of detail for that selection.
2. The next level of detail may include for each floor, specific areas and systems, with basic point values, for example, selection of the data center may access a detailed floor plan of the area, with the space temperature, relative humidity, and equipment indicated.

Selection of a Precision Cooling System shall show basic measurements such as supply and return air temperatures, differential and static pressures, compressor operation, compressor data, etc.

3. Relative humidity, the next level of detail, based on the examples above, may be to select a specific item of equipment, which would access a graphic screen for that unit, showing the entire unit operating parameters and alarm conditions reported through the open communication interface. A mouse click on any of those graphics could access (through password protection) the ability to view and change individual set points and alarm points, reset schedules, and the like
4. The number of screens, and the number of levels of detail will depend upon the sizes of the systems, the ability of the graphic designer to present information in a logical manner without crowding a display page, and the ability of the system to display the screen and update the point measurements in real time. As a minimum, however, there shall be screens based on floor plans to show individual rooms and there shall be screens showing the individual systems and their relationship to other systems. Each graphic screen shall have a consistent and predictable means of accessing a higher or lower level screen for the respective system, as well as a selection for the “home page” index of systems. A consistent format shall be used for all screens to indicate the difference between set point and measured value, commanded state and status, output and feedback, normal and alarm states. See Part 3 - Control Sequences for more specific display requirements.

2.5 OTHER SOFTWARE REQUIREMENTS

A. The operating system shall be Microsoft Windows Vista, Windows XP Professional, or other equivalent multitasking operating system used as a standard by the BMS vendor. The operating system shall allow operator to run and display several applications at the same time.

B. The workstation shall provide the operator interface and off-line storage of system information. The workstation shall store on its hard disk a copy of the current database for each BCU.

1. This database shall be updated automatically whenever a change is made in any system panel. In the event of a database loss in any BCU, the workstation shall automatically restore that database to the BCU, unless the operator manually disables this feature.
2. A system operator with password access shall be able to save the database from any BCU manually, and shall be able to clear a panel database and manually download a specific database into any BCU in the system.

C. Each operator shall be required to log on to the system with a user name and password in order to view, edit, add, or delete data. System security level and passwords shall be selectable for each operator by the system supervisor, to allow a range of access, from point viewing only, to specific point editing, to control loop programming and database controls. The system shall be set up for at least four levels of security, or as directed by the Owner’s system supervisor.

D. The system software shall include a context-sensitive, on-line help system to assist the operator in operating and editing the system. On-line help shall be available for all applications, and shall provide the relevant data for that particular screen.

E. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

F. Any object in the system shall be configurable to alarm in and out of normal state. The operator shall be able to configure the alarm limits, alarm limit differentials, time delays, states, and reactions for each object in the system.

1. The operator shall be able to define the actions to be taken for each alarm, including logging, printing, starting programs, displaying messages, dialing out to remote stations, paging, providing audible annunciation, or displaying specific system graphics.
2. Logs shall be kept automatically of all alarms and events in the system, maintained chronologically. An operator with the proper security level may acknowledge and clear alarms, and his user id shall be associated with the acknowledged or cleared alarms. Alarms and events shall be archived to the hard disk on the workstation computer on a regular basis.

G. The software package shall be capable of logging point data and providing trend reports in operator-selectable formats. The following capabilities shall be provided as a minimum:

1. The operator shall be able to log any point by selecting the point(s), start time and date, stop time and date, and time interval, or change of value interval. Each BCU shall have the capability to log several related points in a system simultaneously, or in a synchronized fashion to facilitate diagnostics, ie, to determine the effect that an event at one point may have on another point, such as the effect of temperature on relative humidity in a given airstream.
2. Each BCU shall have sufficient memory to handle the sampling and storage of data for all of its associated points for at least an eight-hour period, and shall be configurable to automatically archive the data to the hard disk of the workstation computer to allow long-term, continuous trend logs to be kept. All data shall be easily retrievable from the computer for use in spreadsheets and standard database programs, as well as in reports created through the system software package.
3. The operator shall be able to create standard or custom reports using the system software and logged points (or alarm messages). Each report shall be definable as to data content, format, interval, and date. The software shall facilitate the creation of tables, graphs, and charts for presentation of data.
4. Report data shall be stored on the hard disk of the workstation for historical reporting. Reports and logs shall be readily printed to the system printer, either on operator command, or at a specific time each day.

2.6 DDC SENSORS AND POINT HARDWARE

A. General

1. When providing instruments with 4-20 mA transmitters and conversion to voltage is required at the BCU, the controls contractor shall provide 250 ohm 1% precision resistor.
2. Analog pneumatic outputs (3-15 psi) from BCUs shall be produced by an analog output controlling a dedicated electronic to pneumatic transducer which is separately mounted in the BCU field device section of the enclosure for ease of field replacement. The electronic to pneumatic transducer shall be a separate device which is not printed circuit card mounted.
3. Analog outputs from BCUs should be linear variable outputs. If the BMS installer uses the mode of operation for analog output which incorporates "pulse band width modulation" then the "pulse band width modulated" signal shall be converted through a "pulse band width to analog output transducer" which then provides output to the final control element to eliminate an inherent offset that can occur in mechanical electrical "floating control" type control loops.

B. Alarms

1. Alarm contacts shall be wired normally closed (NC). If equipment only has normally open (NO) contacts, provide an intervening relay that will have NC contacts which shall open via the NO relay. When in alarm condition or if wire to contact is opened (say wire cut in field), BCU shall sense condition and generate alarm.
2. Common alarms shall be wired to alarm terminals on manufacturer's control panel. Contacts shall input to BCU. Line printer shall indicate normal or alarm.

3. Priority levels shall be provided for alarms, and alarm messages shall allow different levels for message outputs.
4. Where shown in sequence, alarms shall be provided with software time delays to prevent nuisance alarms due to momentary, non-critical deviations from design conditions.

C. Temperature Sensors and Transmitters

1. All temperature sensors shall be accurate to +/-0.36°F or better over their respective minimum operating ranges. Stability shall be rated at not more than 0.24°F change over 5 years. Sensor, associated circuitry and readout shall have minimum resolution of 0.5°F. All sensors shall withstand ambient temperatures of -30°F to 240°F, but performance requirements must be met only for ranges specified.
2. Furnish and install room temperature sensors and transmitters as indicated on the control schematics and in the sequence of operation for the data center, UPS room, and battery room, and for all offices and support spaces conditioned by the rooftop units. Wall-mount units shall include surface-mount, low profile, white plastic covers. Operating range shall be 40° to 100°F.
3. Furnish and install duct-mounted temperature sensors/transmitters as indicated on the control schematics and in the sequence of operation for each packaged rooftop units and the battery room exhaust systems. Use single probe type sensors for supply and exhaust ducts and plenums, and use averaging type inside air handling units for intermediate section temperature measurement. Range shall be -20°F to 140°F.
4. Furnish and install temperature sensor for outside air temperature measurement. Sensor shall be mounted in 24 hour shade location, in proximity to a light colored wall, in an aspirated enclosure insulated with foam from thermal transfer with adjacent structure. Sensor shall operate within the following minimum range: -20°F to 140°F.

D. Humidity Sensors and Transmitters

1. Furnish and install wall-mounted humidity sensor/transmitter where shown on the plans and/or control schematics for monitoring space relative humidity. The sensor shall be a resistive polymer type, with minimum accuracy of +/- 2% at 77°F, including hysteresis, linearity, and repeatability. The range shall be 0-100% RH, and transmitter output shall be 4-20 mA, linear with the range. The sensor shall contain an integral single point calibration potentiometer.
2. Furnish and install an outdoor air humidity sensor/transmitter in an aspirated enclosure, with specifications as indicated for room sensors, above.

E. Pressure Sensors and Transmitters

1. All space and underfloor pressure instruments shall conform to the following minimum standards. Additional specifications are given for specific applications below.
2. All space and underfloor pressure sensors shall be Ashcroft CXLDP or XLDP type sensors with 0.4% accuracy and provided with a nine point NIST calibration certification.
   a. All space pressure sensors shall have a range of +/-0.25” wc.
   b. All underfloor pressure sensors shall have a range of 0 to +0.25” wc.
3. Furnish and install a differential pressure air flow switch in the battery room exhaust duct to provide a loss of flow alarm. The switch shall be equal to a Penn Model P32AC.

F. Equipment Status

1. Flow status for the split systems, rooftop units, and exhaust fans shall be proven by motor current sensing transformers. If more than one fan, or other piece of equipment is started from one start/stop command, each shall have its own current transformer for status proof.
2. Sensors shall be capable of producing analog current value proportional to equipment current load. Sensors shall be accurate to +3% of full scale current. Sensors shall be capable of reading 125% of full load amps (FLA).

3. The BMS shall accept status inputs from specific "customer useable" contacts in packaged HVAC equipment, including the CRACs. See the control sequences in Part 3 for more information.

2.7 HARDWIRED/ELECTRICAL CONTROL DEVICES

A. MAU duct mounted smoke detectors will be furnished by Division 28, installed under Division 23, and wired by Division 28. The smoke detector will be wired to the fire alarm system, with control wiring to the MAUs motor starter for fan shutdown. Wiring to fire alarm system shall be part of work of Division 28. Auxiliary contacts will be provided at each duct smoke detector, and the BMS may use these contacts to provide actions associated with the shutdown of the respective fan.

2.8 MOTORIZED CONTROL DAMPERS

A. Dampers: AMCA-rated, parallel-blade design; 0.108-inch- minimum thick, galvanized-steel or 0.125-inch- minimum thick, extruded-aluminum frames with holes for duct mounting; damper blades shall not be less than 0.064-inch- thick galvanized steel with maximum blade width of 8 inches and length of 48 inches.

B. Secure blades to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.

C. Operating Temperature Range: From minus 40 to plus 200 deg F.

D. Edge Seals, Low-Leakage Applications: Use inflatable blade edging or replaceable rubber blade seals and spring-loaded stainless-steel side seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.9 MOTORIZED CONTROL DAMPER ACTUATORS

A. All control dampers, including automatic isolation dampers, shall be furnished and wired by this vendor, and installed by the mechanical installer. Dampers shall be furnished with 120 VAC electric actuators.

B. Actuators for motorized dampers shall be fast acting (15 second) integral spring return, two position units.

C. Actuators for smoke damper applications shall also meet UL 555S and be rated for 350F.

D. All actuators shall be provided with end switches for monitoring by BMS.

E. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

F. Accessories:

1. Auxiliary switches for position indication.
2. Test and reset switches, remote mounted.

2.10 ELECTRICAL WIRING

A. Wiring and connections required for the BMS shall be done under this Section, unless shown otherwise on Drawings, and shall comply with applicable requirements of the Electrical Section. Necessary normal and emergency power wiring to control devices shall be done under this section. Electrical circuits for all controls shall be dedicated only to the control

system. Wiring from building control units to point of use devices shall be a part of the work of this section.

2.11 ADDITIONAL FIELD SERVICES REQUIRED DURING CONSTRUCTION

A. Provide services of control supplier's field engineer to supervise work specified in other Sections:

1. Installation of separable wells, valved pressure taps, and piping furnished under this Section.
2. Provision of auxiliary contacts on magnetic starters with buttons and switches in required configurations.
3. Installation of motorized dampers.

PART 3 - CONTROL SEQUENCES

3.1 GENERAL CONTROL SYSTEM NOTES

A. All control sequences for temperature, relative humidity, air flow rate, and pressurization control shall be PID (proportional-integral-derivative) unless specified otherwise.

B. All set points for temperature, relative humidity, air flow rate, and static or differential pressure shall be adjustable by the operator (with password access), and shall be programmed with operator-adjustable high and low alarm points. In some instances, additional control actions may be specified to occur between the set point control range and the alarm point. In the control sequences that follow, initial set points are indicated where known.

C. All alarm points shall be programmed with an operator-adjustable time delay for alarm reporting, to prevent nuisance alarms due to momentary excursions in a system which is slow response by design. In the control sequences that follow, initial time delays are indicated where known.

D. For any motor or system specified for start/stop control by the BMS system, a digital input shall be reserved for a status tell back, typically via a motor current transformer or a differential pressure switch. The tell back shall indicate actual operation of the system, not just the energizing of a starter or contact. Whenever a “start” or “stop” command is given, and the status of the motor or system does not match the command within an operator-adjustable time limit, a failure alarm shall be generated.

E. The graphic display for each system shall include as applicable, manual command buttons and indication of operating state for on-off controls, such as motors and two-way valves, as well as lead-lag and/or standby status for systems with multiple units, and set point display and associated measured value for all operator-adjustable variables. The individual set point, limit, and alarm point input fields shall be easily accessible (at the correct password level) in a sub-menu display from selection of an icon next to or part of the respective set point in the main graphic display (see graphic display requirements in Part 2 of these specifications).

F. For all fan systems, there shall be a labeled and easily accessible means to shut down each fan manually in case of an emergency, in accordance with NFPA 90A. This may be a run/stop or H-O-A switch on the fan motor starter or variable frequency drive, but in any case, the contractor shall provide a label indicating its use for emergency shutdown of the respective fan. When any fan is shut down manually, the BMS system shall disable associated controls which are designed to function only with the fan in operation (such as dampers, valves, humidifiers, etc.) and shall generate a “fan failure” alarm.

G. Refer to Computer Room Design Criteria table on drawing M001 for indoor environmental requirements.

3.2 PRECISION COOLING SYSTEM SEQUENCE OF OPERATION

A. General

1. The mechanical cooling system includes nine Refrigerant Based Precision Cooling Systems with direct expansion cooling and integral refrigerant economizer operation. The graphics display shall show for each unit, it's on/off and alarm status and total run-time hours. The BMS shall enable each system to operate as described in the attached Sequence of Operation document. Systems are sized to handle the peak estimated cooling load for the data center with one or two units redundant depending on operating conditions.

B. Refer to Owner furnished document in Appendix B, DLR Data Center – Liebert DSE Systems – Data Center and Infrastructure Room - Sequence of Operation – Release Dated 04/01/2016, Version 2.1, for specific and detailed sequences.

C. Refer to Computer Room Design Criteria table on drawing M802 for indoor environmental requirements.

3.3 SMOKE ALARMS

A. HSO & Smoke Alarms

1. In the event of smoke sensed in an MAU supply duct, a relay shall disable the respective MAU from operating.
2. In the event of a simultaneous cross-zoned smoke detection in the computer room subfloor, the fire alarm shall activate the HSO switch which will then shut down all the CRACs serving the computer room.
3. In the case of smoke alarm, an indication will be sent to the BMS and an alarm will be generated.
4. In the case of an HSO trip, an alarm will be generated from the HSO active contact closure at the HSO device itself.

3.4 ELECTRICAL/UPS ROOM CRAC UNITS SEQUENCE

A. The Electrical Rooms are served by four CRACs, each sized to handle the load of each room. A NC motorized damper isolates each UPS room in raised floor (see plans).

B. Refer to Owner furnished document in Appendix B, DLR Data Center – Liebert DSE Systems – Data Center and Infrastructure Room - Sequence of Operation – Release Dated 04/01/2016, Version 2.1, for specific and detailed sequences.

C. During normal operation all electrical room CRACs will serve their respective UPS rooms.

D. Upon a failure of any one CRAC, and if there is no detection of smoke, the isolating motorized damper in the supply and return common headers will open. The active CRAC will increase output (air flow and cooling) to meet the load for all the rooms.

1. Refer to Electrical Room CRAC Damper Diagram on Drawing M201 and Fire Alarm Matrix for additional and specific information.

3.5 PACKAGED ROOFTOP VENTILATION UNIT

A. L230-242 have two ventilation Makeup Air Units (MAU) serving each computer room for ventilation and humidity control.

B. The MAU shall be started and stopped through the BMS, but once started, shall operate continuously through its packaged controls to provide conditioning of outside to the computer

room. Each MAU control package shall communicate through a communications link with the BMS.

C. The BMS graphics shall indicate the MAU, with temperature set points and measured values shown on a floor plan of the building. Hard I/O points related to the MAU, as well as any parameters available through an open communication interface shall be accessible through a sub-menu by clicking the mouse on a specific area of the plan.

D. Refer to Appendix B, DLR Data Center – Liebert DSE Systems – Data Center and Infrastructure Room - Sequence of Operation – Release Dated 04/01/2016, Version 2.1, for specific and detailed sequences.

3.6 COMBINATION FIRE/SMOKE DAMPER

A. Each transfer air opening between UPS rooms shall be equipped with a combination fire/smoke damper, with an actuator which is powered to open, and fails closed by a spring mechanism. Both dampers shall close automatically upon loss of power, upon the detection of smoke in either room. In addition, either damper shall close via its respective fusible link upon sensing air temperatures exceeding 165°F at the damper. The graphics display shall indicate the dampers and their open/closed status and any related alarms.

3.7 UPS ROOMS BATTERY EXHAUST SYSTEM

A. Each UPS room exhaust system includes one in-line duct fan as shown on the plans. The fan is connected via ductwork to exhaust intake register located within the UPS room, near the top of the rooms. It is intended that exhaust be provided on a continuous basis for the UPS rooms.

B. A motor current transformer shall be used to prove operating status for each fan. In addition, an airflow switch shall be installed within the exhaust ductwork below the roof.

C. Upon failure of the fan, as sensed by a loss of flow in the exhaust duct, or by loss of amperage at the current sensing transformer, the BMS shall de-energize the fan and generate a fan failure alarm.

D. The graphics display shall indicate the fans, and the exhaust air ductwork, showing the commanded state and status of fan. The display shall also show the duct air flow switch and its alarm status.

3.8 HUMIDIFIER

A. Humidifier units are located in CRAC gallery as shown on plans. BMS shall control the Humidifiers based on underfloor T/H sensors. Refer to Appendix B, DLR Data Center – Liebert DSE Systems – Data Center and Infrastructure Room - Sequence of Operation – Release Dated 04/01/2016, Version 2.1, for specific and detailed sequences.

3.9 ELECTRICAL INFRASTRUCTURE EQUIPMENT

A. The electrical infrastructure system includes packaged standby generators, located outdoors at grade, as well as utility switchgear, and four complete UPS systems located in the UPS room, and multiple power distribution units (PDUs) located within the computer room.

B. As a minimum, the BMS shall reserve at least twenty-four (24) digital input points (confirm with owner) for acceptance of status or alarm points from the electrical infrastructure equipment, and shall be configured to accept a communication interface from the UPS, PDUs, and the

generators, and display all operating parameters and alarm points as virtual points by selecting the individual equipment item from the layout graphic screen.

3.10 MISCELLANEOUS INTERFACES

A. The BMS shall be capable of interfacing with the data center and/or building security system, fire alarm system, and lighting system, all to be defined and specified under separate Sections.

END OF SECTION

SECTION 23 23 00
REFRIGERANT PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

B. Meet the following performance requirements:

1. Line Test Pressure for Refrigerant R-410A in accordance with|Code:
   a. Suction Lines for Air-Conditioning Applications: 300 psig (2068 kPa).
   b. Hot-Gas and Liquid Lines: 535 psig (3689 kPa).

C. For the Refrigerant Based Precision cooling system, provide refrigerant piping between indoor cooling unit (CRAC) and the air cooled condenser (ACC). Refer to the drawings for specific information.

D. Provide refrigerant R-410A for Refrigerant Based Precision Cooling Systems (section 23 81 23).

1.2 RELATED SECTIONS

A. Section 23 00 10 – General Mechanical Requirements, is an integral part of this section. Requirements and work indicated in 23 00 10 are not repeated in this Section.

B. Section 23 07 00 – Insulation.

C. Section 23 81 23i – Refrigerant Based Precision Cooling System.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 23 00 10.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Shop Drawing Scale: 1/4 inch equals 1 foot.
2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment per manufacturer requirements.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 23 00 10.

B. Provide welding certificates

C. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

D. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

E. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

F. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements indicated in Section 23 00 10.

1.6 SUBMITTALS

A. Submit as required under Section 23 00 10.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 23 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 23 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 23 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 23 00 10.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch (20-mm) misalignment in minimum 7-inch long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Non-rotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

2.3 REFRIGERANTS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

C. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.1 PIPING:

A. Suction and Liquid Lines: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Service valves as recommended by equipment manufacturer and in accordance with good engineering practices.

3.3 GENERAL PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated and size according to manufacturer's recommendations based on elevation change and length of pipe runs unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping adjacent to machines to allow service and maintenance.

E. Install piping free of sags and bends.

F. Install fittings for changes in direction and branch connections.

G. Select system components with pressure rating equal to or greater than system operating pressure.

H. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

I. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

J. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

K. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install traps and double risers to entrain oil in vertical runs., as required.
3. Liquid lines may be installed level.

L. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

M. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

N. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

O. Install sleeves through roof, walls, or ceilings, sized to permit installation of full-thickness insulation.

P. Seal pipe penetrations through roof according to Division 07 Section "Joint Sealants" for materials and methods.

Q. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 REFRIGERANT PIPING GUIDELINES FOR REFRIGERANT BASED PRECISION COOLING SYSTEMS

A. Air-cooled units ship with a nitrogen holding charge. Do not vent the evaporator until all refrigerant piping is in place, ready for connection to the unit and condenser.

B. Use copper piping with a brazing alloy with a minimum temperature of 1350°F (732°C), such as Sil-Fos. Avoid soft solders, such as 50/50 or 95/5.

C. Use a flow of dry nitrogen through the piping during brazing to prevent formation of copper oxide scale inside the piping. When copper is heated in the presence of air, copper oxide forms. POE oils will dissolve these oxides from inside the copper pipes and deposit them throughout the system, clogging filter driers and affecting other system components.

D. A pure dry nitrogen flow of 1-3 ft^3/min (0.5-1.5l/s) inside the pipe during brazing is sufficient to displace the air. Control the flow using a suitable measuring device.

E. Ensure that the tubing surface to be brazed are clean and that all burrs have been removed from the ends of the tubes.

F. Ensure that all loose material has been cleaned from inside the tubing before brazing.

G. Protect all refrigerant line components within 18 in. of the brazing site by wrapping them with a wet cloth or with a suitable heat-sink compound.

H. Isolate piping from building using vibration-isolating supports.

I. The outlet of the receiver must be higher than the elevation of the electronic-expansion valve (EEV) inside the indoor unit. If the vertical height is greater than 60 ft consult the factory. Condensers with receivers cannot be installed below the evaporator.

J. Consult factory if piping run exceeds 200 ft linear length or 300 ft equivalent length.

K. Install traps on hot-gas (discharge) lines at the base of vertical risers over 5 ft and every 20 ft or evenly-divided over the vertical rise. The DA250 has internally-installed traps on the hot-gas lines.

L. Pitch horizontal hot-gas piping down at a minimum rate of1/2 in. per10 ft so that gravity will aid in moving oil in the direction of refrigerant/oil flow.

M. Keep piping clean and dry, especially on units with R-410A refrigerant.

N. Charge systems with refrigerant as recommended by the manufacturer installation instructions.

O. Add oil of the types, viscosities and quantities as recommended by the manufacturer installation instructions.

3.5 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.6 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section “Supports and Anchors”.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) long.
2. Roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet (6 m) or longer, supported on a trapeze.
4. Spring hangers to support horizontal and vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 7/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
4. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
5. NPS 1 3/8: Maximum span, 72 inches; minimum rod size, 1/4 inch.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
   a. Fill system with nitrogen to the required test pressure.
   b. System shall maintain test pressure at the manifold gage throughout duration of test.
   c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
   d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.8 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.9 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Verify that compressor oil level is correct.
2. Open compressor suction and discharge valves.

3. Open refrigerant valves except bypass valves that are used for other purposes.
4. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 23 30 00
DUCTWORK AND ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Provide all materials and equipment, tools, labor and supervision required to fabricate and install sheetmetal ductwork, fittings, dampers, and accessories as required for a complete, operating air distribution system. The scope of work includes the following systems:

1. Fabrication and installation of supply and return air ductwork for packaged rooftop air conditioning units serving the office areas, corridors, and support spaces, including VAV terminals, fan-powered terminals diffusers, and grilles;
2. New exhaust air system including ductwork and fans to serve the new toilet rooms and lanitor's closets.
3. Fabrication and installation of supply and return air ductwork for packaged rooftop air conditioning units (RTU) serving the TKDs/TKFs and electrical Infrastructure rooms
4. New exhaust air systems including ductwork and fans to serve the new battery rooms.

B. All systems are shown on the drawings, with material and installation specifications listed below.

C. Provide supporting and hanging devices necessary to attach entire HVAC system including ductwork and equipment, and to prevent vibration. In general, support all ductwork from secondary structural steel attached to the building structure. Connect hanger rods to suitable supports using beam clamps or inserts. Do not use caddie clips for any duct supports.

D. Provide vertical and horizontal supports as required by codes to meet minimum applicable seismic resistance standards. Ductwork shall be free from vibration under all conditions of operation.

1.2 RELATED SECTIONS

A. Section 23 05 29 – Supports and Anchors

B. Section 23 07 00 - Insulation

1.3 REFERENCES

A. SMACNA HVAC Duct Construction Standards (Metal and Flexible)

B. NFPA 90A – Standard for the Installation of Air Conditioning and Ventilating Systems

C. NFPA 75 – Standard for the Protection of Electric Computer/Data Processing Equipment

D. ARI 880 – Industry Standard for Air Terminals

1.4 GENERAL

A. Section 23 00 10 – Mechanical Requirements, is an integral part of this section. Requirements and work indicated in 23 00 10 are not repeated in this Section.

1.5 QUALITY ASSURANCE

A. All ductwork shall be delivered to the job site in a clean condition, with all fittings and all section ends securely covered with polyethylene. The ductwork shall remain covered until

installation, and a thorough cleaning of each section of ductwork shall be performed as it is installed.

B. Comply with manufacturer's instructions for installation of fire and smoke dampers.

1.6 SUBMITTALS

A. Submit shop drawings for all ductwork systems layout, and product data for all material, sealants, hangers and supports, fabrication, dampers, registers, diffusers, grilles, fans, fan coil units, and specialties as specified in Section 23 00 10.

1. For material and equipment, list sizes, ratings, performance, controls, dimensions and weights, supplier, and connection and installation requirements.
2. Provide scale drawing (min ¼" = 1') of duct layout, coordinated with electrical and other trades to avoid interferences. Electronic files of the design layout will be made available for use by the Contractor to create coordination drawings.
3. Provide damper schedule.
4. Provide installation, operation, and maintenance manuals, including list of recommended spare parts (where applicable) for mechanical specialties.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Lock-forming quality; complying with G90 commercial coating in accordance with ASTM 527; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M) Alloy 303, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view. Used at humidifier manifold as shown and detailed on the drawings.

D. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.

E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.

B. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.

C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

E. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.3 HANGERS AND SUPPORTS

A. Building Attachments: Structural-steel fasteners appropriate for construction materials to which hangers are being attached.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

1. Hangers Installed in Corrosive Atmospheres: Electro-galvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

2.4 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Nexus Inc.
   c. Ward Industries, Inc.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Lockformer.
2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.5 ROUND DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

C. Duct Joints:

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
   a. Manufacturers:
      1) Ductmate Industries, Inc.
      2) Lindab Inc.

D. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

E. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

F. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter.

2.6 FLEXIBLE DUCTWORK AND FLEXIBLE CONNECTIONS

A. Flexible ductwork for HVAC systems, connected to insulated duct shall also be insulated and shall be a Class 1 air duct in accordance with UL 181, with 1-1/2”, ¾ lb. Density fiberglass insulation and an aluminized reinforced vapor barrier.

B. Flexible connections to fans and air handling units shall be neoprene-coated fibrous glass fire retardant fabric, by Ventfabrics or Durodyne. Entire unit shall be a Class 1 connector in accordance with UL 181. Secure flexible connections tightly to fan units with metal bands. Bands shall be same material as duct construction.

2.7 FIRE DAMPERS

A. Furnish install automatic fire (UL555) rated dampers at penetrations of fire rated walls as shown on plans. Refer to architectural drawings for ratings. All penetrations require 1½ -hour or 3-hour rated dampers (to match design).

B. Fire dampers shall be SMACNA Type B, with blades out of the air stream, and shall be constructed with minimum 0.034” thick roll formed galvanized steel frame and interlocking blades. Provide factory or field installed galvanized steel sleeve for each damper not installed within a duct. Dampers shall be equal to Ruskin Model IBD.

C. Fire dampers located within ductwork shall be dynamically rated.

D. Dampers shall be rated for UL555, and shall include a replaceable 165°F fusible link.

2.8 COMBINATION FIRE/SMOKE DAMPERS

A. Provide single or multiple blade combination fire/smoke (UL555/555S) rated dampers for installation as shown on plans. Wiring to Fire Alarm Control Panel provided under Division 28.

B. Damper frames shall be constructed of 16 gauge galvanized sheet metal and shall have flanges for duct mounting. Damper blades should not exceed 6” in width. Blades shall be suitable for high velocity performance. Damper bearings shall be stainless steel.

C. Dampers shall be rated for UL555/555S, Leakage Class 1, +250°F.

D. Seals shall provide tight closing, low leakage damper. Submit leakage and flow characteristic charts for approval. 48” x 48” damper section shall have leakage less than 8 cfm/sf at 4” WG differential pressure. Dampers shall be Ruskin FSD60-EFL or equal.

E. Damper Operators shall be electric/electronic, fail-safe, and matched to dampers for torque requirements. Operators shall have external adjustable stops to limit stroke in both directions. Operators shall be spring return electric actuator, 120 V/ 1 phase AC.

2.9 VOLUME DAMPERS

A. Provide manually adjustable volume dampers, with extended mount indicating and locking quadrants at each take-off to register, grille or diffuser (not all are shown on drawings).

B. Dampers shall be ½” smaller in both dimensions or 1” smaller diameter than size of duct in which they are installed: e.g. use 23-1/2” by 23-1/2” damper for 24” square duct. Dampers larger than 12” in height shall be opposed multi-blade.

C. Damper blades shall be two gauges heavier than adjoining ductwork, and shall be riveted to supporting rods. Hem over edges parallel to rods. Brackets shall be galvanized metal, secured to ductwork with sheet metal screw with locking quadrant arms (see seal class section for additional requirements). Provide 2” handle extension for all dampers on externally insulated ductwork.

D. Note: All required volume dampers may not be indicated on drawings but dampers shall be provided as necessary for system balancing.

2.10 DIFFUSERS, REGISTERS, AND GRILLES

A. Provide aluminum diffusers and registers for supply, return, transfer, and exhaust air for the data center and infrastructure rooms. Diffusers and registers shall be of size, type and design shown on drawings. Acceptable manufacturers shall be Tuttle & Bailey, Krueger, or Titus.

1. Equipment shall be tested and rated per ASHRAE 70.
2. Equipment shall handle air quantities at operating velocities with maximum diffusion within space, without objectionable air movement or noise. Maximum NC rating for any occupied space is 35.

2.11 IN-LINE EXHAUST FANS

A. Provide in-line, direct drive exhaust fans as scheduled on the drawings and as specified herein.

B. Fan types shall be as manufactured by Greenheck, Loren Cook Co. or Carnes Company, Inc.

C. The fan wheel, housing, and frame shall be constructed of aluminum,.

D. Provide each fan with gravity backdraft damper, belt guard and factory-mounted disconnect switch.

E. Damper: Gravity operated, parallel blade, integral backdraft damper.
   1. Blades: Die formed sheet aluminum
   2. Frame: Extruded aluminum, with waterproof, felt blade seals.
   3. Linkage: Non-ferrous metals, connecting blades to counter weight.

F. The fans shall be UL-Listed for electrical components and AMCA Rated as noted above.

G. Furnish disconnect switch.

H. Furnish duct collars on intake and discharge.

I. Furnish removable access panels.

2.12 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:
      a. CertainTeed Corporation; Insulation Group.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Owens Corning.
      e. Substitutions: Under provisions of Section 23 00 10.
      f. Maximum Thermal Conductivity:
         1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature.
         2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F (0.033 W/m x K) at 75 deg F (24 deg C) mean temperature.
   2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by trh EPA for use in HVAC systems.
   3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
      a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
   1. Basis-of-Design Product: Subject to compliance with requirements provide the product indicated on the Drawings or the first listed manufacturer or product below. Subject to compliance with requirements a comparable product by one of the others listed may be acceptable:
   2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:
      a. Aeroflex USA Inc.
      b. Armacell LLC.
      c. Rubatex International, LLC
      d. Substitutions: Under provisions of Section 23 00 10.
   3. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
   4. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
      a. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, [0.106-inch- (2.6-mm-)] [0.135-inch- (3.5-mm-)] diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- (0.41-mm-) thick aluminum; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches (38 mm) in diameter.

D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm (12.7 m/s).
7. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Terminate ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used; secure buildouts to duct walls with bolts, screws, rivets, or welds.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Ducts: 2-inch wg.(downstream of Air terminal Units).
2. Supply Ducts (before Air Terminal Units): 4-inch wg.
3. Return Ducts (Negative Pressure): 1-inch wg.
4. Exhaust Ducts (Negative Pressure): 1-inch wg.

B. Ducts shall be galvanized steel.

3.2 INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Make changes in duct size with tapered connections as required by SMACNA. Changes shall NOT exceed 30° from line of air flow. Take-off to the diffusers shall be 45° leading edge type or bellmouth type. Branch fittings shall be as detailed on the drawings.

C. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

D. Exposed ductwork shall have the joints and seams sealed in a professional and clean manner to create a professional appearance.

E. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

F. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

G. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant.

H. Supports for ductwork and equipment shall be galvanized unless specified otherwise.

I. Connect supply and return air ducts to RTU, fan coil units and fans to ductwork using flexible connections. Support ductwork independently from units. Where RTU is rigidly mounted and fans are isolated within the units, flexible connections to ducts are not required.

J. Make transverse joints, field connections, collar attachments and flexible connections to ducts and equipment with sheet metal screws or bolts and nuts. Do not use rivets and staples.

K. Elbows and bends for rectangular ducts shall have centerline radius of 1.5 times duct width wherever possible. Turning vanes and mitered elbows are not allowed for supply air ductwork, but may be used for transfer and exhaust air ductwork.

L. Provide proper pressure and leakage-rated, gasketed, duct mounted access panels/doors. In insulated ducts, access doors shall be insulated double wall. Gauges of door materials, number of hinges, number and type of door locks shall be as required by the SMACNA Duct Construction Standards. Unhinged doors shall be chained to frame with a minimum length of 6” to prevent loss of door. Door metal shall be the same as the attached duct material. For high temperature ducts, door assembly shall be rated for 2300°F. The minimum sizes are:

1. Fire dampers – 12” x 12” minimum.
2. Suction and discharge sides of inline fans – 24” x 24” minimum.
3. At locations indicated on drawings, or specified elsewhere – 12” x 12” minimum.

M. Provide supports for flexible ductwork at manufacturer’s recommended intervals. Sag shall not exceed ½” per foot of spacing between supports. Ducts shall not exceed 6 feet long and shall be used for straight run only, no offsets or turns.

N. Insulate all ductwork in accordance with Section 230700.

3.3 INTEGRATED SYSTEMS TESTING

A. Provide support for Integrated Systems Testing (Commissioning Level 5) in addition to and after successful completion of Acceptance Testing (Level 4). Provide for three12-hour days for air systems (fans, dampers, controls).

END OF SECTION

SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Fan-powered air terminal units.

B. Meet the following performance requirements:

C. Structural Performance:

1. Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible". Refer to Section 23 00 10.

1.2 RELATED SECTIONS

A. Section 23 00 10 – Basic mechanical requirements, is an integral part of this section. Requirements and work indicated in 23 00 10 are not repeated in this Section.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 23 00 10:

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 23 00 10.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2016, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements indicated in Section 23 00 10.

1.6 SUBMITTALS

A. Submit as required here in and under Section 23 00 10.

B. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.

1. Air terminal units.
2. Liners and adhesives.
3. Sealants and gaskets.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 23 00 10

B. Provide the following additional materials:

1. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   a. Fan-Powered-Unit Filters: Furnish one spare filter for each filter installed.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 23 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 23 00 10.

B. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.10 WARRANTY

A. Provide under provisions indicated in Section 23 00 10.

PART 2 - PRODUCTS

2.1 SERIES FAN-POWERED AIR TERMINAL UNITS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Environmental Technologies, Inc.
2. Nailor Industries Inc.
3. Price Industries.
4. Titus.

B. Configuration: Volume-damper assembly and fan in series arrangement inside unit casing with control components inside a protective metal shroud for installation above a ceiling.

C. Casing: 0.034-inch double wall.

1. Casing Lining: Adhesive attached, 1/2-inch- (13-mm) thick, coated, fibrous-glass duct liner complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
   a. Cover liner with nonporous foil and perforated metal.
2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
3. Air Outlet: S-slip and drive connections.
4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket and quarter-turn latches.
5. Fan: Forward Curved, dynamically balanced, galvanized wheel.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2016.
7. Radiated Sound Damper.

D. Volume Damper: Galvanized steel with flow-sensing ring and peripheral gasket and self-lubricating bearings.

1. Maximum Damper Leakage: ARI 880 rated, 2 percent of nominal airflow at 3-inch inlet static pressure.
2. Damper Position: Normally open

E. Air terminals shall be equipped with a multi-point, center-averaging or multiple point flow sensing ring type air flow sensor. The airflow sensor shall be designed to provide a differential pressure signal which is amplified 2.5 times the normal velocity pressure over the range or a minimum of 0.03” wg at 500 FPM.

F. Motor:

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."
2. Type: Electronically Commutated Motor (ECM) brushless DC controlled by an integral inverter controller.
3. Fan-Motor Assembly Isolation: Rubber isolators.
4. Efficiency: Premium efficient.
5. Motor Speed:
   a. Speed Control: Infinitely adjustable through a Pulse Width Modulating (PWM) controller designed for compatibility with the EMC motor. The speed controller shall have terminals for field verification of fan capacity with a digital volt meter. A calibration graph shall be supplied for each fan powered terminal unit indicating fan CFM verses DC volts.

G. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Material: Pleated cotton-polyester media having 90 percent arrestance and 7 MERV.
2. Thickness: 2 inches.

H. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with primary automatic, and secondary manual, reset thermal cutouts. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware.

1. Stage(s): Proportional (SSR) heater control.
2. Single point electrical connection.
3. Access door interlocked disconnect switch.
4. Downstream air temperature sensor with local connection to override discharge-air temperature to not exceed a maximum temperature set point (adjustable.)
5. Nickel chrome 80/20 heating elements.
6. Airflow switch for proof of airflow.
7. Fan interlock contacts.
8. Fuses in terminal box for overcurrent protection (for coils more than 48 A).
9. Mercury contactors.
10. Magnetic contactor for each step of control (for three-phase coils).
11. Provide a 480Volt/3 ph./60 to 277 Volt/1 ph/60 transformer with single feed to serve fan motor at 277volt and electric heating coil at 480 volt.

I. DDC Controls: Furnished by DDC system manufacturer and installed at factory terminal unit manufacturer. Control devices shall be compatible with temperature controls specified in Division 23 Section "" “Building Monitoring System” and shall have the following features:

1. Occupied and unoccupied operating mode.
2. Remote reset of airflow or temperature set points.
3. Adjusting and monitoring with portable terminal.
4. Communication with temperature-control system specified in Division 23 Section ”Building Monitoring System”.

2.2 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

C. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to ARI 880.

1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Terminal box manufacturer shall factory mount terminal box controller, damper actuator, velocity pressure transducer, and control transformer furnished by Division 23 Section Controls Contractor. Controls shall be installed in accordance with control manufacturer's recommendations.

1. Install pneumatic tubing from the terminal box airflow sensor to the terminal box controller transducer.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Structural-steel fasteners appropriate for construction materials to which hangers are being attached.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

A. Make connections to air terminal units with flexible connectors complying with requirements in Division 23 Section "Air Duct Accessories."

3.4 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Air terminal unit will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION

SECTION 23 74 13
PACKAGED ROOFTOP VENTILATION UNIT

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish and install equipment and appurtenances related to the Data Center ventilation air system as specified herein, and as scheduled on the drawings. The equipment includes packaged rooftop ventilation unit (MUA) and related accessories and controls as specified in Part 2, below.

B. The scope of work includes rigging the MAU to the roof, setting, leveling, and anchoring them on factory-furnished roof curb, and connecting related ductwork and controls.

C. Provide for start-up of equipment by a qualified representative of the manufacturer, commission and test all new equipment, and provide signed, written reports as specified in Section 23 08 00.

1.2 RELATED SECTIONS

A. Section 23 08 00 – Testing, Adjusting, and Balancing

B. Section 23 00 10 – General Mechanical Requirements

C. Section 23 30 00 – Ductwork and Accessories

D. Section 23 80 13 - Provide manufacturer's support as required to coordinate with the Commissioning Agent and all commissioning efforts and paperwork for Acceptance and Integrated Systems Testing

1.3 REFERENCES

A. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilation Systems

B. ASHRAE 90.1 Energy Efficient Design of New Buildings Except Low Rise Residential Buildings

C. International Energy Conservation Code 2012

D. UL - Underwriters Laboratories

1.4 QUALITY ASSURANCE

A. Conform to ANSI/NFPA 90A for the installation of all air conditioning units.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2016, Section 4 – "Outdoor Air Quality," Section 5 – "Systems and Equipment," Section 6 – "Ventilation Rate Procedures," and Section 7 – "Construction and startup."

1.5 SUBMITTALS

A. Submit shop drawings for packaged rooftop unit and accessories indicating dimensions, weights, mounting locations and anchoring recommendations, required clearances, field assembly requirements, locations and sizes of ductwork connections, and complete power and control wiring diagrams

B. Submit complete product data for units indicating all pertinent performance data for cooling, heating, and air flow rates. Provide fan curves, compressor data, electrical data, and certified sound measurement data for all equipment.

C. Submit sets of manufacturer's installation instructions, operation, and maintenance manuals, and list of recommended spare parts prior to shipment of equipment.

D. Provide full parts and labor warranty for a period of not less than one year from the date of start up for all equipment, with a five-year warranty on compressors.

PART 2 - PRODUCTS

2.1 PACKAGED ROOFTOP VENTILATION UNIT

A. General

1. The unit shall be down discharge airflow. Cooling performance shall be rated in accordance with ARI testing procedures. The unit shall be factory assembled, internally wired, fully charged with R-410A, and 100 percent run tested control sequence checkout before leaving the factory.
2. Units shall be ETL listed and labeled, classified in accordance to UL 1995/CAN/CSA No. 236-M40 for Central Cooling Air Conditioners.

B. Casing

1. Unit casing shall be constructed of zinc coated, heavy gauge, and galvanized steel. Exterior surfaces shall be phosphatized and finished with a weather-resistant baked enamel finish. Unit's surface shall be tested 1000 hours in a salt spray test in compliance with ASTM B45. Unit shall have a two inch thick antimicrobial Insulation. All insulation edges shall be captured or sealed. Casing shall be 2-inch, double wall construction.
2. The base pan shall have no penetrations within the perimeter of the curb.
3. The top cover shall be one piece construction or, where seams exist, it shall be double-hemmed and gasket-sealed. The ribbed top adds extra strength and enhances water removal from unit top
4. Furnish modulating outside air/return air with economizer controller.

C. Sensors

1. A factory installed combination outdoor air sensor located in the outdoor air hood will sense both outdoor air temperature and relative humidity. A factory installed discharge air sensing tube will sense the supply air temperature and relative humidity downstream of the indoor fan section.

D. Indoor Fans

1. Supply fan motor shall be direct drive type with factory installed Variable Speed Drive.

E. Evaporator Coil

1. Internally finned, 5/16 inch copper tubes mechanically bonded to a configured aluminum plate. The evaporator coil shall be leak tested to 500 psig and pressure tested to 500 psig.
2. A stainless steel double-sloped condensate drain pan with provision for through the unit wall condensate drain.
3. Evaporator coil shall have six interlaced rows for sensible and latent cooling.

F. Hot Gas Reheat

1. Furnish a modulating hot-gas reheat coil located on the leaving air side of the evaporator coil pre-piped and circuited with a low pressure switch.

G. Compressors

1. Compressors shall be direct-drive, hermetic, scroll type with centrifugal oil pumps. Motors shall be suction gas-cooled and shall have a voltage utilization range of plus or minus 10 percent of unit nameplate voltage.
   a. One compressor shall be digital scroll.

2. Internal overloads shall be provided with the scroll compressors. Crankcase heaters shall be included.

H. Condensers

1. Air Cooled condenser coil shall have a series of flat tubes containing a series of multiple, parallel flow micro-channels layered between the refrigerant manifolds. Coil construction shall consist of aluminum alloys for fins, tubes, and manifolds.

I. Capacity Control

1. Service pressure ports, and refrigerant line filter driers are factory-installed as standard. An area shall be provided for replacement suction line driers.
2. Capacity is controlled by Adiabatic Proportional Regulator (APR) installed on the lead circuit.

J. Unit Controls

1. Unit is completely factory wired with necessary controls and contactor pressure lugs for power wiring. Units will provide an external location for mounting fused disconnect device. Micro-processor controller is furnished for all 24 volt control functions. The resident control algorithms will make all heating, cooling and/or ventilating decisions in response to electronic signals from sensors measuring outdoor temperature and humidity as well as indoor temperature. The control algorithm maintains accurate temperature control, minimizes drift from set point and provides better building comfort. A centralized micro-processor will provide anti-short cycle timing for a higher level of machine protection. Terminals are provided for a field installed dry contact or switch closure to put the unit in the Occupied or Unoccupied modes.
2. Controller shall include BACnet communication with BMS and display screen.
3. Refer to Owner furnished document in Appendix A, DLR Data Center – Liebert DSE Systems – Data Center & Electrical Room – Sequence of Operations – Release dated 04/01/16, Version 2.1, attached to this specification for specific controls sequences.

K. Filters

1. Aluminum mesh filters shall be installed on the intake of the unit. In addition, one row of 2 inch MERV-13 rated filters (80 percent) shall be installed upstream to the evaporator coil.

L. Hail Guard

1. Hail guards shall be installed on the outside of the condenser coil. The guards shall consist of perforated metal, of the same gauge and color as the unit itself. Airflow through the hail guards shall not be restricted due to location or size of the perforations. Guards shall be removable to accommodate coil cleaning.

M. Electric Heater

1. Furnish electric resistance heating coil. Heaters shall meet the requirements of the National Electrical Code and shall be listed by Underwriters Laboratories for zero clearance to combustible surfaces and for use with heat pumps and air conditioning equipment.
2. Heating elements shall be open coil, 80% nickel, 20% chromium, Grade A resistance wire. Coil shall be machine crimped into stainless steel terminals extending at last 1 inch into the air stream and all terminal hardware shall be stainless steel. Coil shall be supported by ceramic bushings staked into supporting brackets.
3. Heater frames and terminal boxes shall be corrosion resistant steel. The terminal box shall be NEMA 1 construction and shall be provided with a hinged, latching cover.

4. Heater shall be furnished with a disc type, automatic reset thermal cutout for primary over temperature protection. Heater shall be furnished with disc type, load-carrying manual reset thermal cutouts, factory wired in series with heater stages for secondary protection.
5. Control will be SCR.

N. Miscellaneous Options and Accessories

1. Furnish low ambient operation capability.

O. Communications: As a minimum, provide a network interface card for the MAU, capable of communicating all operating conditions, set points, and alarms to the BMS. Coordinate with the BMS vendor to provide information in MODbus protocol, which is standard protocol used by the BMS.

P. Electrical: MUA shall be 460V, 3 Phase, 60 Hz.

Q. Powered convenience outlet for each unit shall be by electrical contractor.

2.2 ROOFTOP UNIT SCHEDULE

A. Furnish rooftop unit as scheduled on drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that roof and structure is ready to receive work and opening dimensions are as indicated on shop drawings. Install roof curb and ductwork prior to installation of unit.

B. Verify that proper power supply is available

3.2 INSTALLATION AND START UP

A. Install unit in accordance with manufacturer's instructions. Coordinate installation of rooftop air conditioning unit with roof work.

B. Verify roof curb cavity has been insulated as called for on M201 and in section 23 07 00.

C. Set and level unit on roof curb after ductwork connections are complete. Provide condensate drain with cleanable trap for each unit, discharging onto splash pad on roof.

D. Arrange and pay for the services of a qualified representative of the manufacturer to start up and commission all new rooftop air conditioning units, and to provide a written start up report for each unit.

3.3 INTEGRATED SYSTEMS TESTING

A. Provide support for Integrated Systems Testing (Commissioning Level 5) in addition to and after successful completion of Acceptance Testing (Level 4). Provide for one 12-hour day for the MAU.

END OF SECTION

SECTION 23 81 25
REFRIGERANT BASED PRECISION COOLING SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. These specifications describe requirements for a refrigerant based Precision Cooling system. The system shall be designed to control temperature and humidity conditions in rooms containing electronic equipment, with good insulation and vapor barrier. The manufacturer shall design and furnish all equipment to be fully compatible with heat dissipation requirements of the room.

1. Systems shall include indoor unit (CRAC), air cooled condensers, pumping unit, integral controllers and control devices, and piping riser assembly.

B. The system shall be furnished by a single manufacturer and be a fully integrated system complete with indoor cooling units, piping, condensers, piping assemblies, pumping unit, controls and start-up services.

C. Basis of Design is the Liebert DSE series. Certain nomenclature herein reference Liebert products.

1.2 DESIGN REQUIREMENTS

A. The Precision Cooling system shall be a Liebert self-contained, factory-assembled unit with downflow air delivery. The system shall have a net total cooling capacity of 181.5 kW with a net sensible cooling capacity of 181.5 kW based on an entering air temperature of 95 °F dry bulb, 20.5% RH.

B. The unit is to be supplied with 460 volt 3 ph 60 Hz 3 wire, no neutral electrical service. Net capacities shall include losses due to fan motor heat. The system cooling capacity shall be factory certified per ASHRAE127-2007, and the system sensible coefficient of performance (SCOP) shall exceed ASHRAE 90.1-2010.

1.3 RELATED SECTIONS

A. Section 23 00 10 – General Mechanical Requirements, is an integral part of this section. Requirements and work indicated in 23 00 10 are not repeated in this Section.

B. Section 23 05 29 – Supports and Anchors

C. Section 23 07 00 - Insulation

D. Section 23 08 00 – Mechanical Systems Identification

E. Section 23 08 13 – Testing, Adjusting and Balancing

F. Section 23 09 00 – Building Management System

G. Section 23 23 00 – Refrigerant Piping

1.4 COORDINATION

A. Coordinate work under provisions indicated in Section 23 00 10.

1.5 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 23 00 10.

B. ASHRAE Compliance:

1. Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment," and Section 7 - "Construction and Startup."
2. The system cooling capacity shall be factory certified per ASHRAE127-2007, and the system sensible coefficient of performance (SCOP) shall exceed ASHRAE 90.1-2010.

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004.

1.6 REGULATORY REQUIREMENTS

A. Conform to requirements indicated in Section 23 00 10.

1.7 SUBMITTALS

A. Submit as required herein and under Section 23 00 10 and 01 33 00.

B. Product Data: For each type of product indicated, include rated capacities, operating characteristics, operating conditions, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings: For the precision cooling system, submit all equipment and components, including plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.8 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 23 00 10.

B. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set(s) of filters for each indoor cooling unit.

1.9 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 23 00 10.

1.10 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 23 00 10.

1.11 WARRANTY

A. Provide under provisions indicated in Section 23 00 10.

PART 2 - PRODUCT

2.1 FRAME AND CASING

A. The frame shall be welded, formed sheet metal. It shall be protected against corrosion using the autophoretic coating process. The frame shall be capable of being separated into three parts in the field to accommodate rigging through small spaces.

B. The supply air shall exit from the bottom of the unit.

C. The return air shall enter the unit from the top

D. The exterior panels shall be insulated with a minimum 1 in., 1.5 lb. density fiber insulation. The main front panel shall have captive quarter-turn fasteners. The indoor unit color shall be ZP-0420, Charcoal Gray.

E. Filter access through filter access plenum.

2.2 FILTERS

A. The filter plenum shall be exterior to the main CRAC unit, and shall be field assembled and installed. The filters shall be removable from the front of the filter plenum. The filter plenum shall match the panel colors and finish of the indoor cooling unit (CRAC).

B. Filters shall be deep pleated 4" filters with an ASHRAE 52.2, MERV 8 efficiency rating.

C. One extra set of filters shall be provided per each indoor cooling unit.

2.3 FAN SECTION

A. The fans shall be plug/plenum Electronically Commutated (EC) type, with motorized impellers, single inlet and dynamically balanced. The drive package shall be direct drive, electronically commutated and variable speed. The fans shall be located to draw air over the A-frame coil to ensure even air distribution and maximum coil performance. EC fans shall be capable of being lowered into a raised floor (during field installation) with minimum height of 24". EC fans shall also be capable of operating within the cooling cabinet, instead of under the floor.

2.4 DUAL REFRIGERATION SYSTEM

A. Each unit shall include two independent refrigeration circuits and shall include liquid line filter driers, refrigerant sight glass with moisture indicator and electronic expansion valves. Compressors shall be located outside the airstream and shall be removable and serviceable from the front of the unit. Each compressor circuit shall be connected to the full-face area of the evaporator coil.

B. The compressors shall be tandem, scroll-type with a variable capacity operation capability of one compressor of the pair. Compressor solenoid valve shall unload the compressor and allow for variable capacity operation. The compressor shall have vibration isolators, thermal overloads, automatic reset high-pressure switch with lockout after three failures, rotalock service valves, suction line strainer and a maximum operating speed of 3500 RPM. The compressor motor shall be suction gas cooled.

C. The compressors shall include crankcase heaters, powered from the indoor unit electric panel.

D. The evaporator coil shall be A-frame design and have 56.2 sq. ft. face area, six rows deep, with each circuit feeding three rows. It shall be constructed of rifled copper tubes and aluminum fins with a maximum face velocity of 374 ft. per minute at 21,000 CFM. A stainless steel condensate drain pan shall be provided.

E. The indoor evaporator unit shall include refrigerant piping and shall have a factory holding charge of nitrogen. The hot-gas and liquid lines shall be spun shut and each shall include a factory-installed Schrader valve. Field-relief of the Schrader valve shall indicate a leak-free system from the factory

F. The system shall be designed for use with R-410A refrigerant, which meets the U.S. Clean Air Act for phase-out of HCFC refrigerants. Refrigerant shall be field supplied and field charged by the installing contractor.

2.5 ECONOPHASE PUMPING UNIT

A. Furnish factory packaged Econophase Pumping Units for each Precision Cooling System in the Computer Room (Not included on UPS Room units). During cold outdoor temperatures, refrigerant pumps in the Pumping Unit shall circulate refrigerant through the cooling system, in lieu of operating the compressors. The compressors shall ramp down during EconoPhase operation, and if able to completely offset the load, the control system shall shut the compressors off. Dual refrigerant pumps shall be housed in an enclosure, with each pump dedicated to its own refrigerant circuit. The EconoPhase system shall include a variable speed drive on each refrigerant pump to enable to pumps' speed to adjust in response to the load.

B. Furnish accessory SFA #: DC-35515-1, with Single Point Power in an outdoor enclosure for the condensers and EconoPhase Pump. Connection shall serve two condensers and single EconoPhase Pumping Unit.

2.6 FACTORY FABRICATED CONDENSER SKID

A. Coil

1. Microchannel coils are all-aluminum construction with full-depth louvered aluminum fins.
2. Tubes, fins and aluminum headers are oven-brazed to form a complete refrigerant-to-air heat exchange coil. Baffles are used in the headers to separate one coil slab into multiple passes as needed.
3. The coil shall be factory leak tested at a minimum of 300 PSIG and dehydrated.
4. Copper stub pipes are electric resistance welded to aluminum coils and joints are protected with polyolefin to seal joint from environmental corrosive elements.
5. Hot gas and liquid lines are brazed to stub pipes with spun closed ends for customer piping connections.
6. Coil pipe assembles to be filled and sealed with a nitrogen holding charge for shipment.

B. Fan/Motor Assembly

1. The fan/motor assembly is complete with external rotor motor, fan blades and fan/finger guard.
2. Fan blades are constructed to stamped aluminum or steel extrusion coated with PP plastic.
3. Fan guards are heavy gauge, close meshed, steel wire, coated with a black corrosion resistant finish.
4. Fan terminal blocks located on the top of the fan guard with IP54 protection class.
5. Fans are factory balanced and tested before shipment.
6. Fan motors are variable speed. The EC fans provide internal overload protection through the built-in electronics.
7. Each EC fan motor has built-in controller and communication module, linked via RS485 communication wire to each fan and the Premium Control Board.

C. Premium Efficiency Fan Control

1. The premium efficiency condenser control system is complete with control board, EC fan motor(s), refrigerant-pressure transducer(s), refrigerant-temperature thermistor(s),

ambient-temperature thermistor, and motor overload protection in the factory wired control panel.

2. The control board maintains EC fans on the same circuit to the same speed in order to maintain refrigerant head pressure. The control board receives a run signal from the compressor of the indoor unit via field-supplied low voltage interlock wires or with optional, field-supplied CANBUS communication wires from the indoor unit iCOM. The system head pressure can be maintained to a minimum ambient temperature of 0°F (-18°C).

D. Housing

1. The condenser housing is constructed of bright aluminum sheet and divided into individual fan sections by full width baffles.
2. Internal structural support members, including coil support frame, are galvanized steel for strength and corrosion resistance.
3. Panel doors are provided on two sides of each coil/fan section to provide for coil cleaning.
4. Aluminum legs are provided with rigging holes for hoisting the unit into position.

E. Electrical

1. Locking unit disconnect switches are factory installed and wired in attached condenser control section.

F. Skid Mounting

1. Condensers shall be skid mounted at the manufacturer's factory, and be pre-piped and pre-wired. Refer to the drawings for arrangement and details.

2.7 MISCELLANEOUS OPTIONS

A. Dual Locking Disconnect Switches

1. SFA #: E-33253-6, Dual Locking disconnect switches and reversing starter.
2. 460V 60Hz unit with two Reversing starters to provide primary power and secondary power. First reversing starter to provide power to main fan motor, compressors, controls and condensate pump. Second reversing starter to provide power to PRE unit, which provides single point power to Liebert MC (condensers).
3. Unit to be marked for 65 KAIC SCCR.
4. Furnish two pneumatic timers for delay on switchover for either power supply, selector switch in low volt section, status contacts to customer connection terminals, and Indicator lights on accent panel.

B. Smoke Sensor

1. The smoke sensor in the indoor cooling unit shall immediately shut down the Precision Cooling system and activate the alarm system when activated. The smoke sensor shall be mounted in the electrical panel with the sensing element in the return air compartment. The smoke sensor is not intended to function as or replace any room smoke detection system that may be required by local or national codes. The smoke sensor shall include a supervision contact closure.

C. Condensate Pump, Dual Float

1. The condensate pump shall have a minimum capacity of 145 GPH at 20 ft. head. It shall be complete with integral dual-float switches, pump-and-motor assembly and reservoir. The secondary float shall send a signal to the local alarm and shut down the unit upon high water condition.

D. Main Fan Overload

1. A pair of N/O contacts shall be factory-installed and wired to indicate Main Fan Overload.

E. Compressor Overload

1. A pair of N/O contacts shall be factory-installed and wired to each compressor to indicate Compressor Overload.

F. Electrical

1. Indoor unit configured for 460V, 3Φ, 3-wire service.
2. Unit rated at 65 KAIC.
3. Unit configured for 120V.1Φ UPS power to indoor CRAC unit iCOM controller.

G. Furnish iCOM control over ride (Quick Start). Fan(s) to re-start immediately on power up. iCOM controls take over after time delay.

2.8 LIQUID SENSORS

A. One leak detection cable.

2.9 FLOOR STAND

A. The floor stand shall be constructed of a welded steel frame. The floor stand shall have adjustable legs with vibration isolation pads. The floor stand shall be 36 inches to match access flooring.

B. Isolation pads furnished by Section 23 05 29.

2.10 FILTER ACCESS

A. Furnish and install separate 18” filter access section located at the top of the indoor cooling unit (CRAC) to enable front filter access.

2.11 CONTROL AND SEQUENCES

A. The Liebert iCOM unit control is factory-set for Intelligent Control. Proportional and Tunable PID are user selectable options. Internal unit component control shall include the following: System Auto Restart, Sequential Load Activation, and Predictive Humidity Control. The control system and electronic circuitry shall be provided with self-diagnostics. The microcontroller board shall be diagnosed and reported as pass/not pass. Control inputs shall be indicated as on or off at the front monitor panel. Control outputs shall be able to be turned On or Off from the front monitor panel without using jumpers or a service terminal.

B. Refer to Owner furnished document in Appendix A: DLR Data Center – Liebert DSE Systems – Data Center & Electrical Room – Sequence of Operations – Release dated 10/09/14, Version 1.8, attached to this specification for specific controls sequences.

2.12 ICOM MICROPROCESSOR CONTROL WITH LARGE GRAPHIC DISPLAY

A. The Liebert iCOM Large Graphic Display shall include a 320x240 dot matrix graphic display and a 120V power supply.

B. The system displays user menus for active alarms, event log, graphic data, unit view/status overview (including the monitoring of room conditions, operational status in % of each function, date and time), total run hours, various sensors, display setup and service contacts. A password is required to make system changes within the service or advanced menus.

C. The Liebert iCOM control shall activate an audible and visual alarm in event of any of the following conditions:

D. High/Low Temperature, High/Low Humidity, Main Fan Overload (if option selected), Change Filters, Loss of Air Flow or Power, and four separate Custom Alarms.

2.13 ADDITIONAL SENSORS

A. A factory furnished and commissioned supply air temperature sensor with 40'-0" of horizontal wiring ships with the unit for sensor location in the field. The sensor is terminated on the Liebert iCOM unit controller terminal strip and the associated cable wiring is coiled within the unit for shipment.

B. A factory furnished and commissioned differential pressure sensor ships with the unit for sensor location in the field. The sensor is terminated on the Liebert iCOM unit controller terminal strip.

C. A factory furnished combination return air temperature/humidity sensor is factory installed and wired within the return plenum of the unit. The sensor is terminated on the Liebert iCOM unit controller terminal strip.

2.14 LOW VOLTAGE TERMINAL PACKAGE

A. Two additional remote shutdown terminals.

B. Two additional common alarm normally open contacts for remote indication of unit alarms.

C. Main fan auxiliary switch, with one set of normally open contacts

2.15 NETWORK INTERFACE CARD (NIC)

A. The Liebert IntelliSlot 485 Card provides Liebert SiteScan® Web or Building Management Systems monitoring and control of your Liebert equipment. The card delivers Modbus or Liebert's proprietary protocol via the RS-485 port.

2.16 SMOKE SENSOR

A. Furnish smoke sensor in the return air and shuts down the unit if smoke is detected.

B. Furnish a visual and audible alarm.

C. Furnish dry contacts are available for a remote alarm.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify that flooring system is ready to receive work and opening dimensions are as indicated on shop drawings.

B. Verify that proper power supply is available.

C. Contractor shall field verify Piping and Electrical Riser Connection Assembly dimensions.

D. Field fabricated return air plenum to be furnished and installed by mechanical installer.

3.2 INSTALLATION & START UP

A. Install units in accordance with manufacturer's instructions. Coordinate installation of indoor cooling units with computer room raised floor installer. Place floor stands during construction

of raised floor. Provide adequate drainage connections for condensate system. Secure floorstands to floor slab with anchor bolts.

B. Connect field furnished refrigerant piping to equipment and Riser Assembly. Refer to section 23 23 00 for requirements.

C. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

D. Arrange and pay for the services of a qualified representative of the manufacturer to start up and commission all new CRAH units, and to provide a written start up report for each unit.

E. Install condensers and EconoPhase Pumping Units on the roof structural supports, as indicated on the drawings.

F. Refrigerant shall be field supplied and field charged by the installing contractor.

3.3 INTEGRATED SYSTEMS TESTING

A. Provide support for Integrated Systems Testing (Commissioning Level 5) in addition to and after successful completion of Acceptance Testing (Level 4). Provide for one 4-hour day for each Precision Cooling System.

END OF SECTION

SECTION 23 84 13
HUMIDIFIERS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following humidifiers:

1.2 RELATED SECTIONS

A. Section 23 00 10 – General Mechanical Requirements, is an integral part of this section. Requirements and work indicated in 23 00 10 are not repeated in this Section.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 23 00 10.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 23 00 10.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements indicated in Section 23 00 10.

1.6 SUBMITTALS

A. Submit as required herein and under Section 23 00 10.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 23 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 23 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 23 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 23 00 10.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. General: Except as otherwise indicated, provide packaged humidifiers and ancillary equipment with manufacturer's standard materials and components as indicated and published product information, designed and constructed by manufacturer, and as required for complete installation.

2.2 ADIABATIC WETTED MEDIA HUMIDIFIER

A. General: Provide humidifiers, of size and capacity as scheduled.

B. The casing of the Humimax humidifier is made of stainless steel. A humidification pad is mounted in the air inlet. The air to be humidified is drawn through the pad by an axial fan positioned in the outlet of the unit.

C. The bottom of the unit forms a water reservoir. Water is supplied to the reservoir through a water filter, a solenoid valve and a float valve that controls the water level. A circulation pump, in the water reservoir, feeds water to the distribution manifold located at the top of the humidification pad. The reservoir is emptied and refilled with fresh water to ensure low level of minerals, on a regular basis, using a drain valve that is opened or closed electrically.

D. Equip unit with a built-in overflow protection.

E. Equip unit with a control panel with possibility to set maximum fan speed, batch drain intervals and biocide intervals.

F. Furnish a factory humidity set point control unit for each humidifier. Control units shall be mounted beneath the raised floor as shown on the Contract Drawings. Up to six units may be circuited together. The control unit is wired to a terminal at the unit mounted control panel.

G. Furnish wall stand.

H. Furnish rear filter for the humidifier units.

I. Humimax humidifier power required is single phase 120V, 60 Hz.

J. Manufacturer:

1. Munters

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which humidifiers are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF HUMIDIFIERS

A. General: Install humidifiers where indicated, in accordance with equipment manufacturer's written instructions, and with recognized industry practices, to ensure that humidifiers comply with requirements and serve intended purposes.

B. Access: Provide access space around humidifiers for service as indicated, but in no case less than that recommended by manufacturer.

C. Support: Provide supports humidifiers as indicated and in accordance with manufacturer's installation instructions. Coordinate supports with structural and architectural trades.

D. Connect humidifier to water supply piping (provided by Div 22) and drainage piping.

E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.
2. Install humidity control units under Computer Room raised floor as shown on the Drawings.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation and prior to initial operation, test and demonstrate that air humidification equipment is leak-tight.

B. Repair or replace air humidification equipment as required to eliminate leaks, and retest as specified to demonstrate compliance.

3.4 ADJUSTING AND CLEANING

A. Start-Up: Start-up humidifiers in accordance with manufacturer's instructions by factory authorized personnel.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain humidifiers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 26 00 10
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Contract and General and Supplementary Conditions and Division 1 Specifications are hereby made a part of Division 26, 27, and 28 as fully as if repeated herein. Where provisions of Division 1 and 26, 27, and 28 conflict, the greater or more strict shall prevail.

B. This Section includes general administrative and procedural requirements for electrical installations including Division 26, 27, and 28. The requirements included in this Section expand the requirements specified in Division 1.

C. Electrical work shall comply with the requirements indicated in all sections of Division 26, 27, and 28. Examine all Divisions of the specifications and drawings to determine the complete Scope of the electrical work.

D. The work to be done under Divisions 26, 27, and 28 of the Specifications shall include the furnishing of all labor, material, equipment, tools and appurtenances and performing all operations necessary to provide complete, fully functional systems in accordance with the Specifications, the Drawings and requirements of the applicable codes and standards listed herein. Where the specifications, drawings, applicable codes or standards conflict provide the greater or more strict requirement.

E. Visit areas of construction where Work is to take place, and examine the construction site carefully, noting locations and conditions under which the Work will be performed and accepting the responsibility for performing the Work under the existing conditions.

F. The work shall include the following specification sections:

1. Division 26
   26 00 10 Basic Electrical Requirements
   26 05 00 Common Work Results for Electrical
   26 05 19 Electrical Power Conductors and Cables (600 Volts or Less)
   26 05 26 Grounding
   26 05 29 Hangers and Supports for Electrical Systems
   26 05 33 Raceway and Boxes for Electrical Systems
   26 05 36 Cable Trays for Electrical Systems
   26 05 38_Cable Bus for electrical systems
   26 05 39_Trenwa precast trench solution
   26 05 43 Underground Ducts and Raceways for Electrical Systems
   26 05 48 Vibration and Seismic Controls for Electrical Systems
   26 05 53 Identification for Electrical Systems
   26 08 00 Electrical General Commissioning Requirements
   26 08 13 Testing of Electrical Systems
   26 09 23 Lighting Control Devices
   26 22 00 Low – Voltage Transformers
   26 24 13i Switchboards – Install
   26 24 16 Panelboards
   26 26 00i Power Distribution Units – Install
   26 27 26 Wiring Devices
   26 28 13 Fuses

26 28 16 Enclosed Switches and Circuit Breakers
26 32 13i Engine Generators – Install
26 32 16 Engine Generator Field Startup Requirements
26 33 53i Static Uninterruptible Power Supply – Install
26 41 13 Lightning Protection For Structures
26 43 13 Surge Protective Devices
26 51 00 Interior Lighting

2. Division 27
   27 05 26 Grounding and Bonding for Communication Systems
   27 05 28 Low Voltage Raceway Systems

3. Division 28
   28 31 11_Digital, addressable fire-alarm system - PBB
   28 31 11 Digital, Addressable Fire-Alarm System – Suite
   28 31 46_Air sampling smoke detection system

G. The work shall include, but not be limited to, providing equipment and items listed below and installing items furnished under other Divisions of these specifications.

1. The following Drawing Series:

   a. “E” Series
   b. “ES” Series
   c. “EA” Series
   d. “FA” Series

2. Commissioning of Building Systems – assistance and coordination.
3. Electrical Service – coordinate and install. Provide metering provisions required and meet all utility requirements.
4. Conduit, wire and electrical connections to items furnished under other Divisions.
5. Supplementary steel, channel and supports.
6. Coordination with Construction Manager and General Contractor for controlled environmental conditions for stored and installed equipment in compliance with NFPA 70B and the manufacturer/vendor’s requirements. This includes equipment furnished by others and stored or installed under this Section.
7. Provide controllers, starters and variable speed drives for plumbing, fire protection, heating, ventilating and air conditioning equipment except for packaged equipment with integral controllers, unless otherwise indicated.
8. Power wiring and connections for all Heating, Ventilating, Air Conditioning, Plumbing Systems, Elevators and Utilization Equipment including power wiring to control panels.
9. Provide conduit and wiring for dock levelers, motor operated doors and windows, projection screens and their control stations. Install control stations.
10. All materials and appurtenances that can reasonably be inferred to be a part of the electrical systems and necessary to its proper operation, but not specifically mentioned or indicated on the drawings, shall be furnished and installed without additional charge.
11. Identification and Signage as required herein, by code or local authorities.
12. Concrete precast pits, manholes, handholes, frames and covers and miscellaneous hardware for work in Division 26, 27, and 28.
13. Touch-up painting of prefinished equipment furnished or damaged.
14. Fire stopping, smoke, acoustical, water and environmental seals.
15. Furnish, erect, maintain, relocate, and remove all hoisting, rigging, staging and scaffolding required to perform the work of this Section of the specifications.
16. Provide cutting and patching under Provisions of Division 1.
17. Provide core drilling through concrete, steel reinforcement and metal decking.

18. Provide required sleeves. Coordinate and set sleeves and watertight fittings in construction as it progresses so as not to impede the work of other trades.
19. Mounting of the final full size as-built electrical one-line diagram on the wall of the electrical room between two sheets of plexiglass. Secure back sheet to wall and secure front sheet separately so it can be removed to allow updating of the one-line diagram. Provide clips and a lip at the bottom of the back sheet to secure the drawing to prior to overlaying the top sheet of plexiglass.
20. Compliance with construction requirements and procedures to qualify for LEED points.
21. Start up and acceptance testing for all systems provided or installed under this section. Include all requirements indicated herein, recommended by manufacturer or system vendor, and as required by the Owner or Commissioning Authority. Submit written documentation of all inspections and testing.
22. Commissioning of Building Systems – assistance and coordination with Owner and Commissioning Authority.
23. Attendance at and support of Integrated Systems Testing (after all start-up and acceptance testing is complete) of all systems. Include in bid time for 2 electricians (including foreman) for 3 days at a minimum. Refer to individual sections for required scope.

1.2 RELATED WORK

A. The following items of procedures, requirements, labor and material incidental and/or related to the installation of the Electrical Work are specified under other Divisions of these Specifications unless specifically indicated otherwise. Provide, assist and coordinate work to meet requirements indicated in the Specifications and on the Drawings.

1. Cutting and patching in accordance with the requirements under Division 1.
2. Temporary fire alarm system - Division 1.
3. Temporary electric services including consumption fees are to be provided by the General Contractor in accordance with Division 1.
4. Controlled environmental conditions for electrical equipment per the manufacturer's recommendations or as specified in this Division by the General Contractor.
5. Excavation and backfilling - Division 31.
6. Concrete work including forms for duct banks, transformer pads, lighting standards, housekeeping pads for equipment -Division 3.
7. Reinforcing steel - Division 5.
8. Watertight penetrations for electrical conduits through roof - Division 7.
9. Flashing and caulking - Division 7.
10. Setting of frames for access panels - Division 8.
11. Painting of all equipment and material other than touch up of prefinished fixtures, equipment and other Electrical components - Division 9.
12. Furnishing and setting of motors for Process, Heating, Ventilating, Air Conditioning and Plumbing Systems is included under each applicable Division of work.
13. Temperature control systems for Heating, Ventilating and Air Conditioning systems including controls, relays, time clocks, wiring and devices are provided under Divisions 23/25 unless specifically indicated otherwise.
14. Aquastats, alternators, float switches and other direct control devices for the control of the Plumbing System Equipment are provided under Division 22 unless specifically indicated otherwise.
15. Utility (electric, telephone, cable TV, fire alarm) backcharges will be paid by the General Contractor with no additional markups allowed. Refer to Section 01005 for Utility backcharges.
16. Communications equipment is by Owner.
17. Telephone system equipment and instruments are provided by the owner.
18. Control devices for plumbing, fire protection, heating, ventilating and air conditioning equipment are included under Division 21, 22, 23, 25 unless otherwise indicated.

19. Security system equipment, wiring and connection under Division 28 unless specifically indicated otherwise.
20. Wiring or Connection of Owner's Equipment, unless indicated on the Drawings or in the Specifications.

B. The following items incidental and/or related to the installation of the electrical work will be furnished and/or installed by others and wired and/or installed under this Section.

1. Sprinkler system tamper, flow and pressure switches are provided under Division 21 and wired under this Section.
2. Any Division 21, 22, 23 furnished motor controllers, variable frequency drives, capacitors and associated disconnects for installation under this Section. Generally these are provided under this Section.
3. Duct smoke detectors in computer room air conditioning units (CRAC, CRAH, etc.) are integral to the unit. Connect to the fire alarm system through an addressable relay.

C. Furnish the following items for installation by others and provide coordination, cooperation, assistance and wiring as required:

1. Duct smoke detectors for installation in ductwork per NFPA 72 under Division 23. Furnish quantity required to meet the installation requirements of NFPA 72.
2. Pitch pocket or approved roofing penetration material for conduit or lightning protection system for installation under Division 7.
3. Furnish access panels as required for electrical work behind finished surfaces or otherwise concealed for installation under Division 8.
4. Precast pits, concrete manholes and handholes for installation under Division 3.

D. Install items purchased by others. Coordinate delivery and be responsible for unloading from delivery vehicles, rigging, and for safe handling and field storage up to the time of installation. This Section shall be responsible for:

1. Coordination of delivery and shipping splits for size and weight restrictions of the project site.
2. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural conditions.
3. Connection to building systems including the purchase and installation of all terminating fittings, lugs, etc. necessary to adapt and connect them to the building systems.
4. Provide all work indicated in the specifications and on the drawings related to the pre-purchased items that are not specifically indicated as pre-purchased.
5. Carefully examine such items upon delivery, and advise the General Contractor and Owner of any damages or defects noted, as well as the shipper.
6. Installation, testing, coordination of vendor’s work and responsibilities and compliance with warranty coverage, requirements and support.
7. Pre-purchased equipment as specified:

    a. Engine Generator - Suite – Owner Furnished
    b. Engine Generator Set Enclosure - Suite - Owner Furnished
    c. Power Distribution Units - Owner Furnished
    d. Static Transfer Switches – Owner Furnished
    e. Static Uninterruptible Power Supply - Owner Furnished
    f. Modular Power Solutions Skid - Owner Furnished
    g. Engine Generator Set Enclosure - PBB - Owner Furnished
    h. Switchboards – Interior and Exterior - Owner Furnished

E. Work by Owner

1. Refer to Division 1 for additional requirements and information.
2. Accommodate concurrent work provided by Owner.

F. Existing Materials

1. All existing equipment and materials to be reused is assumed to be in good operating condition.
2. Any existing electrical equipment to be reused (i.e., panels, light fixtures, etc.) found to be defective, upon commencement of this contract, shall be reported to the Architect.
3. Guarantee all replacement work, equipment or materials for a period of one year from date of acceptance by the Architect.

1.3 COORDINATION OF THE WORK

A. Refer to Division 1 for additional requirements for coordination of the Work including Section 01 31 00 Project Management and Coordination.

B. Before submitting bid examine all Drawings and Specification, including other Divisions, for requirements that affect work of this Division and include it in the scope of work for this section whether or not such work is specifically mentioned in this Division. Be responsible, under this Division of the Specifications, for the proper coordination of the electrical work with the installations under other Divisions, including proper clearances. Any changes required to avoid interferences shall be submitted to the Architect for approval and shall be made as approved, without additional cost to the Owner.

C. Coordinate work with that of all other trades affecting or affected by work of this Division. Cooperate with such trades to ensure the steady progress of work under the contract.

D. Coordinate work with the General Contractor and the project schedule. Provide manpower and materials as required to meet the schedule and not to interfere with or impede the progress of or increase the cost of work by others. Submit shop drawings and order equipment in a timely manner. Expedite deliveries and manufacturing as required.

E. Deliver products to the project in a timely manner to meet all schedule requirements, properly identified with name, model numbers, compliance labels, and other information needed for identification.

F. Install materials and apparatus as fast as conditions of the building will permit. Materials and apparatus must be installed when directed and in the fashion specified. Examine the Architectural Drawings for the location of suitable openings and aisles for the passage of equipment to be installed under this Section. The installer shall be responsible for having suitable openings and aisles left open until his equipment has been properly installed. If necessary, request the vendor to ship equipment in sections sized to permit passage. Provide sleeves, pockets, supports and incidentals.

G. Examine the drawings, the building construction, and vertical transportation for weight and size restrictions. Provide equipment and installation methods to comply with restrictions including shipping split sizes, weights, and disassembled components as required. Obtain manufacturer's approval and assurance warranty will be honored.

H. Prepare and submit coordination drawings in conjunction with the other Trades, on common CAD drawings of at least 3/8"=1'-0", as directed by the General Contractor. Each system shall be color-coded, and for cad drawings, each system shall be on a different layer. Meet to resolve conflicts between the various Installers prior to submission to the Architect for review. Identify conflicts resolved that include changes to the design. Note on coordination drawings submitted to the Architect any conflicts that the trades could not resolve. The Architect will

provide direction that all Installers will comply with, at no additional cost to the project. In general, distribution systems which require pitch or slope such as plumbing drains, steam and condensate piping shall have the right of way over those which do not. Lighting fixtures have minimal flexibility and should not be moved without prior approval. Install work to avoid interferences and to allow proper clearance around all trades' work for access, maintenance and as required by code. Prepare coordination drawings in the following order (subject to above): HVAC (with lighting fixtures indicated), plumbing, fire protection, electrical and telecommunications systems. Work installed prior to complete and reviewed coordination drawings must be corrected as required at no additional expense to the project.

I. In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated request information from Architect.

J. Check Contract Drawings as well as Shop Drawings of all Installers and vendors to verify and coordinate space in which work of this section will be installed.

K. Obtain from manufacturers the proper method of installation and connection of the equipment that is to be furnished, installed or wired. Obtain all information that is necessary to facilitate the work and to complete the project.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Refer to Division 1 for additional requirements for quality assurance and control of the installation.

B. Receive, handle, house, and protect equipment required for installation under this specification. Replace damaged equipment with new equipment. Provide environmental requirements per NFPA 70B and manufacturer’s requirements during shipping, storage and installation.

C. Review submittals of equipment furnished under other Divisions prior to installation and electrical rough-in. Verify location, size, and required connections. Coordinate details of equipment connections with supplier and Installer.

D. Utilize Installers with at least five years experienced and properly licensed or certified in the type of work to be performed.

E. Manufacturers shall be companies experienced and are properly licensed or certified in manufacturing products specified for a minimum of five years.

F. Be responsible for the care and protection of all work included in this Section until it has been tested and accepted.

G. Protect all equipment and materials from damage from all causes including theft. All materials and equipment damaged or stolen shall be repaired or replaced with equal material or equipment.

H. Protect all equipment, outlets and openings with temporary plugs, caps and covers. Protect work and materials of other trades from damage that might be caused by work or workmen and make good any damage caused.

I. Provide workmanship in accordance with the best accepted practices. Rework installations judged by the Architect as unacceptable.

J. Power Quality Specialist Qualifications: A registered professional electrical engineer or engineering technician, currently certified by the National Institute for Certification in Engineering Technologies, NICET Level 4, minimum, experienced in performance testing UPS installations and in performing power quality surveys similar to that required in "Performance Testing" Article.

K. 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.

L. 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.

M. UL Compliance: Listed and labeled under UL 1778 by an NRTL.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Refer to Division 1 for additional regulatory or reference requirements.

B. Arrange and pay for permits, licenses, inspections and certificates. Give the proper Authorities all requisite notices or information required relating to the work under this Section. Request inspections from Authorities having jurisdiction. At the conclusion of the work, deliver certificates of inspection from authorities having jurisdiction to the Owner's Representative.

C. Provide products listed and classified by an OSHA certified Nationally Recognized Testing Laboratory (NRTL) as suitable for purpose specified and indicated. Provide NRTL-listed material and equipment where standards are available. Notify Architect of any material or equipment that is not NRTL listed when submitting information.

D. Perform work in strict accordance with the rules, regulations, listing or labeling requirements, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities having legal jurisdiction over the site. No additional compensation shall be granted for work that must be changed as a result of the work not originally complying with the codes, standards, local requirements, etc.

E. Equipment and installation shall be suitable for the wind, snow, ice, flood, and earthquake requirements indicated in the Building Code and ASCE 7 for the location and usage.

1. Building occupancy classification per ASCE 7 – category II
2. Spectral Acceleration Parameters:
3. S_S (0.25 sec) = 0.125
4. S_1 (1 sec)= 0.052
5. Seismic Design Category A
6. Site Class as defined in the IBC: C
7. Component importance factor is 1.5
8. Wind load = 90 MPH
9. Snow load = 5 PSF

F. Materials and equipment shall be manufactured, installed and tested as specified in the latest and required editions of applicable parts of the following publications, standards and rulings of:

1. State and local codes and ordinances.
2. Local Utility Company Requirements and Standards.
3. NEC - National Electrical Code (ANSI/NFPA 70).
4. UL - Underwriters' Laboratories, Inc.

5. NRTL - Nationally Recognized Testing Laboratory. (OSHA Certified)
6. NEMA - National Electrical Manufacturers' Association
7. IEEE - Institute of Electrical and Electronic Engineers
8. ASTM - American Society for Testing Materials
9. ANSI - American National Standards Institute
10. NBFU - National Board of Fire Underwriters
11. NFPA - National Fire Protection Association
12. ICEA - Insulated Cable Engineers' Association
13. OSHA - Occupational Safety and Health Act
14. IMSA - International Municipal Signal Association.
15. FM - Factory Mutual
16. AADAG - Americans with Disabilities Act Guidelines
17. EIA/TIA - Electronics Industry Association / Telecommunications Industry Association
18. BICSI – Building Industry Consulting Service International, Inc.
19. ASCE7 – Minimum Design loads for Buildings and other Structures

G. Where conflicts occur among the codes, ordinances, standards, Drawings or Specifications, the more restrictive requirements shall govern.

H. The Drawings and Specifications do not undertake to repeat requirements written or all work required in the above codes, ordinances and standards.

I. Comply with applicable codes and regulations regarding toxicity of combustion products of materials used.

J. Legally dispose of all material. Adhere to all regulations regarding disposal of hazardous material. Recycle hazardous material where recycling is possible. Submit certificates of legal recycling or disposal to the Architect. Include copy in the Owner and Maintenance Manual.

K. Nothing in these Contract Documents shall be construed to permit work not conforming with applicable codes and regulations. When conflicts occur the more restrictive requirements shall govern.

L. Should the Facility have established building standards, rules or regulations, obtain a copy from the Building Owner and comply with them.

1.6 SUBMITTALS

A. Provide and submit under provisions of Division 1 and as indicated herein.

B. Submit at time of bid any equipment or materials that have lead times that will affect the construction schedule. Provide alternate costs to expedite delivery and manufacturing so that the project schedule can be accomplished.

C. Submit at time of bid, any proposed substitutions. List reasons the owner should accept substitutions including improved performance or equal performance and improved delivery time. Acceptance of substitutions is subject to acceptance by the Architect, whose decision will be final. A substitution is considered to be any manufacturer or product not specifically identified in the specifications or drawings. If only performance requirements are indicated, and no specific manufacturer is indicated, then a manufacturer meeting the Contract Document requirements is not considered a substitute.

D. Substitutions of specifically indicated items will be reviewed only if identified at time of bid, otherwise submittals will be returned rejected. It is the proposer's responsibility to submit the first time, all information required to prove equality and a written letter on the proposer's letterhead indicating that the item is in full compliance with the Contract Documents and will fit

in the designated location. Include in bid, coordination of all work and all costs for all trades for any work that may be required, including any architectural or engineering fees, to accommodate the substitution. Acceptance of the proposed substitution is up to the Architect and is not assured. Review will include, but is not limited to, quality, life cycle costs, size, appearance, construction, manufacturer, service record, efficiency, dependability, performance, etc.

E. Submit for review, within 10 days after being given Notice to Proceed and prior to the submission of any shop drawings, an itemized list of manufacturer's of material and equipment and of firms or subcontractors proposed to be used to perform the work. Include a list of submissions and the proposed schedule to submit them, so that based on the approval times and procedures indicated below, the proposed project schedule will be accomplished. FAILURE TO SUBMIT WITHIN THE TIME LIMIT OF 10 DAYS WILL BE CONSIDERED A CONTRACT VIOLATION and will require that all items will be provided in a timely manner to maintain the schedule and all costs required to meet the schedule are included to expedite delivery and manufacturing.

F. After approval of the list and schedule, submit 1 electronic and 3 bound hard sets of detailed Shop Drawings and product Data per the submission schedule or within 30 days or sooner if required to meet the construction schedule. Substitutions will not be accepted for failure to comply with the schedule above. Electronic Submissions shall match the requirements for hard copy submissions. Provide one hard copy submission that matches the Electronic Submission.

G. Submit related shop drawings at one time. SUBMIT ALL ITEMS IN A SPECIFICATION SECTION AT THE SAME TIME. Incomplete submittals will be held until a complete submittal is accumulated.

H. The review of systems, equipment and Shop Drawings is a general review subject to the Contract Drawings, specifications and verification of all measurements at the job. Review does not relieve the Installer from the responsibility of Shop Drawing errors or complying with the Specifications and Drawings. Carefully check and correct all Shop Drawings prior to submission for approval. Regardless of any information included in the shop drawings submitted for review, the requirements of the Contract Documents shall not be superseded in any way by the Shop Drawing Review.

I. Mark submittals to clearly identify (including when photocopied) proposed equipment including their accessories, options, and modifications and exclude parts not applicable to the Project, otherwise the Architect will identify items and options to be provided at no additional cost to the project.

J. Each submittal including electronic submittals, shall be reviewed, stamped and certified prior to submission to the Architect. Such certification shall be made by a person duly authorized to sign binding Agreements for the Contractor. The certification shall state that the data and details contained on each Shop Drawing, layout drawing, catalog data and brochure has been reviewed by the Contractor for conformance to the contract documents and that it complies with the Contract Documents in all respects. Submittals will not be reviewed and will be returned to the Contractor unchecked unless they are certified.

K. It is intended that Submittals be complete and accurate at the first submission. If the Submittal is returned marked "Resubmit," only one additional submittal will be permitted. If the second Submission is not acceptable, the right of selection will be lost and the Architect will specify exactly what is required and the specified products shall be provided at no additional cost to the Project.

L. A minimum period of two weeks, exclusive of transmittal time of the hard copies, will be required by the Architect's office each time Submittals are submitted or resubmitted for review.

This time period shall be considered when scheduling the work, and any costs associated with expediting equipment delivery to meet the Schedule will be at no additional cost to the Owner. Submittals of numerous items at the same time may extend the time needed for review, so plan accordingly.

M. Provide submittals in a timely manner sufficiently in advance to give ample time for checking, correcting, resubmitting and rechecking if necessary. No claim for delay or additional costs will be granted for failure to comply with this requirement.

N. If proposed equipment deviates from the Specifications or Drawings, indicate those differences and provide sufficient data to justify acceptance. FAILURE TO INDICATE DEVIATIONS OR SUBSTITUTIONS IMPLIES FULL COMPLIANCE WITH DRAWINGS AND SPECIFICATIONS.

O. Indicate clearly all equipment, components or assemblies that are not NRTL listed or labeled. Failure to indicate otherwise implies NRTL listing or labeling.

P. Provide products of one manufacturer for each classification of equipment.

Q. Meet Project requirements including space, size and weight restrictions before submitting to Architect. Equipment shall be of proper size for its allocated space. Equipment may be disassembled so that it can be installed through available openings only if it will not invalidate manufacturer's warranties.

R. At the job site, maintain the latest equipment submittals showing the action taken by the Architect. Make these submittals available to Architect.

S. Product Data: Submit catalog data sheets or other published materials showing appearances, electrical ratings characteristics and connection requirements, performance characteristics, dimensions, weights, installation methods, and space requirements of electrical equipment and their accessories, as listed below and required by the individual sections.

26 05 00	Common Work Results for Electrical
26 05 19	Conductors and Cables (600V and Below)
26 05 26	Grounding
26 05 29	Hangers and Supports for Electrical Systems
26 05 33	Raceways and Boxes for Electrical Systems
26 05 38	Cable Bus for electrical systems
26 05 39	Trenwa precast trench solution
26 05 43	Underground Ducts and Raceways for Electrical Systems
26 05 48	Vibration and Seismic Controls for Electrical Systems
26 05 53	Identification for Electrical Systems
26 09 23	Lighting Control Devices
26 22 13	Low-Voltage Transformers
26 27 26	Wiring Devices
26 28 13	Fuses
26 28 16	Enclosed Switches and Circuit Breakers
26 43 00	Surge Protective Devices
26 50 00	Lighting
27 05 28	Low Voltage Raceway Distribution

T. Shop Drawings: Submit shop drawings (drawn to scale) indicating physical size and arrangement, (plans and elevations) construction details, provisions for conduits, access requirements for installation and maintenance, finishes, and materials used in fabrication. Supplement shop drawings with wiring diagrams and information as described under Product Data. Provide shop drawings for the following and as required by the individual sections:

26 05 38	Cable Bus for electrical systems
26 05 39	Trenwa precast trench solution
26 24 16	Panelboards
26 41 00	Lightning Protection System for Structures
28 31 11	Digital Addressable Fire Alarm System

U. Manufacturer's Instructions:

1. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
2. Include instructions for storage, handling, protection, examination, preparation, operation and installation of product.
3. Include instructions on manufacturer’s requirements for cable restraint in equipment.
4. Submit manufacturer’s standard and recommended receiving start up and acceptance testing checklists.

V. In addition to copies of submittals as required under Operation and Maintenance Manuals, provide electronic copies on CDs or DVDs of all submittal information in PDF or Microsoft Word format with O&M manuals.

1.7 EXTRA MATERIALS

A. Provide extra materials as specified in each section.

B. Extra materials shall be turned over to the Owner prior to receiving final payment. Obtain itemized receipt properly signed and dated. Submit with request for final payment.

C. Extra materials shall be in original standard manufacturer's packaging.

1.8 PROJECT RECORD DOCUMENTS

A. Provide and submit under provisions of Division 1 and this Section the following:

1. Record Drawings
2. Specifications
3. Product Data
4. Operation and Maintenance Manual.
5. Equipment Warranties.
6. Certification of proper disposal of regulated materials.

B. Refer to Division 1 for additional Project record document requirements beyond those indicated herein.

C. Provide and maintain at the site a set of prints on which shall be accurately indicated the actual installation of all work under this Division, indicating any variation from Contract Drawings, including change orders, field conditions, Architect's direction and changes in sizes, locations and dimensions. Changes in circuitry shall be clearly and completely indicated as the work progresses. Modify Schedules to reflect data consistent with that of the installed equipment.

D. Record Drawings shall be maintained in a clean, dry and legible condition and shall not be used for construction purposes.

E. These progress prints shall be available for inspection by the Architect and shall be used to determine the progress of electrical work. Indicate daily progress by color-coding materials

and apparatus installed. Progress prints shall be reviewed weekly and shall be corrected immediately if found inaccurate or incomplete. Drawings will be used as a guide for determining the progress of the work installed. Requisitions for payment will not be approved until the Drawings are accurate and up-to-date.

F. At the completion of the work, obtain and pay for a CADD set of record drawings, modify drawings to represent the work as actually noted on the marked-up prints, including the DIMENSIONED location of all underground conduit. Remove all superseded data to show only the completed installation. Mark all Drawings as "Final Record Drawings" and date them.

G. Electronic files shall be AutoCad 2008 or 3D or Revit.

H. Provide phase load data and final circuit identification for all panelboards as part of Record Drawing submittal.

I. Furnish these record documents to the Architect for review and transmission to the Owner.

1.9 OPERATING INSTRUCTIONS AND MAINTENANCE (O&M) DATA

A. In addition to the requirements of Section 01 78 23, provide the following: After completion of the work and prior to final completion furnish and deliver three copies of a complete O&M manual. Each manual shall include one copy of each approved shop drawing, catalog pages, instruction sheets, operating instructions, installation, instructions and recommended maintenance procedures and intervals, and spare parts bulletins. Provide separate sections for each separate system, i.e., power system, lighting system, fire alarm system, sound system, security system, etc.

B. Give detailed instructions, using O&M manuals, prior to final completion of work, to the responsible personnel designated by the Owner in the operation and maintenance of all work installed under this Division. A letter with two copies containing the name of the person or persons to whom the instructions were given and the dates of the instruction period shall be submitted to the Architect at the completion of the project. Provide instructions for the following:

1. Electrical service, switchboards and switchgear.
2. Generator system.
3. Transfer switch operation.
4. Roll up generator and load bank connection procedures.
5. Lighting control system.
6. Fire alarm system.
7. UPS system.
8. PDU system.
9. Static Transfer Switch
10. Electrical metering.

C. Prepare sets of manufacturer's catalogs, and other similar data, including the necessary photographic equipment cuts, wiring diagrams covering all mechanical equipment and devices under this Section. These manuals shall provide complete instructions for the proper operation and use of the equipment, together with instructions for lubrication and periodic maintenance and trouble-shooting. Operating instructions shall be specific for each system and shall include copies of posted specific instructions. This manual shall contain only that information which specifically applies to this Project and all unrelated material shall be deleted. During the instruction period, this manual shall be used and explained. The material shall be bound in 3-ring binders, indexed and have a Table of Contents. On the edge of the binder, provide a clear, see-through plastic holder with a typed card indicating the Project name, the Architect's name, the Installer's name and the Volume number (e.g., Vol. No. 1 of 2).

D. Include a copy of all inspection sign offs, test reports and certifications in the O&M Manuals.

E. Include name, address and telephone number of the manufacturer's representative and service company for each piece of equipment so that the source of replacement parts and service for each item of equipment can be readily obtained.

F. Provide three copies of the O&M manual information on CD ROM or DVD. Files shall be in a readable format such as PDF or image files (TIF, etc). Record drawings shall be scanned in, and shall also include the AutoCad dwg files if Record Drawings are provided on Cad.

G. Furnish these manuals to the Architect for review and transmission to Owner.

1.10 WARRANTY

A. Refer to individual sections and Division 1 for additional warranty (guarantee) requirements.

B. Remedy work performed under this Division that is found not to comply with the Contract Documents, requires excessive service, or fails less than one year from the date of final acceptance.

C. Manufacturers shall provide their standard warranties for material and equipment furnished under this Division, unless otherwise indicated in each Section.

D. Materials, equipment and work furnished under this Division shall be guaranteed against all defects in materials and workmanship for a period of one year, commencing with the date of final acceptance by the Owner. Any failure due to defective material, equipment or workmanship shall be corrected as quickly as possible and at no expense to the Owner, including all damage to areas, materials and other systems resulting from such failures.

E. Upon receipt of notice from the Owner of failure of any part of the systems during the guarantee period, the affected parts shall be replaced as quickly as possible. Any equipment requiring excessive service (more than two unscheduled services) shall be considered defective and shall be replaced.

1.11 LEED / SUSTAINABILITY

A. Comply with the requirements of Section 01 81 13 – Sustainable Design Requirements.

B. Minimize packing materials delivered to the site to minimize waste and maximize opportunity for qualifying for LEED points.

1.12 INTERPRETATION OF CONTRACT DOCUMENTS

A. Division One, General and Supplementary Conditions are in addition to the requirements indicated in Division 26, 27, and 28, Drawings and Specifications.

B. Where Drawings or Specifications conflict or are unclear, advise Architect in writing before Award of Contract. Otherwise, interpretations of Contract Documents by the Architect shall be final, and no additional compensation shall be permitted due to discrepancies or unclarities resolved according to the Architect's interpretation.

C. The intent of the Drawings and Specifications is to assist and guide and to establish minimum requirements.

D. Drawings and Specifications form complimentary requirements; provide work specified and not indicated, and work indicated and not specified as though explicitly required by both.

E. Should there be conflicts in Contract Documents, provide the greater quantity, the higher quality and the more restrictive of equipment and work.

F. Electrical Drawings do not limit responsibility of determining full extent of work required by Contract Documents. Refer to Architectural, HVAC, Electrical, Telecommunications, Security, Plumbing, Fire Protection, Structural, specialty trades and other Drawings and other Divisions that indicate types of construction in which work shall be installed and work of other trades with which work of this Division must be coordinated.

G. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the Drawings or Specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

H. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

I. Where Drawings or Specifications do not coincide with manufacturer's recommendations, or with applicable Codes and Standards, alert Architect in writing before installation. Otherwise, make changes in installed work as Architect requires within Contract Price.

J. It is the intent of these Contract Documents to have systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component. In cases such as this, where the bidder has failed to notify the Architect of the situation prior to contract award, provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

K. In situations or where potential conflicts and Installer believes guidance is required, submit a sketch identifying a proposed solution and the Architect shall review, note if necessary, and return this sketch appropriately marked as required.

L. Portions of these Drawings and Specifications are abbreviated and may include incomplete sentences. Infer the omitted words or phrases such as "the Contractor shall", "shall be", "as indicated on the Drawings", "in accordance with details", "a", "the", and "all".

M. "As permitted" means by Code, by Architect or by prevailing conditions.

N. "Acceptable", "approved", and "satisfactory" means by Architect.

O. Work indicated on the Drawings is intended to be approximately correct to scale, but figures, dimensions, and detailed Drawings are to be followed. Take measurements at the building before fabrication commences.

P. Size of pipes or conduits and methods of installing them are indicated, but it is not intended to show every offset and fitting, nor every structural difficulty that may be encountered.

Q. Drawings are generally diagrammatic and indicate the arrangement and approximate location of fixtures, equipment and conduits. When necessary to deviate from the arrangement indicated, to meet structural conditions or to clear work of other Divisions, inform the Architect

of proposed deviation before proceeding. Obtain in the field all information relevant to the placing of electrical work.

R. Drawings and Specifications do not undertake to indicate every item required to produce a complete and properly operating installation. Materials, equipment or labor not indicated but which can be reasonably inferred to be necessary for a fully complete, secure and properly operating installation suitable for the intended use shall be provided.

S. The right is reserved to make reasonable changes in locations of equipment indicated in Drawings prior to installation without increase in contract cost.

T. Schematic diagrams shown on the drawings indicate the required functions only. Standard circuits of the particular manufacturer may be used to accomplish the functions indicated without exact adherence to the schematic drawings shown. Furnish additional wiring or conduit required for such deviations.

U. Generally, except in the case of certain raceways and empty and underground raceways, the runs of feeder, branch circuits, communications and signal systems raceways are not indicated on the drawings. Final determination as to the routing shall be governed by structural conditions, and interferences with other trades and by terminal locations on apparatus.

V. Contract Documents indicate scope of work required. Jurisdictional assignment shall be a responsibility under this Section's contractual obligation.

W. The Term "Conduit" or "C" is used on the Drawings as a generic term for raceways. The exact raceway to be used shall be as specified in the specifications or notes.

X. The following definitions apply to the Drawings and Specifications:

Furnish: The term "furnish" is used to mean "supply and deliver to the Project site, ready for unloading, unpacking, assembly, installation, and similar operations."

Install: The term "install" is used to describe operations at project site including the actual "unloading, unpacking, rigging in place, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations".

Provide: The term "provide" means to "furnish and install, complete and ready for the intended use".

Installer: An "Installer" is the Contractor or an entity engaged by the Contractor, either as an Employee, Subcontractor, or Sub-Subcontractor for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.

1.13 TEMPORARY LIGHT, POWER AND FIRE ALARM

A. Work provided under Division 1.

PART 2 - PRODUCTS

2.1 SPECIFIED PRODUCTS AND SUBSTITUTIONS

A. Provide new, unused, full weight, standard equipment that meets or exceeds Contract Document requirements to the satisfaction of the Architect. No equipment or material shall be used unless previously approved by the Architect.

B. The manufacturer's catalog number and description is the basis of the design and establishes quality and performance required for this project. Generally, the first manufacturer listed is the one the project design is based on.

C. Manufacturers of generally compatible products may also be listed, subject to compliance with requirements. Substitution of equal products or manufacturers of equal products are also acceptable when indicated in each section.

D. The description following a catalog number is basically to identify the item but may also call for accessories, options, or modifications that are beyond the cataloged item.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to beginning work in a particular area of the project visit the site and examine conditions under which work must be performed, including preparatory work done under other Divisions or Contracts or by the Owner. Report conditions that might affect work adversely in writing through Contractor to Architect. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

B. Arrangements shall be made to have the openings, inserts, sleeves and other such incidentals set in place ahead of the construction work, where practical to eliminate the need for cutting and patching. If cutting becomes necessary for the installation of the work, it shall be done under this Division in accordance with the requirements of Division 1 and other applicable Divisions. All openings shall be neatly patched and finished to match the adjoining work in a manner approved by the Architect, any penetration in fire-rated walls or floors must be fire-stopped as indicated in Division 7 and Section 26 05 00 – Common Work Results for Electrical. All cutting shall be performed in a manner not to weaken the structural parts. The cutting manner and method shall meet the approval of the Architect.

C. The equipment shall be kept upright at all times. If equipment has to be tilted for ease of passage through restricted areas, the manufacturer shall brace the equipment to ensure that the tilting does not impair the functional integrity of the equipment. Comply with manufacturer’s requirements.

3.2 INSTALLATION

A. Do not cut structural members without written acknowledgement from the Architect.

B. Do not attach to metal roof decking.

C. Arrange equipment so working parts are accessible for inspection, repair, and renewal.

D. Where not specified or indicated, mount equipment at heights directed by the Architect.

E. Generally, the Drawings do not show wiring. Provide wiring to best suit circuiting indicated on the Drawings.

F. Single-phase non-lighting circuits require separate neutrals. Circuits to data processing equipment and isolated or dedicated circuits require separate neutrals. Circuits for lighting may use common neutrals as allowed by the Electric Code. Systems furniture shall use common neutrals as indicated on the Drawings.

G. Do not combine or reduce the number of homeruns indicated on the Drawings without written acknowledgement from the Architect.

H. Locate pull boxes, panelboards, control pushbuttons, terminal cabinets, safety switches and such other apparatus as may require periodic maintenance, operation, or inspection, so that they are easily accessible. If such items are shown on the plans in locations which are found to be inaccessible, advise the Architect of the situation before work is advanced to the point where extra costs will be involved.

I. Circuits on panelboards shall be field connected to result in evenly balanced loads on each phase.

J. The panelboard circuit numbering system is for outlet grouping purposes only indicate the final circuit identification on the Record Drawings and the panelboard schedules.

K. Any work installed contrary to Contract Drawings shall be subject to change as directed by the Architect, and no extra compensation will be allowed for making these changes.

L. Where installed in damp, wet and areas requiring washing down, all surface mounted panel boxes, junction boxes, conduit, etc., shall be supported by spacers to provide a clearance between wall and equipment.

M. All connections to equipment shall be made as required, and in accordance with the approved shop and setting drawings.

N. Unless otherwise approved by the Architect, conduit indicated exposed shall be installed exposed; conduit indicated concealed shall be installed concealed.

O. Where exact locations are required for roughing in, stubbing-up and terminating conduit request Shop Drawings, equipment location drawings, foundation drawings, and any other data required to locate the concealed conduit before the floor slab is poured or wall or ceiling is installed.

P. Verify the ceiling type, ceiling suspension system and clearance above hung ceilings prior to ordering lighting fixtures. Notify the Architect of any discrepancies.

Q. Fire ratings of enclosures, walls, ceilings, and floors shall be maintained. Penetrations for electrical Work shall be fire-stopped as indicated in Division 7, Section 26 05 00, or indicated in individual Sections on Drawings, or by Architect. Review Architectural drawings for fire ratings.

R. Smoke ratings, acoustical, water tightness of enclosures, walls, ceilings, and floors shall be maintained. Provide necessary fittings, accessories and coordination as required.

S. Do not use powder actuated tools or anchors without written permission from the General Contractor or Construction Manager. Only allow personnel who are properly trained and licensed to use the powder actuated tools.

3.3 TESTING AND STARTUP

A. Provide start up and acceptance testing as indicated in individual sections and in Section 26 08 13. Submit written results.

B. Assist Owner in performing Integrated Systems Testing.

3.4 INSTRUCTIONS

A. For additional requirements for starting, demonstration, and instructions of systems refer to Division 1.

B. Provide starting, demonstration, and instructions of systems as required in individual Sections.

C. Insure that the Owner's operating personnel are made entirely familiar with the nature, operation, and maintenance of the systems and equipment provided under this Division.

3.5 SUBSTANTIAL COMPLETION

A. For additional requirements refer to Section 01 77 00 Closeout Procedures.

B. When Work under this Section (or designated portion of Work) is considered substantially complete, submit written notice through the General Contractor with a list of items remaining to be completed or corrected.

C. All systems shall be operational and tested. Submit test reports.

D. Submit local authority final sign off inspection reports. Include copy in O&M manuals.

E. Should Architect observe and find Work is not substantially complete, written notification will be provided listing observed deficiencies.

F. Remedy deficiencies and send a second written notice of substantial completion.

G. When Architect finds Work is substantially complete, a Certificate of Substantial Completion will be prepared in accordance with provisions of General Conditions.

H. Submit test reports for review prior to Architect’s site visit.

3.6 FINAL COMPLETION

A. For additional requirements refer to Section 01 77 00 Closeout Procedures.

B. When Work under this Section is considered complete, submit through the General Contractor written certification that:

1. Contract documents have been reviewed.
2. Work has been inspected for compliance with Contract Documents.
3. Work has been completed in accordance with Contract Documents (and deficiencies listed with Certificate of Substantial Completion have been corrected).
4. Equipment and systems have been tested, adjusted and balanced and are fully operational.
5. Work is complete and ready for final Architect review.

C. Upon completion of all work, and as a condition to receiving final payment, furnish to the Architect the following original, signed certificates and include copies of these certificates as part of the Operation and Maintenance manuals:

1. From the manufacturer's authorized representative, stating that authorized factory engineers have inspected and tested the operation of their respective equipment and found same to be installed in accordance with the manufacturer's requirements and to be in satisfactory operating condition. This certification shall be provided for all major equipment and for all complete systems. It is not required for other components unless specifically requested by the Architect.
2. Certificates of inspections, letters and notices from the appropriate government-authorized inspectional authorities stating that all portions of the work (indicate trade and responsibility) have been inspected and are installed in conformance with the applicable codes, laws, ordinances and referenced standards. If non-conformance notices are received, include the re-inspection certificate, letter of explanation, etc. as required to indicate complete conformance. Provide written evidence of all variations, exceptions, variances, etc. given by the inspectors.
3. Certificate from the Installing firm responsible for the work (indicate trade and responsibility) signed by an authorized officer or owner of the Firm and the Foreman or Project Manager in charge, stating that to the best of the signer's knowledge and belief that the project (indicate project name and address) has been installed in compliance with the Contract Plans, Specifications and Addenda, and all applicable codes and laws, ordinances and referenced standards. Where subcontractors perform a portion of the work of this Section, include certificates from them.

D. Should Architect observe and find Work incomplete, the review will be promptly suspended and written notification will be provided through the General Contractor.

E. Complete Work, remedy deficiencies and send a second certification of final completion.

F. Architect shall, upon receipt of a second certification of completion, make a second review and provide notification in writing through the General Contractor, listing observed deficiencies.

G. When Architect finds work complete, close-out submittals will be considered.

END OF SECTION

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sleeves for raceways and cables.
2. Sleeve seals.
3. Grout.
4. Access floor seals
5. Fire rated sleeves
6. Watertight Seals
7. Smoke and Firestopping Seals
8. Expansion/Deflection Fittings
9. Conduit sealing bushings
10. Cable supports
11. Acoustical Sealant
12. Caulking
13. ARC/Fire Proofing Materials
14. Cable Ties
15. Measure Pulling Tape

1.2 RELATED WORK

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

B. Division 07 specification sections.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

B. Provide the following additional materials: None

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

1.11 LEED / SUSTAINABILITY

A. Conform to requirements indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:
   a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
   b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
   a. O.Z. Gedney
   b. Advance Products & Systems, Inc.
   c. Calpico, Inc.
   d. Metraflex Co.
   e. Pipeline Seal and Insulator, Inc.
   f. Substitutions: Under provisions of Section 26 00 10.
2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

B. Polywater® InstaGrout™ Sealant creates a barrier to protect electrical structures and equipment. It keeps out moisture and stops insects, snakes and rodents from tunneling

through earthen gaps into the enclosure. The strong, lightweight seal withstands freeze-thaw cycles and environmental extremes. It is compatible with cable jacket materials and will not corrode metal. Polywater® InstaGrout™ Sealant is a two-part system packaged in pre-measured quantities for easy, onsite mixing. The repair compound flows and expands around complex conduit stub-ups. It adheres to metals, plastics, wood, and concrete. InstaGrout™ self-levels and covers uneven dirt and sand base material. The result is a continuous barrier created from a convenient liquid system.

2.4 ACCESS FLOOR SEALS

A. Description: Brush type seal with brushes extending to cover the entire opening to provide a flexible air seal.

1. Manufacturers: Subject to compliance with requirements provide products of one of the following:
   a. Sealeze
   b. PDU Cables
   c. Koldlok
   d. Armour flex insulation-plenum rated low smoke rating (25max)
   e. “The Plugg” foam barrier (www.theplugguc.com)
   f. Subzero “the cube”
   g. Gaphog
   h. Substitutions under provisions of Section 26 00 10.

B. Description: Solid pliable seal to seal off openings around conduit or conductors.

1. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
   a. Compressible material.
   b. Armour flex sheet material – plenum rated, low smoke (25 max)
   c. Nelson tan caulking fire seal putty.
   d. Substitutions under provisions of Section 26 00 10.

2.5 FIRE RATED SLEEVE

A. Description: Pre filled fire barriers.

1. Manufacturers: Subject to compliance with requirements provide products of one of the following:
   a. 3M Quick pass fire barrier
   b. Specified Technologies Inc. (STI)
   c. Roxtec
   d. Substitutions: Under provisions of Section 26 00 10.

2.6 WATERTIGHT SEALS

A. Manufacturers: Subject to compliance with requirements provide products of one of the following:

1. O-Z Gedney Type WSK or FSK (if only one side is accessible)
2. Crouse Hinds
3. Appleton
4. Polywater Corporation FST foam sealant inside conduits.
5. Substitutions: or equal, under provisions of Section 26 00 10.

B. The foam duct sealant shall be FST™Sealant. The foam duct sealant shall be a two part “blown” urethane foam with 98% closed cell content. The foam duct sealant shall have a compressive strength of 300 pounds (ASTM D1691), and shall have a tensile strength of 250 pounds (ASTM D1623). The foam duct sealant shall have a flexural strength of 450 pounds(ASTM D790), and shall withstand temperatures from -20° F to 200° F. The foam duct sealant shall be chemically resistant to gasoline, oils, dilute acids and bases. The foam duct

sealant shall be available as a kit suitable for sealing various sized ducts. The product shall foam and react in five to ten minutes at 70° F. When installed, the sealant shall be capable of holding 7.25 psi air pressure continuously (equivalent of 16.4 feet water-head pressure).

2.7 SMOKE AND FIRESTOPPING SEALS

A. Manufacturers: Subject to compliance with requirements provide products of one of the following:

1. Specified Technologies Inc
2. 3M.
3. Protective Coatings, Inc.
4. Carborundum Company.
5. Substitutions: or equal, under provisions of Section 26 00 10.

2.8 EXPANSION/DEFLECTION FITTINGS

A. Manufacturers: Subject to compliance with requirements provide products of one of the following:

1. O-Z Gedney – DX for up to 3/4 inch movement in any direction.
2. Crouse-Hinds – XD for up to 3/4 inch movement in any direction.
3. Spring City Electrical Mfg. Co. - Type DF for up to 3/4 inch movement in any direction.
4. Manufacturer of raceways including but not limited to busway, cable tray, wireway, fiber guide, etc.
5. Substitutions: or equal, under provisions of Section 26 00 10.

B. Where greater movement than 3/4 inch is required provide fittings or combination of fittings that allow movement in all directions. Fittings shall allow expansion of 3 inches, compression of 3 inches and deflection of 2 inches.

2.9 CONDUIT SEALING BUSHINGS

A. Description: Seals interior of conduit against fluids and gases.

1. Manufacturers: Subject to compliance with requirements provide products of one of the following:
   a. O.Z. Gedney type CSB
   b. Substitutions: or equal, under provisions of Section 26 00 10.

B. Description: Seals around exterior of conduit against fluid and gas.

1. Manufacturers: Subject to compliance with requirements provide products of one of the following:
   a. O.Z. Gedney type CSM
   b. Substitutions: or equal, under provisions of Section 26 00 10.

2.10 CABLE SUPPORTS

A. Description: Fitting with wedge type cable support for cables 600V or less installed vertically

1. Manufacturers: Subject to compliance with requirements provide products of one of the following:
   a. O.Z. Gedney one piece plus type ‘S’ – indoors
   b. O.Z. Gedney type CMT – outdoors
   c. Substitutions: or equal, under provisions of Section 26 00 10.

B. Description: Fitting with wedge type cable support for cables over 1000V installed vertically.

1. Manufacturers: Subject to compliance with requirements provide products of one of the following:
   a. O.Z. Gedney multi-segment plus type “R” – indoors
   b. O.Z. Gedney type CMT – outdoors

c. Substitutions: or equal, under provisions of Section 26 00 10.

2.11 ACOUSTICAL SEALANT

A. Manufacturers: Subject to compliance with requirements provide products of one of the following:

1. D.A.P.
2. Pecora - Type BR-96
3. Fremco
4. U.S.G.
5. Substitution: or equal, under provisions indicated in Section 26 00 10.

B. Sealants for acoustical purposes shall be silicone non-setting sealants.

2.12 CAULKING

A. Manufacturers: Subject to compliance with requirements provide products of one of the following:

1. D.A.P.
2. Pecora – Type BR-96
3. Fremco
4. U.S.G.
5. Substitution: or equal, under provisions indicated in Section 26 00 10.

B. Sealants shall be low VOC 20 year silicone non-setting sealants.

2.13 ARC/FIRE PROOFING MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. Plymouth 53 plyarc with 77 ply glass.
2. 3M Sotch 77 with Sotch 69 glass ply cloth.
3. D.A.P.
4. Pecora - Type BR-96
5. Fremco
6. U.S.G.
7. Substitution: or equal, under provisions indicated in Section 26 00 10.

B. Cable arc-proof type shall be flexible, conformation organic fabric, coated one side with a flame retardant flexible elastomer, self-extinguishing, with the following minimum properties:

1. Thickness ASTM D100, 0.76mm.
2. Intumescent to 0.3 inch (8mm) thick.
3. Compatible with cable jacket.

C. Type for first course on metal objects: 10 miL (250 micrometer) thick, corrosion-protective, moisture resistant, PVC pipe wrapping tape.

D. Glass cloth tape: Pressure sensitive adhesive type, ½ inch (13 mm) wide.

2.14 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black.

C. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
5. Color: Black.

2.15 MEASURE/PULLING TAPE

A. Manufacturers: Subject to compliance with requirements provide products of one of the following:

1. Greenlee Tool Division
2. Substitution: or equal under provisions indicated in Section 26 00 10.

B. Polyester measure pulling tape. Durable and stretch resistant.

1. ½" width – average breaking strength 1250 lbs.
2. ¾" width – average breaking strength 2500 lbs.

C. Factory lubricated to reduce burn through.

D. Easy to read footage markings for quick and accurate measurements.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give way to piping systems installed at a required slope.

F. Seal all openings to prevent air transfer between spaces. Provide fire and smoke rated seals where required or indicated.

G. Provide grout, sealant or fittings for all openings around raceways penetrating walls, floors, or from underground as specified herein, required by the utility or required by code. Including padmount transformers, exterior equipment, equipment with underground services, etc. Seal keep moisture, gasses and rodents out of the equipment.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate floors, concrete slabs, concrete or masonry walls, fire-rated floor and wall assemblies, acoustical or full height walls.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 3 inches (75 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise, required by fire or smoke seal product, or unless seismic criteria require different clearance.

H. Seal space outside of non-fire-rated, non-watertight sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable tray, busway, raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements herein and in Division 07 Section "Joint Sealants.".

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable tray, busway, raceway and cable penetrations. Install sleeves and seal penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified herein and in Division 07 Section "Penetration Firestopping" and in this Section.

3.5 INSTALLATION OF SEALS

A. Watertight Seals

1. Conduits entering from the exterior or below grade shall have watertight fittings on the outside and on the inside of the conduit.
2. Conduits penetrating walls above grade shall be installed in sleeves. Seal with foam and caulking around sleeve and conduit to ensure a watertight and air tight seal.
3. Fittings on the outside of the conduit shall be O-Z Gedney type FSK or approved equal. Provide type WSK if penetration is within two feet of the high water table. Provide grounding attachment.
   a. Fittings on the inside of the conduit shall be O-Z Gedney type CSBI or approved equal. Provide type CSBG if penetration is within two feet of the high water table. Provide a blank fitting to seal spare or empty conduits.
   b. O-Z Gedney type CSM fitting may be used when sealing within a sleeve or cored hole.

B. Environmental Seals

1. Provide seals on raceways exposed to widely different temperatures, as in refrigerating or cold storage areas or when penetrating the building envelope. Install raceway seal to prevent circulation of air from warmer to colder sections through the raceway.
2. Provide seal under device plates for devices mounted or walls between conditioned and non-conditioned spaces, in computer rooms, rooms with gaseous fire suppression systems or clean rooms.
3. Seal air tight with caulking and insulation around light fixtures and equipment installed in exterior soffits.
4. Provide seals on raceways entering or leaving computer rooms, data halls and pressure-controlled rooms. Seal raceways air tight with pliable non-hardening material such as duct seal or an environmental seal fitting. Provide seal at panel, PDU or equipment connection. Provide threaded caps on unused conduits.

C. Acoustical Seals

1. Provide acoustical sealant around penetrations through sound-sensitive areas such as toilet rooms, conference rooms, electrical or mechanical rooms, elevator rooms, training rooms, etc. Provide at any wall where Architect or mechanical specifies sound attenuation provisions.

D. Firestopping Seals

1. Penetrations through fire-resistant-rated walls, partitions, floors or ceilings shall be fire stopped using approved methods and NRTL-listed products to maintain the fire resistance rating. Follow all listing and manufacturers recommendations and requirements.
2. Installation restrictions of the listing agencies shall be strictly adhered to (e.g. 24 inch (610 mm) minimum horizontal separation between boxes on opposite sides of the wall, maximum square inch opening on wall.
3. Fire stopping in sleeves or in areas that may require the addition or modification of installed cables or raceways shall be soft, pliable, non-hardening fire-stop putty. Putty shall be water resistant and intumescent.
4. Fire stopping in locations not likely to require frequent modifications shall be a NRTL-listed putty, caulk or mortar to meet the required fire resistance rating.
5. Box penetrations into a fire rated wall or shaft shall have a fire stopping pad installed on the back of the box.

6. Fire stopping of cable trays or busways through walls shall be with fire rated sleeves with intumescent material, non-hardening putty or with seal bags on tap, below and on sides of trays.
7. Fire stopping of plastic pipes shall be accomplished by using a collar specifically listed for the use.
8. Installation methods shall conform to a UL fire stopping system.
9. Provide gas tight sealing fitting and compound at each enclosure around conductors with intumescent fire protection insulation
10. Provide Specified Technologies SpecSeal fire stop plugs for conduit sleeves.

E. Explosion Proof seals

1. Provide seals where required by code.
2. Fill seal with sealant following manufacturer's recommendation being careful to spread conductors so as to allow seal to flow around all conductors.

3.6 EXPANSION/DEFLECTION FITTINGS

A. Install bonding ground wire across fitting.

B. Install as recommended by manufacturer. Allow for expansion, contraction or deflection after installation.

C. Install on raceways rising from underground where exposed to ground movement or extreme temperature variation or freezing.

D. Install on PVC conduit installations 100 feet or longer.

E. Install on raceways subject to varying environmental conditions such an exterior/interior, air conditioning/non-air conditioned, refrigerated/non-refrigerated spaces, etc.

F. Install where raceways cable trays or busways cross building expansion or seismic joints. Provide two expansion deflection fittings, one on each side of the joint or wall, with a continuous piece of raceway or busway across the joint.

G. Install where raceways cable trays or busways pass from one building to another.

3.7 WATER DAMS

A. Provide three inch high water dams across floor penetrations that are not water tight and where there are openings allow the passage of water such as for busway on cable tray penetrations, where seismic or other requirements leave openings around penetrations.

3.8 ARC PROOFING

A. Unless otherwise indicated, at locations with multiple feeders in manholes, hand holes or pits under equipment arc proof feeder conductors at locations not protected by conduit, direct burial, or termination materials. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:

1. Clean cable sheath.
2. Wrap metallic cable components with 10-mil (250-micrometer) pipe-wrapping tape.
3. Smooth surface contours with electrical insulation putty.
4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
5. Band arc proofing tape with one-inch (25mm) wide bands of half-lapped, adhesive, glass cloth tape 2 inches (50mm) o.c.
6. Extend arc proofing one-inch (25mm) into duct.

3.9 MEASURE/PULLING TAPE

A. Provide measure/pulling tape in all empty raceways.

1. Provide ½” width, 1250 lbs rate in innterducts or raceways 2” or less in diameter.
2. Provide ¾” width, 2500 lbs rated in all other raceways.

B. Provide 12 inches minimum at each end. Secure tape so it will not fall back into raceway.

C. Install tape after cleaning underground raceway installations.

END OF SECTION

SECTION 26 05 19
ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS OR LESS)

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Conductors and Cables
2. Connectors and Splices

B. Meet the following performance requirements:

1. Where not indicated size branch circuit wiring per the Energy Code not to exceed 3 percent voltage drop and feeders not to exceed 2% voltage drop. Do not reduce conductor sizes indicated.
2. Aluminum conductor substitution
   a. Not Allowed

1.2 RELATED WORK

A. Section 26 00 10 – Basic Electrical Requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

B. Field verify measurements.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

B. Provide written test results after installation. Indicated procedures and values obtained.

C. Toxicity: Materials shall comply with applicable codes and regulations regarding toxicity of combustions products.

D. NRTL Compliance: Comply with applicable requirements of UL Standard 910 (or NRTL equivalent) “Test Method for Fire and Smoke Characteristics of Cables Used in Air Handling Spaces.” Provide products that are NRTL listed and labeled for such use.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

B. Record actual locations of concealed cable assemblies and branch circuit arrangements and branch circuit numbering.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 BUILDING WIRE AND CABLE – INTERIOR DRY AREAS ABOVE GROUND

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Southwire Company.
2. American Insulated Wire Corporation.
3. The Okonite Company.
4. Cerror Wire & Cable Company
5. Cobra Wire and Cable Inc.
6. Substitutions: or equal under provisions of Section 26 00 10.

B. Building Wire and Cable – above ground in raceways. Southwire SimPull or equal.

1. Description: Single conductor insulated wire.
2. Conductor: Copper
3. Insulation Voltage Rating: 600 volts.
4. Insulation: ANSI/NFPA 70; Type THWN-2, XHHW-2 (No. 6 AWG or larger) insulation for feeders and branch circuits. 90 degree C rated wet or dry, Southwire SimPull or equal.

C. Control Circuits: ANSI/NFPA 70; Type THHN/THWN insulation.

D. Conductors in Cable Tray (#4/0 awg and larger):

1. Description: Single conductor insulated wire.
2. Conductor: Copper
3. Insulation Voltage Rating: 600 volts.
4. Insulation: ANSI/NFPA 70: Type DLO/RHW-2, THW, or RHH, 90 degree C rated for cable tray use. For DC circuits provide extra flexible construction using a maximum strand size of 24AWG (0.0020 inch diameter).

2.2 BUILDING WIRE AND CABLE – UNDERGROUND OR WET AREAS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Southwire Company.
2. American Insulated Wire Corporation.
3. The Okonite Company.
4. Cerro Wire & Cable Company.
5. Cobra Wire and Cable Inc.
6. Substitutions: or equal under provisions of Section 26 00 10.

B. Service entrance, feeder or branch circuit conductors in raceways: Type USE-2/RHW-2 or SimPull THHN/THWN-2 or XHHW-2 by Southwire.

1. Conductor: Copper.
2. Insulation Voltage Rating: 600 volts.
3. Insulation Temperature Rating: 90 degrees C. wet

2.3 NONMETALLIC SHEATHED-CABLE – INTERIOR

A. Not Used

2.4 OVERHEAD MANUFACTURERS – SERVICE-ENTRANCE CABLE

A. Not Used

2.5 ARMORED CABLE

A. Not Allowed.

2.6 METAL CLAD CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Southwire Company.
3. Cobra Wire and Cable
4. Substitutions: Under provisions of Section 26 00 10.

B. Metal Clad Cable

1. Description: ANSI/NFPA 70, Type MC.
2. Conductor: Copper.
3. Insulation Voltage Rating: 600 volts.
4. Insulation Temperature Rating: 90 degrees C. Used at 60 degree C ampacity rating.
5. Insulation Material: Thermoplastic or Thermosetting.
6. Armor Material: Steel (for EMI protection)
7. Armor Design: Interlocked metal tape.
8. Jacket: None, except PVC in non plenum areas, for connections to vibrating equipment or in wet or damp locations or in mechanical or generator rooms.
9. Provide grounding conductor.

2.7 CORDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. American Insulated Wire Corp.
2. Cerro Wire & Cable Company.
3. Southwire Company.
4. Substitutions: Under provisions of Section 26 00 10.

B. Oil-resistant thermoset, insulated multi-conductor flexible cord with identified equipment grounding conductor, suitable for extra hard usage in damp locations.

2.8 MANUFACTURED (MODULAR) WIRING SYSTEM - OPTIONAL WIRING METHOD

A. Not Used

2.9 WIRING CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Split Bolt Connectors:
   a. Appleton Electric Company.
   b. Crouse Hinds Company.
   c. Teledyne - Penn - Union Electric.
   d. Substitutions: Under provisions of Section 26 00 10.
2. Solderless Pressure Connectors:
   a. Burndy Electrical Connectors.
   b. Thomas and Betts.
   c. AMP Special Industries.
   d. Substitutions: Under provisions of Section 26 00 10.
3. Spring Wire Connectors:
   a. Burndy Electrical Connectors.
   b. Thomas and Betts.
   c. AMP Special Industries.
   d. Substitutions: Under provisions of Section 26 00 10.
4. Compression Connectors:
   a. Burndy Electrical Connectors.
   b. Teledyne - Penn - Union Electric
   c. Crouse Hinds Company

2.10 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:

1. 3M; Electrical Products Division.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. AFC Cable Systems, Inc.
5. Tyco Electronics Corp.
6. Substitutions: Under provisions of Section 26 00 10.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

C. For damp or wet areas provide connectors pre-filled with waterproofing sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire. Repeat until no foreign material or water is evident.

3.3 COLOR CODING

A. Wiring and cable systems shall be color-coded to denote polarity to match existing building system coding or color-coded as follows:

208/120 Volt Systems		480/277 Volt Systems	
Phase A	Black	Phase A	Brown
Phase B	Red	Phase B	Orange
Phase C	Blue	Phase C	Yellow
Neutral	White	Neutral	Gray

Grounding Conductor: Green
Isolated Grounding Conductor: Green with Yellow Stripe

B. Neutral (Grounded Conductor): Grounded conductors for each voltage system shall be uniquely color-coded. For voltage systems not identified above, provide white insulation with colored stripes other than green or black.

C. Conductors larger than No. 6 AWG that do not have colored insulation provide wrap of two full turns of 1-inch wide (25 mm) wide colored tape at two locations (12 inches (300 mm) apart) at each location where conductor is accessable.

D. Provide engraved nameplate indicating color-coding system at each panelboard or switchboard on the interior of the door if so equipped; otherwise, install on the front trim. Refer to specification 26 05 53. “Identification for Electrical Systems” for nameplates requirement.

3.4 GENERAL

A. Generally, the Drawings do not show point-to-point wiring. Provide complete wiring and raceway systems to suit project.

B. Do not group circuits into multi-wire branch circuits unless specifically indicated. Protect multi-wire circuits with multi-pole or adjacent single-pole over-current devices with handle ties.

C. Provide separate neutrals where indicated and for the following:

1. Single phase circuits protected by ground fault circuit interrupters.
2. Single phase circuits protected by arc fault circuit interrupters.
3. Circuits to convenience outlets in office or work areas.

D. Do not reduce the number of home runs indicated on the Drawings without written acknowledgement from the Architect.

E. Neatly train and secure wiring inside of boxes and equipment enclosures.

F. Wiring and cable routing indicated on Drawings is approximate unless dimensioned. Route wire and cable as require to meet Project Conditions. Include wire and cable lengths within 10 feet (3 m) of lengths required.

G. Provide required separation between cable and other work.

H. Determine cable routing to avoid interference with other work.

3.5 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. Control Circuits: Copper. Stranded.

3.6 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS WHERE ALLOWED BY THE ELECTRICAL CODE

A. Service Entrance:

1. Type Southwire SimPull THHN/THWN-2, single conductors in raceway
2. Type Southwire SimPull XHHW-2, single conductors in raceway
3. Mineral-insulated, metal-sheathed cable, Type MI
4. Type USE-2/THW-2 cable.

B. Exposed Feeders:

1. Type THHN/THWN-2, or XHHW-2 single conductors in raceway
2. Metal-clad cable, Type MC
3. Mineral-insulated, metal-sheathed cable, Type MI.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawl spaces:

1. Type THHN/THWN-2, or XHHW-2, single conductors in raceway
2. Metal-clad cable, Type MC
3. Mineral-insulated, metal-sheathed cable, Type MI.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground:

1. Type Southwire SimPull THHN/THWN-2 single conductors in raceway
2. Type Southwire SimPull XHHW-2 single conductors in raceway.
3. Type USE-2/THW-2, single conductors in raceway

E. Feeders Installed below Raised Flooring:

1. Type THHN/THWN-2, or XHHW-2 single conductors in raceway
2. Metal-clad cable, Type MC with PVC jacket if installation follows the electrical code NEC 70 article 645.
3. Mineral-insulated, metal-sheathed cable, Type MI.

F. Feeders in Cable Tray:

1. Metal-clad cable, Type MC
2. Mineral-insulated, metal-sheathed cable, Type MI
3. Type DLO/RHW-2 or RHH 90°C rated for cable tray use, single or multi conductor.

G. Exposed Branch Circuits, Including in Crawlspaces:

1. Type THHN/THWN-2, or XHHW-2 single conductors in raceway
2. Metal-clad cable, Type MC
3. Mineral-insulated, metal-sheathed cable, Type MI.

H. Branch Circuits Concealed in Ceilings, Walls, and Partitions:

1. Type THHN/THWN-2, or XHHW-2 single conductors in raceway
2. Metal-clad cable, Type MC
3. Mineral-insulated, metal-sheathed cable, Type MI.

I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground:

1. Type Southwire SimPull THHN/THWN-2, single conductors in raceway
2. Type Southwire SimPull XHHW-2, single conductors in raceway
3. Type USE-2/THW-2 single conductors in raceway

J. Branch Circuits Installed below Raised Flooring:

1. Type THHN/THWN-2, or XHHW-2 single conductors in raceway
2. Metal-clad cable, Type MC with PVC jacket if installation follows the electrical code NEC 70 article 645
3. Mineral-insulated, metal-sheathed cable, Type MI.

K. Branch Circuits in Cable Tray:

1. Type THHN/THWN-2, or XHHW-2 single conductors in raceway
2. Metal-clad cable, Type MC
3. Mineral-insulated, metal-sheathed cable, Type MI
4. Type DLO/RHW-2 – or RHH-2 90 deg C rated for cable tray use, extra flexible cable.

L. Cord Drops and Portable Appliance Connections:

1. Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

M. Class 1 Control Circuits: Type THHN/THWN, in raceway.

N. Class 2 Control Circuits: Type THHN/THWN, in raceway; power-limited cable, in raceway; power-limited tray cable, in cable tray.

O. Fire rated feeders, as indicated in the documents or required by code, shall be installed underground or in mineral insulated (MI) cable or in a NRTL listed circuit protective system.

3.7 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation and shall remain slippery when dry. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, swivel grips, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables including cables behind removable surfaces such as ceilings, access floors, etc., parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

G. Install conductors of each wiring system such as 480/277 volt, 208/120 volt, emergency, sound, fire alarm, security, etc. in separate raceway systems unless otherwise indicated.

H. Install conductors in conduit where exposed to abuse or below 8 feet above finished floor unless indicated otherwise.

I. Exposed wiring and wiring in mechanical and electrical rooms and homeruns to panelboards shall be in conduit. Homeruns start within 20 feet of the last outlet served.

J. Type MC cable may be used in concealed areas where properly supported with listed devices, and installed parallel and perpendicular to the structure. Tie wire or wraps shall not be used to support cable(s). Maintain proper spacing between cables so as not to require derating. Support cable from structure using listed support means equal to Caddy systems. Do not support from ceiling tie wires except cables going from fixture to fixture in non-fire rated ceilings. Do not rest cables on ceiling tiles. Maintain one cable width spacing between cables.

K. The following areas are air plenums: Provide wiring as required herein and allowed by the Electric Code. 1. Under raised floors 2. above suspended ceilings.

L. Do not reduce the size or number of homeruns or conduits indicated without written permission of the Architect indicating specific exceptions and locations.

M. Cords may be used to connect chain or pendant hung industrial-type fixtures as allowed by the Electric Code.

N. Install products in accordance with manufacturers instructions.

O. Use solid conductor for power circuits #10 AWG and smaller.

P. Use stranded conductors for control circuits.

Q. Use conductor not smaller than #12 AWG for power and lighting circuits.

R. Use conductor not smaller than #14 AWG for control circuits unless specifically indicated otherwise.

S. Use #10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (23 m) or larger as indicated on the drawings for voltage drop.

T. Use #10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 175 feet (53 m) or larger as indicated on the drawings for voltage drop.

U. Pull all conductors into raceway at same time.

V. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

W. Protect exposed cable from damage.

X. Support cables not in raceways above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.

Y. Use suitable cable fittings and connectors.

Z. Neatly train and lace wiring inside boxes, equipment, and panelboards.

AA. Clean conductor surfaces before installing lugs and connectors.

BB. Terminate connections to switchgear, switchboards, panels, transformers, generators, UPS, ATS and distribution equipment with two hole bolt type compression fittings with inspection windows.

CC. Feeders and branch circuits shall be installed in independent raceways and boxes, unless otherwise indicated.

DD. Redundant circuits to equipment shall be installed in independent raceways utilizing diverse pathways, unless otherwise indicated.

EE. Feeders and branch circuit conductors 100A or larger shall be installed as one continuous piece. Install conductor splices only where specifically indicated. Location and reason for proposing a splice shall be submitted to the Architect for approval prior to installation. Splices shall be compression type, fully insulated and accessible for future infrared inspections.

FF. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

GG. Terminate aluminum conductors with tin-plated aluminum-bodied compression connectors only. Fill with anti-oxidant compound before installing conductor.

HH. Use suitable reducing connectors or mechanical connector adapters for connecting aluminum conductors to copper conductors.

II. Use insulated, compression type connectors for copper conductor splices and taps, 4 AWG and larger

JJ. Use split bolt connectors for copper splices and taps for 6 & 8 AWG conductors. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

KK. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

LL. Grounding Conductors: Exothermic welding and irreversible compression-type connections allowed above and below ground. Provide exothermic welding connections for all lightning protection components.

MM. Terminations of Control Wiring: Screw or pressure type insulated terminal blocks using spade or ring connectors or wago connectors.

NN. Fire Alarm, Control, Security, Sound and other Low Voltage Systems: Screw or pressure type insulated terminal blocks using spade or ring connectors. Mount in cabinets or junction boxes, otherwise conductors are to be continuous and unspliced. Wiring is to be permanently labeled at each termination with mylar ring labels or heat shrink type labels.

OO. Cables or conductors in common manholes, hand holes or pits under equipment shall be protected by arc fireproofing tape. Tape shall be a flexible fabric tape of an organic composition coated with a flame retardant material. Tape shall be two half lapped or two layers butt-lapped (staggered) over the entire length of exposed conductors. Tape shall be held on place with a glass cloth adhesive tape. Extend one inch into raceway.

3.8 MANUFACTURED (MODULAR) WIRING SYSTEMS

A. Not Applicable.

3.9 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.10 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Provide and coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping" and Section 26 05 00 “Common Work Results for Electrical”.

3.11 ARC/FIRE PROOFING

A. Cables or conductors of multiple feeders in common hand holes, manholes or pits under equipment shall be protected by arc fireproofing tape. Tape shall be flexible fabric tape of an organic composition coated with a flame retardant material. Tape shall be two half lapped or two layers butt-lapped (staggered) over the entire length of exposed conductors. Tape shall be held in place with a glass cloth adhesive tape. Extend tape 1 inch (25mm) into duct.

3.12 IDENTIFICATION

A. Identify wire and cable under provisions of Section 26 05 53.

B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.13 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping" and Section 26 05 00 “Common Work Results for Electrical”.

3.14 FIELD QUALITY CONTROL

A. After installing conductors and cables and before electrical circuitry has been energized, test conductors and cables for conformance with requirements.

B. Perform field inspection and testing under provisions of Section 260010 and 260813.

C. Test feeders and branch circuit conductors rated over 100 amps, with 500 volt megger. Replace conductor with less than 250,000 ohms resistance.

D. Test and verify proper phasing connections at distribution equipment and motor-operated equipment.

E. Test polarity and grounding at each receptacle device.

F. Inspect wire and cable for physical damage and proper connection. Replace conductors with cable damage including nylon jacket.

G. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values with permanent marker, mark bolt location for correct torque. Correct those bolted connections not meeting manufacturer’s or NRTL’s recommendations.

H. Verify proper conductor supports for short circuit withstand requirements and to keep stress off terminations as recommended by NEMA, NRTL and manufacturer.

END OF SECTION

SECTION 26 05 26
GROUNDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Section includes:

1. Conductors
2. Connectors
3. Grounding Electrodes
4. Bonding
5. Electrical Room Grounding
6. Transformer Grounding
7. Generator Grounding
8. Telecommunications System Grounding

B. Meet the following performance requirements:

1. Unless specified elsewhere, the ohmic values for grounds and grounding systems shall be as follows:
   a. For grounding metal enclosures and frames for electrical and electronically operated equipment--5 ohms maximum.
   b. For grounding systems to which electrical utilization equipment and appliances are connected--5 ohms maximum. To MGB.
   c. For grounding secondary distribution systems, neutrals, noncurrent carrying metal parts associated with distribution systems, and enclosures of electrical equipment not normally within reach of other than authorized and qualified electrical operating and maintenance personnel -- 5 ohms maximum. To MGB.
   d. All Telecom Ground Busbars' resistance must be under 3 ohms to the MGB.
   e. MGB to earth – 5 ohms maximum
   f. Ground well/rod to earth – 5 ohms maximum.
   g. Power and Lighting Equipment or System with Capacity 500 kVA and Less 5 ohms.
   h. Power and Lighting Equipment or System with Capacity 500 to 1000 kVA: 5 ohms.
   i. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
   j. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohms.
   k. Substations and Pad-Mounted Equipment: 5 ohms.
   l. Manhole Grounds: 10 ohms.

C. System Description:

1. Grounding and Bonding for safety and performance

D. Definitions:

1. MGB- Main Ground Bar
2. TMGB- Telecommunications Main Ground Bar
3. SRG- Signal Reference Grid
4. PANI- 'P' surge producers; 'A' surge absorbers (Grounding Electrode System, Building Structure Ground and Metallic Pipe Water System) 'N' non-isolated equipment frames, 'I' isolated equipment frames.

1.2 RELATED WORK

A. Section 26 00 10 - Basic Electrical Requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this section.

B. Section 27 05 26 – Grounding and Bonding for Communications Systems.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS/QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

B. Grounding System Resistance: 5 ohms.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10.

B. Codes and Standards in addition to Section 26 00 10:

1. ANSI/IEEE C2 - National Electrical Safety Code.
2. ANSI/IEEE 80 - Guide for Safety in Substation Grounding.
3. ANSI/IEEE 81 - Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
4. ANSI/IEEE 1100 - Power and Grounding Electronic Equipment

1.6 SUBMITTALS

A. Submit as required herein and under Section 26 00 10.

B. Product Data: Provide data for grounding electrodes and connections.

C. Written test results.

D. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

B. Accurately record actual locations of grounding electrodes and buried grounding conductors.

C. Submit test reports of service ground resistance and resistance readings from ground bar to ground bar and from SRG to raised floor.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

1.11 LEED / SUSTAINABILITY

A. Conform to requirements indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 ROD ELECTRODE

A. Manufacturers:

1. A.B. Chance.
2. Copperweld Bimetallics Div.
3. National Ground Rod.
4. Substitutions: Or equal, under provisions of Section 26 00 10.

B. Material: Copper or Copper-clad steel.

C. Diameter: 3/4 inch (19 mm).

D. Length: 10 feet (3 m).

2.2 ACTIVE ELECTRODES (NOT USED)

2.3 MECHANICAL CONNECTORS

A. Manufacturers:

1. O.Z. Gedney.
2. Burndy.
3. A.B. Chance.
4. Erico
5. Substitutions: Or equal, under provisions of Section 26 00 10.

B. Material: Bronze.

C. NRTL listed for grounding.

2.4 EXOTHERMIC CONNECTIONS

A. Manufacturers:

1. Caldweld.
2. Thermoweld.
3. Substitutions: Or equal, under provisions of Section 26 00 10.

2.5 WIRE

A. Material: Stranded copper.

B. Grounding Electrode Conductor: Size to meet Electrical Code requirements. No 4/0 AWG minimum for incoming service.

C. Ground grid and loop electrode: No. 4/0 AWG.

2.6 GROUNDING WELL COMPONENTS

A. Well Pipe: 8 inch (200 mm) diameter by 24 inch (600 mm) long concrete pipe with belled end.

B. Well Cover: Cast iron with legend "GROUND" embossed on cover.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that final backfill and compaction has been completed before driving rod electrodes.

3.2 INSTALLATION

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

B. Install rod electrodes at locations indicated. Install ground rods 30 inches (750 mm) minimum below grade and from foundation and locate outside of roof drip line.

C. Provide ground loop as indicated on Drawings; install 30 inches (750 mm) below grade and 30 inches (750 mm) minimum from foundation unless otherwise indicated.

D. Provide grounding well pipe with cover at rod locations where indicated (minimum of 1). Install well pipe top flush with finished grade.

E. Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel columns and rebar together.

F. Provide bonding to meet Electrical Code requirements. Bond all systems together with #410 copper cable, including ground ring, transformer generator, and primary equipment ground systems.

G. Bond together metal siding not attached to grounded structure; bond to ground.

H. Install ground to access floors. Use bare copper, hollow braided conductor (60A ampacity), Belden 8669 or equal. Bond to building steel, transformer and panelboards serving area.

I. Signal Reference Ground (SRG) – Refer to Drawings.

J. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid and single point ground. Use bare copper, hollow braided, conductor (Belden 8669 or equal).

K. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

L. Provide grounding as required by the lightning protection system, including bonding all metallic objects within six feet of down conductors.

M. Bond metal fences and gates around the transformers and generators to the transformer/generator grounding system.

3.3 PRIMARY/SUBSTATION GROUNDING

A. Provide ground loop around primary voltage equipment. Refer to Drawings.

3.4 TRANSFORMER GROUNDING

A. Provide grounding of transformers as separately derived systems, as required by the Electrical Code. Ground to the nearest building steel frame or code-approved grounding electrodes.

B. Bond neutral, equipment grounding conductor, transformer case and the grounding electrode at the transformer.

C. Provide grounding at utility transformers in accordance with utility company requirements.

3.5 GENERATOR GROUNDING

A. Provide grounding of the generators as separately derived systems, as required by the Electric Code.

B. Bond the generator neutral and generator frame together and to the grounding electrode conductor.

3.6 TELECOMMUNICATIONS SYSTEM GROUNDING

A. Provide a copper ground bus in the computer room.

B. Connect the ground bus to building steel.

C. Ground bars in consecutive Telecommunication Rooms and conduits and cable tray entering the room shall be bonded together using a hollow braided, bare copper conductor.

3.7 GROUND ROD ALTERNATE

A. Where it is not possible install ground rods vertically due to rock or other obstructions, Install Three #4/0 bare copper conductors of length equal to the ground rod (10 Ft minimum) radiating out from the proposed ground rod location. Conductors shall be equally spaced in the direction away from the building or ground loop the proposed ground rod is connected to. Install conductors 30 inches below grade.

3.8 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions indicated in Section 26 00 10.

B. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

C. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

D. Test resistance-to-earth grounding connections in accordance with ANSI/IEEE 81. Perform 4 point fall-of-potential test on main system. Use two-point method test to determine resistance between main system and neutral.

E. Minimum Acceptable Ground Resistance: Notify Architect of ground resistance tested. Notify in time for corrective action to be taken if necessary.

END OF SECTION

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Support, Anchorage, and Attachment Components
2. Fabricated Metal Equipment Support Assemblies

B. Meet the following performance requirements:

1. Size for 200% minimum safety factor.
2. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a quantified professional engineer, using performance requirements and design criteria indicated.
3. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
4. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
5. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.
6. Wind, snow, ice, flood and earthquake performance: In accordance with Section 26 00 10.

C. System Description:

1. Supports and procedures for installing electrical systems.

1.2 RELATED WORK

A. Section 26 00 10. – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10. are not repeated in this Section.

B. Section 26 05 48 – Vibration and Seismic Controls for Electrical Systems.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

1.11 LEED / SUSTAINABILITY

A. Conform to requirements indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
      g. Substitutions: Under provisions of Section 26 00 10.
   2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
   3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
   4. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c., in at least 1 surface.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. Fabco Plastics Wholesale Limited.
      d. Seasafe, Inc.
      e. Substitutions: Under provisions of Section 26 00 10.
   2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
   3. Fitting and Accessory Materials: Same as channels and angles[, except metal items may be stainless steel].
   4. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
      a. O.Z. GEDNEY

b. Cooper Systems
c. Thomas & Batts
d. Substitutions: under provisions of Section 26 00 10.

D. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Requires written permission from the General Contractor or Construction Manager. Only properly trained and licensed personnel shall operate this equipment.
   a. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:
      1) Hilti Inc.
      2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.
      4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
      5) Substitutions: Under provisions of Section 26 00 10.
2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.
      6) Rawl
      7) Substitutions: Under provisions of Section 26 00 10.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
6. Toggle Bolts: All-steel springhead type.
7. Hanger Rods: Threaded steel.
8. Seismic rated where required.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

E. Underground supports shall be non-metallic or stainless steel.

F. Install support systems sized and fastened to accommodate weight of equipment. Fasten hanger rods, support chains or wire, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, cast-in-place inserts or beam clamps. Do not use spring steel clips and clamps. Provide channel spanning structural members where required.

G. Provide multiple trapeze supports where appropriate.

H. Support all conduit under concrete slabs using non-metallic or stainless steel threaded rods and supports. Refer to detail on drawings.

I. Do not fasten supports to support wires, piping, ductwork, mechanical equipment, or conduit.

J. Do not drill structural steel members.

K. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

L. Install free-standing electrical equipment on concrete pads, and bolt to pad using Seismic rated Rawl studs.

M. Install surface-mounted cabinets backboards, panelboards etc. with a minimum of four anchors. Provide steel channel supports to stand backboards one inch (25 mm) off wall.

N. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

O. When obstructions such as ductwork, etc., do not allow direct connection to building structure, provide channel supports, rated for three times the working weight to be supported, across the obstruction to allow direct support of the equipment or material. Support the channel with threaded rods supported directly from the building structure.

P. Rigidly support all equipment, material and devices unless specifically indicated otherwise.

Q. Provide Seismic supports and fittings as required for the conditions indicated in Section 260010, including:

1. Galvanized or stainless steel cable support #10 AWG wire installed at 45° angle in two directions to prevent movement for supports over 12 inches long.
2. Bolt all equipment and supports to structure.

R. Do not attach metal roof decking.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts or Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section.

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

D. Anchor concrete base to floor slab with rated bolts or dowels at least equal to those required by the equipment installation requirements.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Metal Conduit and Tubing
2. Nonmetallic Conduit and Tubing
3. Optical Fiber/Communications Cable Raceway and Fittings
4. Metal Wireways
5. Nonmetallic Wireways
6. Surface Raceways
7. Boxes, Enclosures, and Cabinets

B. Meet the following performance requirements:

1. Wind, snow, ice, flood and earthquake performance: In accordance with Section 26 00 10.

1.2 RELATED WORK

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

B. Section 26 05 00 – Common Work Results for Electrical.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

B. Accurately record with dimensions on As-Built drawings the locations of all concealed raceways.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

1.11 LEED / SUSTAINABILITY

A. Conform to requirements indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. Electri-Flex Co.
6. Manhattan/CDT/Cole-Flex.
7. Maverick Tube Corporation.
8. O-Z Gedney; a unit of General Signal.
9. Wheatland Tube Company.
10. Substitutions: Under provisions of Section 26 00 10.

B. Rigid Steel Conduit: ANSI C80.1.

C. IMC: ANSI C80.6.

D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

1. Fittings for EMT: Steel, set-screw for conduits 2 ¼” or larger with 4 set screws and compression for ½” – 2”.
2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. AFC Cable Systems, Inc.
2. Anamet Electrical, Inc.; Anaconda Metal Hose.

3. Arnco Corporation.
4. CANTEX Inc.
5. CertainTeed Corp.; Pipe & Plastics Group.
6. Condux International, Inc.
7. ElecSYS, Inc.
8. Electri-Flex Co.
9. Lamson & Sessions; Carlon Electrical Products.
10. Manhattan/CDT/Cole-Flex.
11. RACO; a Hubbell Company.
12. Thomas & Betts Corporation.
13. Substitutions: Under provisions of Section 26 00 10.

B. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.

C. Fittings for RNC: NEMA TC 3; match to conduit or tubing type and material.

2.3 OPTICAL FIBER/COMMUNICATIONS CABLE RACEWAY AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Arnco Corporation.
2. Endot Industries Inc.
3. IPEX Inc.
4. Carlon Electrical Products.

B. Description: Comply with UL 2024; flexible type, approved for plenum installation.

2.4 METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Cooper B-Line, Inc.
2. Hoffman.
3. Square D; Schneider Electric.
4. General Electric
5. Substitutions: Under provisions of Section 26 00 10.

B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 1, unless otherwise indicated.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type

E. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS

A. Not used.

B. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Hoffman.
2. Lamson & Sessions; Carlon Electrical Products.
3. Substitutions: Under provisions of Section 26 00 10.

2.6 SURFACE RACEWAYS

A. Surface Metal Raceways: Galvanized steel with snap-on covers. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:
   a. MonoSystems Co.
   b. Walker Systems, Inc.; Wiremold Company (The).
   c. Thomas & Betts Corporation.
   d. Substitutions: Under provisions of Section 26 00 10.

B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors.

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:
   a. MonoSystems Co.
   b. Walker Systems, Inc.; Wiremold Company (The).
   c. Panduit Corp.
   d. Carlon Electrical Products.
   e. Hubbell Incorporated; Wiring Device-Kellems Division.
   f. Enduro Systems, Inc.; Composite Products Division.
   g. Butler Manufacturing Company; Walker Division.
   h. Substitutions: Under provisions of Section 26 00 10.

2.7 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
2. EGS/Appleton Electric.
3. Erickson Electrical Equipment Company.
4. Hoffman.
5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
6. O-Z/Gedney; a unit of General Signal.
7. RACO; a Hubbell Company.
8. Robroy Industries, Inc.; Enclosure Division.
9. Scott Fetzer Co.; Adalet Division.
10. Spring City Electrical Manufacturing Company.
11. Thomas & Betts Corporation.
12. Walker Systems, Inc.; Wiremold Company (The).
13. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary.
14. Substitutions: Under provisions of Section 26 00 10.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Metal Floor Boxes: Cast metal fully adjustable, rectangular.

F. Nonmetallic Floor Boxes: Nonadjustable, round.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized, cast iron with gasketed cover.

I. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.

J. Cabinets:

1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:

1. Exposed Conduit: Rigid steel conduit; RNC, Type EPC-80-PVC.
2. Concealed Conduit, Aboveground: Rigid steel conduit; RNC, Type EPC-40-PVC.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Comply with the following indoor applications, unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: Rigid steel conduit.
7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway or EMT.
8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: Riser-type, optical fiber/communications cable raceway in EMT.
9. Raceways for Concealed General Purpose Distribution of Optical Fiber or Communications Cable: Plenum-type, optical fiber/communications cable raceway or EMT.
10. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel or nonmetallic in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

K. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Secure line so it will not go back into raceway. Provide line with the distance indicated along its entire length.

L. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch (19-mm) Trade Size and Smaller: Install raceways in maximum lengths of 50 feet (15 m).
2. 1-Inch (25-mm) Trade Size and Larger: Install raceways in maximum lengths of 75 feet (23 m).
3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

M. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

N. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed 30 deg F (17 deg C), and that has straight-run length that exceeds 25 feet (7.6 m).

1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C temperature change.
   c. Indoor Spaces: Connected with the Outdoors without Physical Separation: 125 deg F (70 deg C temperature change).
   d. Attics: 135 deg F (75 deg C temperature change).
2. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change.
3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.

O. Flexible Conduit Connections: Use maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed lighting fixtures, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC in damp or wet locations not subject to severe physical damage.

P. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

Q. Set metal floor boxes level and flush with finished floor surface.

R. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping" and Section 26 05 00.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 3 inches (76 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed or unless seismic criteria require different clearance.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping" and Section 26 05 00 – Common Work Results for Electrical. Provide smoke tight pliable seals that allow future cable installation.

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.4 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.5 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping" and Section 26 05 00.

3.6 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 36
CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufacturers
2. Materials and Finishes
3. Cable Tray Accessories
4. Warning Signs
5. Source Quality Control

B. Meet the following performance requirements:

1. Seismic performance: In accordance with Section 26 00 10.

C. System Description:

1. Raceways to support electrical systems.

1.2 RELATED SECTIONS

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements indicated in Section 26 00 10.

B. ASTM A-123: Hot Dip Galvanized After Fabrication.

C. ASTM A-525: Hot-Dip Mill Galvanized Before Fabrication.

D. NEMA VE 1: Metallic Cable Tray Systems.ANSI/TIA/EIA - 568-B Commercial Building Telecommunications Cabling Standard.

E. ANSI/TIA/EIA – 569-A Commercial Building Standard for Telecommunications Pathways and Spaces

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

B. Shop Drawings: Indicate tray type, material dimensions, support points, expansion splice plates, NEMA class, and finishes.

C. Product Data: Provide data for fittings and accessories.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of product.

E. Submit cable each system capacity in pounds per linear foot. Submit deflection at stated capacity.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

1.11 LEED / SUSTAINABILITY

A. Conform to requirements indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. CPI, Chatsworth Products, Inc.
2. Chalfant Manufacturing Company.
3. Cooper B-Line, Inc.
4. Cope, T. J., Inc.; a subsidiary of Allied Tube & Conduit.
5. GS Metals Corp.; GLOBETRAY Products.
6. MONO-SYSTEMS, Inc.
7. MPHusky.
8. PW Industries.
9. Cable Management Solutions Inc.
10. Cablofil Inc.
11. Management Solutions Snake Tray
12. Newton Instrument Co.
13. Substitutions: Under provisions of Section 26 00 10.

2.2 MATERIALS AND FINISHES

A. Cable Trays, Fittings, and Accessories:

1. Steel, complying with NEMA VE 1Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M, Class B2; with chromium-zinc, ASTM F 1136, or Type 316 stainless-steel hardware.
2. Aluminum, complying with NEMA VE 1, Aluminum Association's Alloy 6063-T6 for rails, rungs, and cable trays, and Alloy 5052-H32 or Alloy 6061-T6 for fabricated parts; with

chromium-zinc, ASTM F 1136, or Type 316 stainless-steel splice-plate fasteners, bolts, and screws

3. Stainless steel, Type 304 or 316, complying with NEMA VE 1.
4. Fiberglass, complying with NEMA FG 1 and UL 568. Splice-plate fasteners, bolts, and screws shall be fiberglass-encapsulated stainless steel. Design fasteners so that no metal is visible when fully assembled and tightened. Fastener encapsulation shall not be damaged when torqued to manufacturer's recommended value.
5. Black Powder Coat: Straight sections shall be powder coated black with an average paint thickness of 1.2mils (30microns) to 3.0mils (75microns).
6. Electroplated zin alvanized finish shall not be used in computer room, crac gallery or POP rooms.

B. Sizes and Configurations: Refer to Part 3 and the Drawings for specific requirements for types, materials, sizes, and configurations.

1. Center-hanger supports may be used only when specifically indicated.

2.3 CABLE TRAYS

A. Ladder Cable Trays: Nominally 18 inches (455 mm) wide, and a rung spacing of 12 inches (305 mm).

B. Smooth radiused 90-degree fittings shall be constructed from ASTM A1011 SS Grade 33 steel. They shall have a minimum 12 inch inside radius

2.4 BASKET CABLE TRAY

A. Basket Cable Trays: 12 inches (300 mm) wide and 4 inches (100 mm) deep. Wire mesh spacing shall not exceed 2 by 4 inches (50 by 100 mm).

B. Smooth radiused 90-degree fittings shall be constructed from ASTM A1011 SS Grade 33 steel. They shall have a minimum 12 inch inside radius

2.5 RUNWAY CABLE TRAY

A. Description: Except as otherwise indicated, provide metal cable runways, of types, classes and sizes indicated with splice connectors, bolts, nuts and washers for connecting units.

B. Support Span:

1. 4 Foot Span 350 lbs per LF with Solid rails.
2. 4 Foot Span 200lbs per LF Tubular rails.

C. Runway Types: Material specifications for each runway type are as follows:

1. Communication Cables Tubular Bar style runway: Runway shall be zinc plated and black ladder type with 2 inch side rail height with welded rungs. Stringer side rail shall conform to the minimum chemical and mechanical properties of ASTM A36 structural steel.
2. Cable runway rungs shall be constructed from ASTM A1011 SS Grade 33 structural steel. Each rung shall be 1/2 inch by 1 inch steel c-channel shape with radiused edges.
3. Runway shall be 18, 24 or 36 inches wide and at lengths required to route as indicated on drawings.

D. Finishes: Cable runway shall be provided with black finish. All fittings, supports, splices, rods, clamps etc. for the runway system shall be gold chromate finish and installed to provide a complete assembly- including fasteners, hardware, and other items required to complete the installation as indicated on the drawings.

1. Smooth radiused 90-degree fittings shall be constructed from ASTM A1011 SS Grade 33 steel. They shall have a 12 inch inside radius and 3 inch straight tangents for secure attachment to straight sections. Rungs shall be spaced a maximum of 6 inches on center when measured along centerline of runway.

2. Provide rubber finishing caps at ends.

2.6 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

C. Turns, elbows, tees, crosses etc shall be large radius.

D. Waterfalls shall be provided at each location cable drop out of tray without conduit.

E. Barrier Strips: Same materials and finishes as cable tray.

2.7 WARNING SIGNS

A. Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

B. Materials and fastening are specified in Division 26 Section "Identification for Electrical Systems."

2.8 SOURCE QUALITY CONTROL

A. Perform design and production tests according to NEMA FG 1 and NEMA VE 1.

PART 3 - EXECUTION

3.1 CABLE TRAY APPLICATIONS

A. Power Feeders:
   1. Ladder cable tray

B. Power Branch Circuits:
   1. Above raised floors:
      a. Ladder cable tray
   2. Below raised floor:
      a. Ladder cable tray
      b. Basket cable tray

C. Communication Cables:
   1. Above raised floors
      a. Ladder cable tray
      b. Basket cable tray
   2. Below raised floors
      a. Ladder cable tray
      b. Basket cable tray
   3. In communication rooms (pop, meet me room, entrance room, MDF, IDF, etc).
      a. Runway cable tray

D. DC Power Cables:

1. Ladder cable tray

3.2 CABLE TRAY INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.

C. Remove burrs and sharp edges from cable trays.

D. Fasten cable tray supports to building structure and install seismic restraints.

1. Design each fastener and support to carry load indicated by seismic requirements and to comply with seismic-restraint details according to Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
2. Place supports so that spans do not exceed maximum spans on schedules.
3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
4. Support bus assembly to prevent twisting from eccentric loading.
5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
6. Locate and install supports according to NEMA FG 1 and NEMA VE 1.

E. Support trays in accordance with Section 260529. Provide supports at each connection point, at the end of each run of each side of expansion connectors, within 2 feet, and at other points to maintain spacing between supports of 4 feet maximum for runway and basket tray and 10 maximum for ladder cable tray.

F. Provide sway supports that will support a 200 lb sideward thrust from either direction at least on each end of cable rack but not more than 40 feet apart.

G. Install expansion connectors where cable tray crosses building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA FG 1 and NEMA VE 1. Space connectors and set gaps according to applicable standard.

H. Make changes in direction and elevation using standard fittings.

I. Make cable tray connections using standard fittings.

J. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping" and Section 26 05 00 "Common Work Results for Electrical."

K. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

L. Workspace: Install cable trays with enough space to permit access for installing cables.

M. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15 000 V.

N. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

3.3 CABLE INSTALLATION

A. Install cables only when cable tray installation has been completed and inspected.

B. Fasten cables on horizontal runs with cable clamps or cable ties as recommended by NEMA VE 2. Tighten clamps only enough to secure the cable, without indenting the cable jacket. Install cable ties with a tool that includes an automatic pressure-limiting device.

C. On vertical runs, fasten cables to tray every 18 inches (457 mm). Install intermediate supports when cable weight exceeds the load-carrying capacity of the tray rungs.

3.4 CONNECTIONS

A. Ground cable trays according to manufacturer's written instructions.

B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

C. Ground and bond cable tray under provisions of Section 260526 and as detailed on the Drawings.

1. Provide continuity between tray components. Provide bonding conductor or fitting between sections
2. Provide copper equipment grounding conductor through entire length of tray; bond to each component.
3. Connections to tray may be made using mechanical or exothermic connectors.

3.5 FIELD QUALITY CONTROL

A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:

1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

B. Report results in writing.

3.6 PROTECTION

A. Protect installed cable trays.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.
3. Install temporary protection for cables in open trays to protect exposed cables from falling objects or debris during construction. Temporary protection for cables and cable tray can be constructed of wood or metal materials until the risk of damage is over.

END OF SECTION

SECTION 26 05 37
CABLE TROUGH FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

A. Cable Tray shall be manufactured and tested per one or more of the following: Underwriter's Laboratories, Inc, CSA, ETL, and NEMA.

1.2 DESCRIPTION

A. Complete assembly of steel cable tray system and necessary accessories shall be provided as shown on plans. Install entire cable tray system in accordance with all local governing codes.

1.3 SUBMITTALS

A. Submittal drawings, in the form of "8 ½ x 11" catalog cut sheets, shall be provided for the following items: cable trays, fittings, accessories and load data.

B. Submit as required here in and under Section 26 00 10.

C. Shop Drawings: Indicate tray type, material dimensions, support points, expansion splice plates, NEMA class, and finishes.

D. Product Data: Provide data for fittings and accessories.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation and installation of product.

F. Submit cable each system capacity in pounds per linear foot. Submit deflection at stated capacity.

1.4 SUMMARY

A. Section Includes:

1. Manufacturers
2. Materials and Finishes
3. Wire Trough Accessories
4. Warning Signs
5. Source Quality Control

B. Meet the following performance requirements:

1. Seismic performance: In accordance with Section 26 00 10.

C. System Description:

1. Raceways to support electrical systems.

D.

1.5 RELATED SECTIONS

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

1.6 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.7 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

1.8 REGULATORY REQUIREMENTS

A. Conform to requirements indicated in Section 26 00 10.

B. ASTM A-123: Hot Dip Galvanized After Fabrication.

C. ASTM A-525: Hot-Dip Mill Galvanized Before Fabrication.

D. NEMA VE 1: Metallic Trough Systems.ANSI/TIA/EIA - 568-B Commercial Building Telecommunications Cabling Standard.

E. ANSI/TIA/EIA – 569-A Commercial Building Standard for Telecommunications Pathways and Spaces

1.9 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.10 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.11 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.12 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

1.13 LEED / SUSTAINABILITY

A. Conform to requirements indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Trough Tray shall be manufactured from galvanized Steel, G90 or equal.

2.2 SOLID TROUGH TRAY

A. Steel Trough Tray shall be constructed of a single formed sheet of material, incorporating internal flanges of 7/8”W x ½”H. Each tray length shall possess four holes per end for the connection of a splice connector or other accessories. The Trough Tray shall be 120” in length at widths and heights as shown on plans.

2.3 FITTINGS

A. Splice Connectors - Steel Sections of Trough Tray and all other fittings shall be joined by using U-Splice connectors. The U-Splice connector shall be U-shaped, and shall nest around the exterior of the tray. Each U-Splice shall be attached utilizing eight 3/8” Hex Bolts and Flange nuts. U-Splices shall allow for thermal expansion of tray.

B. Tray Covers - Steel, as well as other accessories shall be constructed of compatible material and design. Covers shall be field installed and rigidly secured by means of self tapping screws. Covers shall be solid.

2.4 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Cooper B-Line, Inc.
2. MONO-SYSTEMS, Inc.
3. Substitutions: Under provisions of Section 26 00 10.

2.5 SUPPORTS

A. A. Each Steel Trough Tray section shall be supported on maximum 10 foot centers, (3.0 meters) in Canada, by two .50 inch (12mm) pieces of threaded rod which attach to an appropriately sized trapeze system supporting the tray. All mounting and trapeze materials shall be furnished and installed by others.

2.6 OPTIONAL PAINTED FINISHES

A. Optional powder coated painted finish to be applied to the outer surfaces of the cable tray and associated components. Prior to the application of the powder coat all surfaces shall be cleaned and have an iron phosphate film applied. The color shall be

2.7 MATERIALS AND FINISHES

A. Cable Trays, Fittings, and Accessories:

1. Steel, complying with NEMA VE 1Hot-dip galvanized after fabrication, complying with ASTM A 123/A 123M, Class B2; with chromium-zinc, ASTM F 1136, or Type 316 stainless-steel hardware.
2. Stainless steel, Type 304 or 316, complying with NEMA VE 1.

2.8 TROUGH TRAYS

A. Refer to drawings for sizes

2.9 CABLE TRAY ACCESSORIES

A. Fittings: Tees, crosses, risers, elbows, and other fittings as indicated, of same materials and finishes as cable tray.

B. Cable tray supports and connectors, including bonding jumpers, as recommended by cable tray manufacturer.

C. Turns, elbows, tees, crosses etc shall be large radius.

D. Waterfalls shall be provided at each location cable drop out of tray without conduit.

E. Barrier Strips: Same materials and finishes as cable tray.

2.10 WARNING SIGNS

A. Lettering: 1-1/2-inch- (40-mm-) high, black letters on yellow background with legend "WARNING! NOT TO BE USED AS WALKWAY, LADDER, OR SUPPORT FOR LADDERS OR PERSONNEL."

B. Materials and fastening are specified in Division 26 Section "Identification for Electrical Systems."

2.11 SOURCE QUALITY CONTROL

A. Perform design and production tests according to NEMA FG 1 and NEMA VE 1.

PART 3 - EXECUTION

3.1 MANUFACTURERS

A. Company specializing in manufacturing products specified in this section must have a minimum of ten years documented experience.

3.2 CABLE TRAY INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Comply with recommendations in NEMA VE 2. Install as a complete system, including all necessary fasteners, hold-down clips, splice-plate support systems, barrier strips, hinged horizontal and vertical splice plates, elbows, reducers, tees, and crosses.

C. Remove burrs and sharp edges from troughs.

D. Fasten cable tray supports to building structure and install seismic restraints.

1. Design each fastener and support to carry load indicated by seismic requirements and to comply with seismic-restraint details according to Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
2. Place supports so that spans do not exceed maximum spans on schedules.
3. Construct supports from channel members, threaded rods, and other appurtenances furnished by cable tray manufacturer. Arrange supports in trapeze or wall-bracket form as required by application.
4. Support bus assembly to prevent twisting from eccentric loading.
5. Manufacture center-hung support, designed for 60 percent versus 40 percent eccentric loading condition, with a safety factor of 3.
6. Locate and install supports according to NEMA FG 1 and NEMA VE 1.

E. Support trays in accordance with Section 260529. Provide supports at each connection point, at the end of each run of each side of expansion connectors, within 2 feet, and at other points to maintain spacing between supports of 4 feet maximum for runway and basket tray and 10 maximum for ladder cable tray.

F. Provide sway supports that will support a 200 lb sideward thrust from either direction at least on each end of cable rack but not more than 40 feet apart.

G. Install expansion connectors where trough crosses building expansion joints and in cable tray runs that exceed dimensions recommended in NEMA FG 1 and NEMA VE 1. Space connectors and set gaps according to applicable standard.

H. Make changes in direction and elevation using standard fittings.

I. Make trough connections using standard fittings.

J. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping" and Section 26 05 00 “Common Work Results for Electrical.”

K. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

L. Workspace: Install trough trays with enough space to permit access for installing cables.

M. After installation of troughs is completed, install warning signs in visible locations on or near cable trays.

3.3 CABLE INSTALLATION

A. Install cables only when cable tray installation has been completed and inspected.

3.4 CONNECTIONS

A. Ground cable trays according to manufacturer's written instructions.

B. Install an insulated equipment grounding conductor with cable tray, in addition to those required by NFPA 70.

C. Ground and bond cable tray under provisions of Section 260526 and as detailed on the Drawings.

1. Provide continuity between tray components. Provide bonding conductor or fitting between sections
2. Provide copper equipment grounding conductor through entire length of tray; bond to each component.
3. Connections to tray may be made using mechanical or exothermic connectors.

3.5 FIELD QUALITY CONTROL

A. After installing cable trays and after electrical circuitry has been energized, survey for compliance with requirements. Perform the following field quality-control survey:

1. Visually inspect cable insulation for damage. Correct sharp corners, protuberances in cable tray, vibration, and thermal expansion and contraction conditions, which may cause or have caused damage.
2. Verify that the number, size, and voltage of cables in cable tray do not exceed that permitted by NFPA 70. Verify that communication or data-processing circuits are separated from power circuits by barriers.
3. Verify that there is no intrusion of such items as pipe, hangers, or other equipment that could damage cables.
4. Remove deposits of dust, industrial process materials, trash of any description, and any blockage of tray ventilation.
5. Visually inspect each cable tray joint and each ground connection for mechanical continuity. Check bolted connections between sections for corrosion. Clean and retorque in suspect areas.
6. Check for missing or damaged bolts, bolt heads, or nuts. When found, replace with specified hardware.
7. Perform visual and mechanical checks for adequacy of cable tray grounding; verify that all takeoff raceways are bonded to cable tray.

B. Report results in writing.

END OF SECTION

SECTION 26 05 38
CABLE BUS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufacturers
2. Standards
3. Construction
4. Electrical
5. Accessories

B. Meet the following performance requirements:

1. Seismic performance: In accordance with Section 26 00 10.
2. The system shall comply with Article 370 of the National Electrical Code and shall be suitable for indoor and /or outdoor use.
3. The cable bus shall include all necessary straight sections, fittings, tap boxes, entrance fittings, conductors, cable connectors, cable terminations, and other accessories required to form a complete system.
4. A complete set of drawings shall be supplied for each system to facilitate system design and installation.

C. System Description:

1. Raceways to support electrical systems.

D. Supporting Documents

1. For additional information, refer to the following drawings
   a. E602
   b. E603
   c. E300D
   d. E301D

1.2 RELATED SECTIONS

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements indicated in Section 26 00 10.

1.6 SUBMITTALS

A. A complete certified ventilated metal enclosed system designed to suit the site conditions shall be provided; including: all necessary fittings, enclosures, connectors, entrance fittings, insulated conductors, electrical connectors, terminating kits and other accessories as required.

B. System to be a certified pre-assembled cable bus system.

C. The bus system shall be suitable for indoor and/or outdoor use with conductor spacing and ventilation maintained throughout the system.

D. All elements of the bus enclosure shall be so designed to eliminate any sharp edges or projections that may injure conductor insulations or personnel.

E. Cable bus shall have all conductors in a common enclosure.

F. The cable bus system shall be supplied complete with 3D layout drawings, enclosure drawings, wall/equipment seal drawings, cut sheets, analysis package, and installation manual.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

1.11 LEED / SUSTAINABILITY

A. Conform to requirements indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Superior Cable Tray Bus-Superior Bus – Superior Tray Systems, Inc.
2. MPHuskey Cable-Bus
3. MDF Cable Bus Systems
4. Substitutions: Under provisions of Section 26 00 10.

2.2 STANDARDS

A. The equipment shall be manufactured, tested, rated and furnished in accordance with the latest standards and regulations of the following:

1. ANSI: American National Standards Institute
2. NEMA: National Electrical Manufacturer's Association

3. National Electrical Code
4. IEEE: Institute of Electrical and Electronic Engineers
5. CLASS 4662 01 Wireways and Busways – Busways
6. CLASS 4681 01 Wireways and Busways - Cabletroughs

PART 3 - CONSTRUCTION

3.1 CABLE TRAY APPLICATIONS

A. Bus enclosure fittings shall have a typical inner radius of eighteen (184) inches unless specified otherwise. The cable bus enclosure shall be manufactured from mill finish aluminum and suitable for indoor or outdoor use. Side rails, rungs, and splice plates shall be manufactured from 6063-T6 or 6061-T6 aluminum alloy and shall be 1/8 inch in thickness for maximum strength and maximum equipment ground conductor ratings.

B. The top and bottom surfaces of the cable bus enclosure shall be .080 5052 H32 aluminum with punched slotted holes (not louvered style) for ventilation. Punched slotted holes shall restrict entry of objects larger than 0.25” in diameter, and shall provide a minimum of 25% total open space in the top and bottom cover surfaces for efficient passage of air. The bottom covers shall be factory welded to the side rails and the top cover shall be a removable bolt-on type.

C. Splice joints between sections of the bus enclosure shall be attached using high pressure spline bolts (UL certified bonding connector) and the expansion joint shall be a limited-slip type.

D. Cable support blocks shall have a chamfered cable bore to eliminate any undo stress or damage to the cable insulation. The Cable Support block shall be manufactured from:

1. High Density Polyethylene (HDPE) UV resistant material suitable for indoor and outdoor use.

2. Fiberglass laminate manufactured in accordance with NEMA grade GPO-3.

Support blocks shall be spaced to withstand the forces due to the specified fault currents but in no case spaced greater than 36 inches for horizontal bus runs and 18 inches on vertical risers.

E. Termination, entrance and tap boxes shall be manufactured in material comparable with the cable bus enclosure and shall minimize galvanic corrosion effects. Weather proof seals shall be supplied with a rigid metallic mounting plate thick enough to resist buckling and deformation on uneven surfaces. The seal shall consist of a glass fiber reinforced polymer frame and appropriately sized cable sealers. The cable sealers shall capture the cables 360 degrees around its circumference and shall be sized appropriately to sufficiently hold the cable without damaging it. Both frames and cable sealer shall come with factory installed thermoplastic rubber gaskets. The thermoplastic gaskets shall seal all mating surfaces between the mounting plate, cable spacers and cable sealers. The assembled seal shall prevent moisture from passing in all weather conditions. The normal operating temperature of the seal shall be between -40c and 140c and shall be made of material that is non-magnetic and non-hydroscopic. The seal shall be electrical isolated from the bus and made of a non-conductive material. Areas where cables come into contact with the seal shall be made of a softer impact absorbing material and shall be free from any sharp corners.

F. Terminations for systems under 1000V shall be NEMA two (2) hole compression lugs.

G. All hardware supplied shall be of non-magnetic stainless steel 304 or better.

PART 4 - ELECTRICAL

A. All current carrying conductors shall be fully insulated and rated for the specified voltage. Cable insulation shall be rated for 90°C operating temperatures.

B. The conductors shall be phased and supported to maintain low impedance and assure the mechanical strength necessary to prevent cable movement or damage under short circuit currents, a minimum of 65,000A symmetrical for a duration of 60 cycles.

C. Maximum conductor ampacities shall not exceed allowable ampacities listed in the NEC and CEC.

D. The cable bus shall be designed so that the overall voltage drop from the source to termination point shall be no greater than 2% at the design full load of the bus unless specified otherwise. Calculations shall be proved at the design stage to illustrate the compliance with this requirement.

E. The conductors shall be arranged in a phasing pattern which exhibits minimal interphase unbalance accompanied by calculations. System shall have a maximum of 5% difference between the average line impedance per phase and line impedance; and a maximum of 5% difference between the average system impedance and the phase impedance.

F. Conductors shall be continuous length and pulled in after the bus enclosure is in place. Electrical connectors shall be used only at the termination of the conductor runs.

G. Cable bus enclosure shall have a continuous current rating of not less than 1000A (50°C rise) and the resistance across the enclosure section shall not exceed 50μΩ.

H. The bus enclosure shall be grounded at sufficient intervals for the purpose of preventing a potential above ground on the bus enclosure in the event of a fault. Cable bus enclosure shall be UL certified as a grounding conductor.

I. Loading on individual conductors in the cable bus system, voltage drop of each phase, impedance of each conductor and phase, and the heat generation of the system.

1. 4.9.2 Temperature rise of the conductors, insulation, enclosure and air leaving the system at the required loading and maximum ambient temperature of the site.

J. Calculations for the maximum value of magnetic field (EMF/EMI) at distances up to 4' from the bus enclosure

PART 5 - ELECTRICAL

5.1 Environmental water-tight seal

A. Fire stop system – minimum two (2) hour rating

B. MCT fire stop system – minimum four (4) hour rating

C. S-fittings (low profile entry fittings)

D. Cable termination kits

E. UDP Aluminum to Steel isolators

F. Transformer Enclosure

G. Equipment Enclosure

H. Support structure

I. Cable expansion/contraction systems

J. Enclosure expansion/contraction systems

END OF SECTION

SECTION 26 05 39
TRENWA PRECAST TRENCH SOLUTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. SCOPE

1. Provide a precast concrete underground utility trench system for electrical cable bus installation as manufactured by Trenwa, Inc. (Patent#2862367); 1419 Alexandria Pike; Fort Thomas, KY 41075. The manufacturer must have experience in design and fabrication of similar products and with facilities for fabricating them with the quality specified herein and without delay to the specified schedule.

B. DESIGN

1. The precast components shall be designed to conform to requirements stated in ASTM C857-07 “Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures, ASTM C858- 07 “Specifications for Underground Precast Concrete Utility Structures” and ACI-318 “Building Code Requirements for Structural Concrete and Commentary on Building Code Requirements in Structural Concrete”.

C. MATERIALS

1. Cement shall conform to ASTM C150/C150M, “Specification for Portland Cement”.
2. Fine and coarse aggregates shall conform to ASTM C33/C33M, “Specification for Concrete Aggregates”.
3. Chemical Admixtures shall conform to ASTM C260/C260M “Air-Entraining Admixtures for Concrete and ASTM C494/C494M “Chemical Admixtures for Concrete”.
4. Steel reinforcing bars shall conform to ASTM A615 “Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement”.
5. Steel reinforcing wires shall conform to ASTM A496 “Specification for Steel Wire, Deformed, for Concrete Reinforcement”.
6. Steel reinforcing welded wire mats shall conform to A1064 Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete”.
7. Embedded steel shapes and plates shall conform to ASTM A36/C36M “Standard Specification for Carbon Structural Steel”.

D. CONCRETE

1. Batching, mixing and placing of concrete shall conform to ACI A301 “Specifications for Structural Concrete” and ASTM C94/C94M “Specification for Ready-Mix Concrete” and ACI 304 “Guide for Measuring, Mixing, Transporting and Placing Concrete”. All materials shall be pre-weighed prior to mixing.
2. Concrete shall obtain a minimum compressive strength of 5,000 psi at 28 days of age.
3. Concrete shall contain 6% entrained air by volume (plus or minus 1%).

E. REINFORCEMENT

1. Fabrication and placement shall conform to ACI-318 “Building Code Requirements for Reinforced Concrete”.

F. SUBMITTALS

1. Engineering layout drawings will be provided for approval and to assist field installation. The drawings will include dimensions, identification and location of each trench part in the trench layout along with a bill of material.

1.2 ONE PIECE TRENCH SPECIFICATIONS

A. **GENERAL**

1. The trench system will consist of precast concrete U-shaped bases and removable covers equivalent to Trenwa's One Piece trench system to be installed in earth trenches with covers extending above the surrounding crushed rock surface.
2. The trench system will be designed to support at least 3,000 lbs. uniform load for pedestrian traffic.
3. The trench shall have an interior clear cross sectional area of 30" wide x 15" deep. The trench will be approximately 46" wide x 28-1/4" deep overall including cover. Note: The width / depth may need to change due to cable bus manufacturer requirements.
4. The precast U-shaped bases for the trench will be furnished in standard 10 foot lengths, except that special lengths will be furnished where required by the layout on the drawings. The U-shaped bases will have openings in the bottom.
5. The precast trench covers will be furnished in lightweight sections, sized to permit removal by a single person. The covers will have slots for lifting tools and will be made of Galvanize or Aluminum Checker Plate grating for free-air rating.
6. The precast trench system shall be designed and constructed so that neither the covers, nor temporary side-to-side braces need to be installed to facilitate installation or subsequent machine backfilling and tamping.
7. Unistrut supports should be installed at the bottom of the trench, approximately 5" from the base to support the lay-in cable bus. Spacing to be determined by manufacturer for coordination with the open windows at the bottom.

1.3 ROAD CROSSING TRENCH SPECIFICATIONS

A. GENERAL

1. Not used

1.4 COMPONENT TRENCH SPECIFICATIONS

A. GENERAL

1. The trench system shall consist of precast concrete support brackets, sidewalls and removable covers assembled to form a completely enclosed trench, except with open earth bottom.
2. The trench system will be designed to support at least 200 pounds per square foot live load for pedestrian traffic.
3. The trench shall have an interior clear cross sectional area of 30" wide by 16" deep. Note: The width / depth may need to change due to cable bus manufacturer requirements. The outside dimensions shall be approximately 42" wide x 28" deep overall (including cover).
4. The precast sides of the trench system shall be furnished in standard 5 foot lengths, except that special lengths shall be furnished where required by the layout on the drawings. The trench design is such that the sidewalls are held in place by the pressure of the external earth backfill. Provide U shaped support brackets at a maximum spacing of 5 feet center to center with rectangular sidewall panels spanning the brackets.
5. The precast trench covers will be furnished in lightweight sections, sized to permit removal by a single person. The covers will have slots for lifting tools and will be made of Galvanize or Aluminum Checker Plate grating for free-air rating.

END OF SECTION

SECTION 26 05 43
UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Underground ducts and raceway systems.
2. Digital photographs with electronic dates embedded shall be provided to document all installations. Digital photographs shall be submitted to the Architect for review and comment prior to back filling or concealing installation.

B. Meet the following performance requirements:

1. Meet the requirements of the project site and the local utility.

C. System Description:

1. Underground systems for primary and secondary electrical and communication systems.

1.2 RELATED WORK

A. Section 26 00 10 – Basic Electrical Requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

B. Section 27 05 28 – Low Voltage Raceway Distribution.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

B. Interruption of Existing Services: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Contractor and Owner no fewer than five days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of service without Contractor's and Owner's written permission.

C. Coordinate layout and installation of ducts, manholes, and boxes with final arrangement of other utilities, site grading, structural features and surface features as determined in the field.

D. Coordinate elevations of ducts and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

E. Notify local AHJ and Architect prior to covering underground work.

F. Provide digital photographs of installation per 1.8 Record Documents.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

B. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

C. Comply with ANSI C2.

D. Comply with NFPA 70.

E. Deliver ducts to Project site with ends capped. Store nonmetallic ducts with supports to prevent bending, warping, and deforming.

F. Store precast concrete and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings are visible.

G. Lift and support precast concrete units only at designated lifting or supporting points.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10.

B. AASHO H-20 - Standard Specification for Highway Bridges.

C. ANSI/ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

D. ANSI/ASTM A569 - Steel, Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled, Commercial Quality.

E. ASTM A48 - Gray Iron Castings.

F. ASTM A123 - Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strips.

G. SCTE 77

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

B. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

C. Submit digital photographs of installation as detailed under 1.8 Record Documents prior to installing concrete or flowable fill or back filling. Expose installation at installer’s expense for Architect’s review if proper dated digital photographs not reviewed or provided prior to concealing.

D. Indicate material specifications, dimensions, capacities, size and location of openings, reinforcing details, and accessory locations.

E. Submit manufacturer's installation instructions.

F. Submit on back fill material.

G. Submit on concrete mix and flowable backfill, include thermal resistivity.

H. Product data: For the following:

1. Duct-bank materials, including separators and miscellaneous components.
2. Duct and conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.

3. Accessories for manholes, handholes, boxes, and other utility structures.
4. Warning tape.
5. Warning planks.

I. Shop Drawings for precast of factory-fabricated underground utility structures: Include plans, elevations, sections, details, attachments to other work, and accessories, including the following:

1. Duct entry provisions, including location and duct sizes.
2. Reinforcement details.
3. Frame and cover design and manhole frame support rings.
4. Ladder or step details.
5. Grounding details.
6. Dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
7. Joint details.

J. Shop Drawings for factory-fabricated handholes and boxes other than precast concrete: Include dimensional plans, sections, and elevations, and fabrication and installation details, include the following:

1. Duct entry provisions, including locations and duct sizes.
2. Cover design.
3. Grounding details.
4. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

K. Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings. Drawings shall be signed and sealed by a qualified professional engineer.

L. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C 858.

M. Source quality-control test reports.

N. Field quality-control test reports.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

B. Identify on As-Built drawings: Dimensionally accurate locations of all underground raceways handholes, manholes and subsurface splices, joints or terminations. Dimension from two remote fixed permanent points for each end point and change of direction.

C. Accurately record on butterfly diagrams the conductors entering and leaving manholes and vaults. Indicate what is in each conduit; identify circuit, conduit size and material, and conductor size, quantity and material. Diagram shall indicate location of all conduits, occupied and spare.

D. Digital photographs shall be taken of all underground installations documenting conduit placement, support and arrangement. Photograph where conduits are ended underground, documenting watertight screw caps on ends of conduits, sloped concrete encasement with exposed reinforcing bar and manholes and handholes indicating conduit entry and installation before backfill. Each photograph shall have a digital date on the picture.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 CONDUIT

A. Rigid Steel Conduit: Galvanized. Comply with ANSI C80.1.

B. RNC: NEMA TC 2, Type EPC-40-PVC and Type EPC-80-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

2.2 NONMETALLIC DUCTS AND DUCT ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Carlon Electrical Products.
2. Underground Devices Inc.
3. Cantex, Inc.
4. ARNCO Corp.
5. Condux International, Inc.
6. Electri-Flex Company.
7. Spiraduct/AFC Cable Systems, Inc.
8. Substitutions: Under provisions of Section 26 00 10.

B. Duct Accessories:

1. Duct Separators: Factory-fabricated rigid PVC interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum of 3 inches between conduits and 7.5 inch center to center duct spacings while supporting ducts during concreting or backfilling.
2. Warning Tape: Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."
3. Concrete Warning Planks: Nominal 12 by 24 by 3 inches (300 by 600 by 76 mm) in size, manufactured from 6000-psi (41-MPa) concrete.
   a. Color: Red dye added to concrete during batching.
   b. Mark each plank with "ELECTRIC" in 2-inch- (50-mm-) high, 3/8-inch- (10-mm-) deep letters.

2.3 PRECAST CONCRETE HANDHOLES AND BOXES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Oldcastle Precast Group.
2. Utility Concrete Products, LLC.
3. Utility Vault Co.
4. Trenwa
5. Substitutions: Under provisions of Section 26 00 10.

B. Comply with ASTM C 858 for design and manufacturing processes.

C. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.

1. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
2. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
3. Cover Legend: Molded lettering as indicated for each service.
4. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
5. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
   a. Extension shall provide increased depth required and as indicated on Drawings.
   b. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
6. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
   a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
   b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
   c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
7. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
   a. Type and size shall match fittings to duct or conduit to be terminated.
   b. Fittings shall align with elevations of approaching ducts and be located near interior corners of handholes to facilitate racking of cable.
8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.4 HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Quazite
   b. Armorcast Products Company.
   c. Carson Industries LLC.
   d. CDR Systems Corporation.
   e. NewBasis.
   f. Substitutions: Under provisions of Section 26 00 10.

B. Description: Comply with SCTE 77.

1. Color: Gray
2. Configuration: Units shall be designed for flush burial and have closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, as indicated for each service.
6. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
7. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

8. Handholes 12 inches wide by 24 inches long (300 mm wide by 600 mm long) and larger shall have factory-installed inserts for cable racks and pulling-in irons.

C. Polymer Concrete Handholes and Boxes with Polymer Concrete Cover: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.

2.5 PRECAST MANHOLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Oldcastle Precast Group.
2. Utility Concrete Products, LLC.
3. Utility Vault Co.
4. Trenwa
5. Substitutions: Under provisions of Section 26 00 10.

B. Comply with ASTM C 858, with structural design loading as specified in Part 3 "Underground Enclosure Application" Article and with interlocking mating sections, complete with accessories, hardware, and features.

1. Windows: Precast openings in walls, arranged to match dimensions and elevations of approaching ducts and duct banks plus an additional 12 inches (300 mm) vertically and horizontally to accommodate alignment variations.
   a. Windows shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
   b. Window opening shall have cast-in-place, welded wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
   c. Window openings shall be framed with at least two additional No. 4 steel reinforcing bars in concrete around each opening.
2. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
   a. Type and size shall match fittings to duct or conduit to be terminated.
   b. Fittings shall align with elevations of approaching ducts and be located near interior corners of manholes to facilitate racking of cable.

C. Concrete Knockout Panels: 1-1/2 to 2 inches (38 to 50 mm) thick, for future conduit entrance and sleeve for ground rod.

D. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.6 CAST-IN-PLACE MANHOLES

A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for conduit entrance and sleeve for ground rod.

B. Materials: Comply with ASTM C 858 and with Division 03 Section "Cast-in-Place Concrete."

C. Structural Design Loading: As specified in Part 3 "Underground Enclosure Application" Article.

2.7 UTILITY STRUCTURE ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Oldcastle Precast Group.
2. Neenah Foundry Company.
3. Underground Devices, Inc.
4. Campbell Foundry Company.
5. East Jordan Iron Works, Inc.
6. McKinley Iron Works, Inc.
7. NewBasis.
8. Osburn Associates, Inc.
9. Pennsylvania Insert Corporation.
10. Utility Concrete Products, LLC.
11. Utility Vault Co.
12. O.Z. Gedney
13. Substitutions: Under provisions of Section 26 00 10.

B. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.

1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A 48/A 48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inches (737 mm).
   a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
2. Cover Legend: Cast in. Selected to suit system.
   a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
   b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
   c. Legend: "SIGNAL" for communications, data, and telephone duct systems.
3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
   a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities less than 2.0 cu. ft. (60 L) where packaged mix complying with ASTM C 387, Type M, may be used.

C. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.

D. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch- (50-mm-) diameter eye, and 1-by-4-inch (25-by-100-mm) bolt.

1. Working Load Embedded in 6-Inch (150-mm), 4000-psi (27.6-MPa) Concrete: 13,000-lbf (58-kN) minimum tension.

E. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch- (32-mm-) diameter eye, rated 2500-lbf (11-kN) minimum tension.

F. Pulling-In and Lifting Irons in Concrete Floors: 7/8-inch- (22-mm-) diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.

1. Ultimate Yield Strength: 40,000-lbf (180-kN) shear and 60,000-lbf (270-kN) tension.

G. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch (13-mm) ID by 2-3/4 inches (69 mm) deep, flared to 1-1/4 inches (32 mm) minimum at base.

1. Tested Ultimate Pullout Strength: 12,000 lbf (53 kN) minimum.

H. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch (13-mm) bolt, 5300-lbf (24-kN) rated pullout strength, and minimum 6800-lbf (30-kN) rated shear strength.

I. Cable Rack Assembly: Steel, hot-dip galvanized, except insulators.

1. Stanchions: T-section or channel; 2-1/4-inch (57-mm) nominal size; punched with 14 holes on 1-1/2-inch (38-mm) centers for cable-arm attachment.
2. Arms: 1-1/2 inches (38 mm) wide, lengths ranging from 3 inches (75 mm) with 450-lb (204-kg) minimum capacity to 18 inches (460 mm) with 250-lb (114-kg) minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
3. Insulators: High-glaze, wet-process porcelain arranged for mounting on cable arms.

J. Cable rack assembly: Non-metallic.

1. Heavy duty cable racks or stanchions.
2. Underground devices series CR with HDs or RA type brackets.

K. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F (2 deg C). Capable of withstanding temperature of 300 deg F (150 deg C) without slump and adhering to clean surfaces of plastic ducts, metallic conduits, conduit coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.

2.8 CONDUIT OR DUCTBANK BACKFILL

A. Flowable Thermal Backfill (FTB) shall have good heat dissipation properties even when totally dry. The mix design shall provide a thermal rho of 35 to 40°C-cm/W wet, and 70 to 75°C-cm/W dry, with excellent thermal stability.

B. Stone Dust backfill shall have a high quartz content and a low thermal reisistivity.

2.9 SOURCE QUALITY CONTROL

A. Test and inspect precast concrete utility structures according to ASTM C 1037.

B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by a independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

A. Ducts for Electrical Cables Over 600 V: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

B. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

C. Ducts for Electrical Feeders 600 V and Less: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

D. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40-PVC, in direct-buried duct bank, unless otherwise indicated.

E. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, in concrete-encased duct bank, unless otherwise indicated.

F. Underground Ducts for Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC installed in direct-buried duct bank, unless otherwise indicated.

G. Underground ducts crossing driveways and roadways RNC, NEMA type EPC-40-PVC, encased in concrete.

3.2 UNDERGROUND ENCLOSURE APPLICATION

A. Handholes and Boxes for 600 V and Less, Including Telephone, Communications, and Data Wiring:

1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.
2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20, Polymer concrete, SCTE 77, Tier 15 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 Polymer concrete units, SCTE 77, Tier 8 structural load rating.

B. Manholes: Precast concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.3 EARTHWORK

A. Excavation and Backfill: Comply with excavation section but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

D. Cut and patch existing pavement in the path of underground ducts and utility structures repair to match existing construction in like new condition.

3.4 DUCT INSTALLATION

A. Electrical power conduits shall be stacked no more than 2 rows high or 2 columns wide. When installed in configurations over two rows high or wide the conductors will need to be derated.

B. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.

C. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches (1220 mm), both horizontally and vertically, at other locations, unless otherwise indicated.

D. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in same plane.

E. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches (250 mm) o.c. for 5-inch (125-mm) ducts, and vary proportionately for other duct sizes.

1. Begin change from regular spacing to end-bell spacing 10 feet (3 m) from the end bell without reducing duct line slope and without forming a trap in the line.
2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
3. Grout end bells into structure walls from both sides to provide watertight entrances.

F. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 5 feet (1.5 m) outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Extend rigid steel conduit 5 feet (1.5m) beyond foundation wall.

G. Sealing: Provide removable closures at terminations of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig (1.03-MPa) hydrostatic pressure.

H. Measure/pulling tape: provide ¾” wide polyester pulling tape in ducts, including spares. Refer to Section 26 05 00 – Common Work Results for Electrical.

I. Concrete-Encased Ducts (Same requirements for flowable fill where it is allowed): 3 inch minimum concrete on all sides.

1. Support ducts on duct separators. Separator Installation: Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent floating during concrete installation. Stagger separators approximately 6 inches (150 mm) between tiers. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
2. Concrete installation Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
   a. Start at one end and finish at the other, allowing for expansion and contraction of ducts as their temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.
   b. If more than one pour is necessary, terminate each pour in a 45 degree plane and install 3/4-inch (19-mm) reinforcing rod dowels extending 18 inches (450 mm) into concrete on both sides of joint near corners of envelope.
3. Pouring Concrete: Spade concrete carefully during pours to prevent voids under and between conduits and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Use a plank to direct concrete down sides of bank assembly to trench bottom. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
4. Reinforcement: Reinforce concrete-encased duct banks where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
5. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
6. Minimum Space between Ducts: 7 ½ inches (190mm) center to center, 3 inches (75 mm) between ducts and exterior envelope wall, 2 inches (50 mm) between ducts for like

services, and 4 inches (100 mm) between power and signal ducts. Minimum 5 feet between duct banks unless otherwise indicated.

7. Depth: Install top of duct bank at least 24 inches (600 mm) below finished grade in areas not subject to deliberate traffic, and at least 30 inches (750 mm) below finished grade in deliberate traffic paths for vehicles, unless otherwise indicated.
8. Stub-Ups: Use manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor. Extend concrete encasement throughout the length of the elbow.
   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
   b. Stub-Ups to Equipment: For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of base. Install insulated grounding bushings on terminations at equipment.
9. Warning Tape: Bury warning tape approximately 12 inches (300 mm) above all concrete-encased ducts and duct banks. Align tape parallel to and within 3 inches (75 mm) of the centerline of duct bank. Provide an additional warning tape for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional tapes 12 inches (300 mm) apart, horizontally.

J. Direct-Buried Duct Banks:

1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet (6 m) of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6 inches (150 mm) between tiers.
3. Excavate trench bottom to provide firm and uniform support for duct bank.
4. Install backfill as specified.
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4 inches (100 mm) over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction.
6. Install ducts with a minimum of 3 inches (75 mm) between ducts for like services and 6 inches (150 mm) between power and signal ducts unless otherwise indicated.
7. Depth: Install top of duct bank at least 36 inches (900 mm) below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete.
   b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
10. Warning Planks: Bury warning planks approximately 12 inches (300 mm) above direct-buried ducts and duct banks, placing them 24 inches (600 mm) o.c. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch (300-mm) increment of duct-bank width over a nominal 18 inches (450 mm). Space additional planks 12 inches (300 mm) apart, horizontally.

K. Where conduits or ductbanks terminate underground provide a marker flush with finished grade above the termination point. Indicate dimensioned location on As-Built drawings.

L. Terminate conduits with watertight screw cover caps to keep water and debris out of conduits.

M. After the conduits are installed, a wire brush 1/2 inch larger than the diameter of the conduits shall be passed through the conduits. All foreign matter shall be removed. If obstructions are found which cannot be removed by cleaning, the conduits shall be removed and re-installed at the expense of the original Installer.

3.5 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891, unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a 12 inch (300mm) level bed of crushed stone or gravel, graded from 1-inch (25-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

B. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches (380 mm) below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch (25 mm) above finished grade.
3. Install handholes with bottom below the frost line.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

C. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

D. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
2. Install chimney, constructed of precast concrete collars and rings to support frame and cover and to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for cast-iron frame to chimney.

E. Hardware: Install removable hardware, including pulling eyes, cable racks and stanchions, as required for installation and support of cables and conductors and as indicated.

F. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches (98 mm) for manholes and 2 inches (50 mm) for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

G. Warning Sign: Install "Confined Space Hazard" warning sign on the inside surface of each manhole cover.

3.6 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting ducts to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of ducts, and seal joint between box and extension as recommended by the manufacturer.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other handholes 1 inch (25 mm) above finished grade.

D. Install handholes and boxes with bottom below the frost line below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for ducts and conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on compacted earth.

1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Division 03 Section "Cast-in-Place Concrete," with a troweled finish.
2. Dimensions: 10 inches wide by 12 inches deep (250 mm wide by 300 mm deep).

3.7 INSTALLATION – CAST IN PLACE CONCRETE MANHOLES

A. Form cast-in-place manholes, inside and outside surfaces, in accordance with the provisions of Section 03100.

B. Manhole Shape: Rectangular. As indicated.

C. Inside Dimensions: As indicated.

D. Wall Thickness: 6 inches minimum, as required to meet load ratings indicated.

E. Form window for duct entry as indicated and required.

F. Include 12 inch (300 mm) drain opening and 2 one inch (25 mm) ground rod openings in base section.

G. Cast cable pulling irons in place opposite each duct entry window.

H. Cast inserts for cable racks in place 2 feet centers on walls without duct penetrations.

I. Cast manhole steps in place on 16 inch (40 mm) centers.

J. Set elevation of each manhole as required to match raceway or as indicated.

3.8 GROUNDING

A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Provide a ten foot by 3/4” diameter copper clad grounding rod in each manhole or vault. Leave rod 12 inches above the bottom of the unit.

C. Bond metallic objects to ground with #6 AWG bore copper conductor.

3.9 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.

1. Clearance: 6 inches (150 mm) minimum each side of pipe or conduit.

C. Evacuation Bottoms - Ductbanks: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches (150 mm) in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches (150 mm) or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Evacuation Bottoms – Direct buried on bedding, manholes and other structures: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.10 SUBGRADE INSPECTION

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

D. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

3.11 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by Architect.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.12 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.13 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

C. Backfill around direct burial conduits shall have low thermal resistively and be thoroughly compacted with no voids. Provide stone dust containing quartz.

3.14 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Backfill trenches excavated under footings and within 18 inches (450 mm) of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings.

D. Provide 4-inch- (100-mm-) thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase.

E. Place and compact initial backfill of subbase material or satisfactory soil, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the utility pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

F. Flowable Thermal Backfill (FTB) Material (flowable fill): Place backfill of FTB material to a height of 12 inches (300 mm) over and under the conduit. FTB shall have good heat dissipation properties even when totally dry. The mix design shall provide a thermal rho of 35 to 40°C-cm/W wet, and 70 to 75°C-cm/W dry, with excellent thermal stability.

G. Backfill voids with satisfactory soil while installing and removing shoring and bracing.

H. Place and compact final backfill of satisfactory soil to final subgrade elevation.

I. FTB Material (flowable fill): Place final backfill of controlled low-strength material to final subgrade elevation.

J. Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.15 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.
2. Under walks and pavements, use satisfactory soil material.
3. Under steps and ramps, use engineered fill.
4. Under building slabs, use engineered fill.
5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.16 SOIL MOISTURE CONTROL

A. Improper compaction and placement of fill around conduits will affect the thermal performance and ampacity of the installed conductors.

B. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.17 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Improper compaction and placement of fill around conduits will affect the thermal performance and ampacity of the installed conductors.

B. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

C. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

D. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698 and ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches (300 mm) of existing subgrade and each layer of backfill or fill soil material at 95 percent.
2. Under walkways, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.
3. Under lawn or unpaved areas, scarify and recompact top 6 inches (150 mm) below subgrade and compact each layer of backfill or fill soil material at 95 percent.

3.18 CLEANING

A. After the conduits are installed, a wire brush ½ inch larger than the diameter of the conduits shall be passed through the conduits. All foreign matter shall be removed. If obstructions are found which cannot be removed by cleaning, the conduits shall be removed and re-installed at the expense of the original Installer.

B. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of ducts. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.

C. Clean internal surfaces of manholes, handholes and boxes including sump. Remove foreign material.

3.19 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground ducts and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 0 percent fill of duct. If obstructions are indicated, remove obstructions and retest.
3. Test manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems."

B. Correct deficiencies and retest as specified above to demonstrate compliance.

END OF SECTION

SECTION 26 05 48
VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vibration Isolators
2. Seismic-Restraint Devices
3. Factory Finishes
4. Isolation pads
5. Spring isolators
6. Restrained spring isolators
7. Channel support systems
8. Restraint cables
9. Hanger rod stiffeners
10. Anchorage bushings and washers

B. Meet the following performance requirements:

1. Wind, snow, ice, flood and earthquake requirements indicated under regulatory requirements in Section 26 00 10.

C. System Description:

1. Provide seismic and vibration control devices, materials and related items. Perform all work as indicated on the Drawings and as specified herein to provide complete vibration isolation systems in proper working order.
2. Coordinate the size, location and special requirements of vibration isolation equipment and systems with other trades. Coordinate dimensions and size of housekeeping pads.
3. Provide vibration isolators of the appropriate sizes and proper loading to meet the specified requirements.
4. Provide any incidental materials needed to meet the requirements stated herein, even if not expressly specified or indicated on the Drawings.
5. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

1.2 RELATED WORK

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

B. Section 26 05 29 – Hangers and Supports for Electrical Systems

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

B. The shop drawing submittal for isolated electrical equipment shall include submittal information for the isolation mounts. Information supplied shall be as follows:

1. Complete description of products to be supplied, including product data, dimensions, specifications, and installation instructions.
2. Detailed selection data for each vibration isolator supporting equipment, including:
   a. The equipment identification mark;
   b. The isolator type;
   c. The actual load;
   d. The static deflection expected under the actual load;
   e. The additional deflection-to-solid under load; and
   f. The ratio of spring height under load to spring diameter.

C. Submission of samples may be requested for each type of vibration isolation device. After approval, samples will be returned for installation at the job. Provide for all costs associated with submission of samples.

D. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

E. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
2. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other Division 26 Sections for equipment mounted outdoors.
3. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
4. Field-fabricated supports.
5. Seismic-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

F. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

G. Welding certificates.

H. Qualification Data: Seismic calculations shall be sealed by a registered Professional Engineer licensed in the state of the project.

I. Field quality-control test reports.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.
10. Substitutions: Under provisions of Section 26 00 10.

B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

C. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

D. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.2 SEISMIC-RESTRAINT DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti Inc.
5. Loos & Co.; Seismic Earthquake Division.
6. Mason Industries.
7. TOLCO Incorporated; a brand of NIBCO INC.
8. Unistrut; Tyco International, Ltd.
9. Substitutions: Under provisions of Section 26 00 10.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 603 galvanized or ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: [Steel tube or steel slotted-support-system sleeve with internally bolted connections] [Reinforcing steel angle clamped] to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

2.4 VIBRATION ISOLATION TYPE DNP (DOUBLE NEOPRENE PAD).

A. Neoprene pad isolators shall be formed by two layers of 1/4 inch (6.4mm) to 5/16 inch (8mm) thick ribbed or waffled neoprene, separated by a stainless steel or aluminum plate. These layers shall be permanently adhered together. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.

B. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Amber/Booth - Type NR.
2. Korfund Dynamics - Type Korpad
3. Mason Industries - Type WSW
4. Kinetics Noise Control - Type NPS
5. Vibration Mounting and Control - Series Shear Flex
6. Substitution: or equal, under provisions indicated in 260010.

2.5 VIBRATION ISOLATION TYPE HN (HANGER NEOPRENE)

A. Vibration isolation hangers shall consist of neoprene-in-shear or glass fiber element contained in steel housing. Neoprene neck bushing (or other element) shall be provided where the

hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing. The diameter of the hole in the housing shall be sufficient to permit the hanger rod to swing through a 30 degree arc before contacting the hanger housing.

B. Type HN isolators shall be one of the following products or approved equal:

1. Amber/Booth - Type BRD-A
2. Korfund Dynamics - Type H
3. Mason Industries - Type HD
4. Kinetics Noise Control - Type RH or FH
5. Vibration Mountings and Control - Type RHD or RFD
6. Substitutions: or equal, under provisions indicated in 260010.

2.6 VIBRATION ISOLATION TYPE FSNTL (FLOOR SPRING AND NEOPRENE TRAVEL LIMITED)

A. Spring isolators shall be free-standing and laterally stable without any housing. Spring diameter shall be not less than 0.8 of the compressed height of the spring at the rated load. Spring shall have a minimum additional travel-to-solid equal to 50 percent of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately one. All mounts shall have leveling bolts. All mounts shall have vertical travel limit stops to control extension when weight is removed. The travel limit stops shall be capable of serving as blocking during erection of the equipment. A minimum clearance of 1/4 inch (6.4mm) shall be maintained around restraining bolts and between the limit stops and the spring to avoid interference with the spring action.

B. Either the spring element in the isolator shall be set in a neoprene cup and have a steel washer to distribute the load evenly over the neoprene, or each isolator shall be mounted on a Type NP isolator. If the NP isolator is used, provide a rectangular bearing plate of appropriate size to load the pad uniformly within the manufacturer's recommended range. If the basic spring isolator has a neoprene friction pad on its base and a NP isolator is to be added to the base, a galvanized steel, stainless steel, or aluminum plate shall be used between the friction pad and the NP isolator. If the isolator is outdoors, the plate shall not be made of galvanized steel. The NP isolator, separator plate, and friction pad shall be permanently adhered to one another and to the bottom of the bearing plate.

C. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Amber/Booth - Type CT
2. Korfund Dynamics - Type WSCL
3. Mason Industries - Type SLR
4. Kinetics Noise Control, Inc. - Type FLS
5. Vibration Mounting and Controls, Inc. - Series AWR
6. Substitutions - or equal, under provisions indicated in Section 260010.

2.7 VIBRATION ISOLATION TYPE NP (NEOPRENE PAD)

A. Neoprene pad isolators shall be one layer of 1/4 inch (6.4mm) or 3/8 inch (9.5mm) thick ribbed or waffled neoprene. The pads shall be sized so that they will be loaded within the manufacturer's recommended range.

B. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Amber/Booth - Type NR
2. Korfund Dynamics - Type Korpad
3. Mason Industries - Type W
4. Kinetics Noise Control, Inc. - Type NPS
5. Vibration Mounting and Controls, Inc. - Series Shear Flex
6. Substitutions: or equal, under provisions indicated.

2.8 FLEXIBLE ELECTRICAL CONNECTIONS

A. Type A

1. Flexible Electrical Connection Type A shall be an expansion/deflection prefabricated unit incorporating a flexible and watertight outer jacket, grounding strap, plastic inner sleeve to maintain smooth wire way, and end hubs with tapered electrical threads to fit standard threaded rigid metal conduit.
2. Manufacturers:
   a. Crouse-Hinds - "XD"
   b. Spring City Electrical Mfg. Co. - Type DF
   c. O.Z. Gedney
   d. Substitutions: or equal, under provisions indicated.

B. Type B

1. Flexible Electrical Connection Type B shall be field fabricated using a minimum three foot length of liquid-tight flexible conduit or cable.

2.9 GROMMETS

A. Grommets shall be custom made by combining a neoprene washer and sleeve. Grommets shall be sized so that they will be loaded within the manufacturer's recommended load range. Grommets shall be specifically formed to prevent bolts from directly contacting the isolator base plate.

B. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. MBIS, Inc.– Isogrommets
2. Barry Control - Series W
3. Substitutes: or equal, under provisions indicated in Section 260010.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

D. Transformers, PDUs and Uninterruptible Power Supplies (UPS).

1. Equipment within the building construction shall be mounted on Type DNP isolators. If the transformers are suspended, use Type HN isolators selected to achieve not less than 0.1 inch static deflection.
2. Electrical connections to isolated equipment shall be made using flexible electrical connections Type A or Type B.

E. Dimmers, TVSS and Remote Ballasts

1. Cabinets shall be mounted on Type DNP isolators.
2. Electrical connections shall be made using flexible electrical connections Type A or Type B.

F. Mechanical Equipment

1. Electrical connections to vibration isolated mechanical equipment shall be made using flexible electrical connections Type A or Type B.

G. Generators

1. In all cases, isolated equipment shall be positioned so that it is free standing and does not come in rigid contact with the building structure or other systems.
2. The static deflection of all isolators specified herein are the minimum acceptable deflections for the mounts under actual load. Isolators selected solely on the basis of rated deflections are not acceptable and will be rejected.
3. Electrical connections to vibration isolated mechanical equipment shall be made using flexible electrical connections Type A or Type B.

H. Base mounted fuel tanks.

1. Mount fuel only on type DNP isolators to provide an air gap under the tank for ventilation and drainage.

3.3 INSTALLATION

A. Isolation Mounts

1. All mounts shall be aligned squarely above or below mounting points for the supported equipment.
2. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plate shall rest entirely on the pad.
3. Hanger rod for vibration isolated support shall be connected to structural beams or joists, not to the floor slab between beams and joists. Provide suitable intermediate support members as necessary.
4. Vibration isolation hanger elements shall be positioned as high as possible in the hanger rod assembly, but not in contact with the building structure, and so that the hanger housing may rotate a full 360 degrees about the rod axis without contracting any object.
5. Fasten isolators to the building structure for Seismic restraint and provide neoprene grommets for each bolt hole in the base plate. Bolt holes shall be properly sized to allow for grommets. Hold-down bolt assembly shall include washers to distribute load evenly over the grommets. Bolts and washers are to be galvanized steel or stainless steel and rated for the appropriate Seismic zone.

B. Flexible Electrical Connections

1. Type B connections shall be installed in a grossly slack "U" shape or a 360 degree loop.
2. Conduit on the isolated-equipment side of the flexible connection, and the flexible connection itself, shall not be tied to the building construction or other rigid structure.

C. The installed and operating heights of equipment isolated from vibration with Type FSNTL isolators shall be identical. Limit stops shall be out of contact during normal operations. Adjust isolators to provide 1/4 inch (6.4mm) clearance between the limit stop brackets and the isolator top plate, and between the travel limit stop and travel limit brackets.

3.4 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.5 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.

4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.7 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Power Raceway Identification Materials
2. Metal-Clad Identification Materials
3. Power and Control Cable Identification Materials
4. Conductor Identification Materials
5. Floor Making Tape
6. Underground-Line Warning Tape
7. Warning Labels and Signs
8. Instruction Signs
9. Equipment Identification Labels
10. Miscellaneous Identification Products
11. Exterior Signs and Nameplaces
12. Arc Flash labeling per the Arc Flash report prepared by the Architect.

B. Meet the following performance requirements:

1. Identification shall be of a material and attachment method suitable to the environment where it is located. Exterior identification shall be weather, chemical and UV resistant.

C. Provide consistent, informative labeling for all furnished wired or installed equipment and devices. Coordinate with the Drawings, Specifications and Short Circuit, coordination and Arc Flash report.

1.2 RELATED WORK

A. Section 26 00 10 – Basic Electrical Requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

B. Refer to electrical Drawings for additional requirements.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements indicated in Section 26 00 10.

B. ANSI Z535 Safety Standards.

C. ANSI A13.1.

D. OSHA

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

B. Submit materials, colors and nameplate schedule for review.

C. Submit materials, colors and schedule for signage for review.

D. Submit on mounting methods and material.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Refer to Part 3 for color code.
2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high letters on 20-inch (500-mm) centers.

D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers diagonally over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stop stripes at legends.

H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

I. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Colors for Raceways Carrying Circuits at 600 V and Less:

1. Refer to Part 3 for color code.
2. Legend: Indicate voltage and system or service type.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high letters on 20-inch (500-mm) centers.

D. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch (50 by 50 by 1.3 mm), with stamped legend, punched for use with self-locking cable tie fastener.

D. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

E. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

F. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.

1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.5 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Underground Warning Tape:

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of

the conductive core, bright-colored, [continuous-printed on one side with the inscription of the utility,] compounded for direct-burial service.
2. Overall Thickness: 5 mils (0.125 mm).
3. Foil Core Thickness: 0.35 mil (0.00889 mm).
4. Weight: 28 lb/1000 sq. ft. (13.7 kg/100 sq. m).
5. 3-Inch (75-mm) Tensile According to ASTM D 882: 70 lbf (311.3 N), and 4600 psi (31.7 MPa).

2.7 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Size as required to fit lettering with minimal size of 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Size as required to fit lettering with minimum size of10 by 14 inches (250 by 360 mm).

E. Danger label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."
3. Refer to Drawings for additional sign requirements.

2.8 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

2.9 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and UV-resistant seal for label.

1. Extra strength laminated TZ tape by P-Touch or approved equivalent.

B. Self-Adhesive, Engraved, Laminated Acrylic Label: Adhesive backed. Minimum letter height shall be 3/8 inch (10 mm).

C. Engraved, Laminated Acrylic Label: Punched or drilled for screw mounting. Minimum letter height shall be 3/8 inch (10 mm).

D. Stenciled Legend: In nonfading, waterproof ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

2.11 EXTERIOR SIGNS AND NAMEPLATES

A. Heavy duty aluminum or stainless steel

B. Plastic expected life with over laminate is 3-5 years. This custom printed sign is made of 60-mil thick high performance plastic which is lightweight enough to mount almost anywhere

1. For indoor or outdoor use
2. Won't fade in the sun and endures temperatures between -40°F to 176°F

C. Provide for extended life and performance, Seton UltraTuff™ overlaminate (this extra layer protects the sign from graffiti, weather, fading, solvents, chemicals and abrasion - plus it guarantees the sign for life).

2.12 ARC FLASH LABELS

A. Arc flash labels shall be machine printed vinyl signs complying with OSHA and NFPA 70E requirements including information and OSHA compliant color coding and symbology.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment and designated devices shall be properly identified by means of permanent, clear and concise nameplates, tags, signs, directories and color coding.

B. Provide engraved acrylic nameplates for all equipment identification and signage unless specifically indicated otherwise. Adhesive Film Label with Clear Protective Overlay may be used for:

1. Device plates

2. 120V circuit number identification (e.g. a Bodine transfer relays)

C. Fire Alarm device identification: Mechanically fasten or engrave identification on the item to be identified. Secure nameplates and signs to equipment using screws or rivets. Properly applied epoxy or superglue adhesive may be accepted for device plate nameplates only with prior approved by the Architect. Embossed adhesive labels are not acceptable for any identification required by the Contract Documents.

D. Verify identity of each item before installing identification products.

E. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install nameplates and signs, etc. parallel to equipment lines.

F. Apply identification devices to surfaces that require finish after completing finish work.

G. Self-Adhesive Identification Products: Degrease and clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

H. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

I. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

J. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

K. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

L. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

M. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

N. Provide nameplates indicating "Breakers to be operated by Authorized Persons only" for the following:

1. Fire Alarm System
2. Security System
3. Control Panels
4. Emergency Lighting

O. Conductor and Raceway Color Coding: 1/8 inch (3 mm) lettering and provide nameplate at each panelboard and switchboard indicating color coding system. Mount on the interior of the door if so equipped; otherwise on the back of the trim.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high black letters on 20-inch (500-mm) centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

B. Accessible Raceways, Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl or Snap-around labels. Install labels at 30-foot (10-m) maximum intervals.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 20 A, and 120 V to ground: Identify with self-adhesive vinyl label self-adhesive vinyl tape applied in bands. Install labels at 10-foot (3-m) maximum intervals.

D. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.
2. Power.
3. UPS.
4. Security
5. Fire Alarm
6. Telecom

E. Power-Circuit Conductor Identification, 600 V or Less: Where conductors can be exposed (for example junction boxes, panels, loads, etc.), use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for conductors.

   a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
   b. Colors for 208/120-V Circuits:
      1) Phase A: Black.
      2) Phase B: Red.
      3) Phase C: Blue.
      4) Neutral: White

   c. Colors for 480/277-V Circuits:
      1) Phase A: Brown.
      2) Phase B: Orange.
      3) Phase C: Yellow.
      4) Neutral: Gray.

   d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) from terminal points and in boxes where

splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

2. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on schematic and interconnection diagrams or equipment manufacturer's shop drawings for control fire alarm and low voltage system wiring.

F. Power-Circuit Conductor Identification, More than 600 V: Where conductors are exposed, use write-on tags or nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

G. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

H. Conductors to Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

J. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels or Baked-enamel warning signs or Metal-backed, butyrate warning signs.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

   a. Power transfer switches.
   b. Controls with external control power connections.
   c. Switchboards.

M. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

N. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and load shedding.

O. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with submittals, wiring diagrams, schedules, and the Operation and Maintenance Manual. Identify device circuit numbers and load served. Apply labels to distribution equipment including each section and device in each section, disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems.

1. Labeling Instructions refer to drawing details for additional information:

    a. Indoor Equipment: Engraved, laminated acrylic label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high with the equipment name ½ inch (13mm) and the additional text ¼" (7mm).
    b. Outdoor Equipment: Engraved, laminated acrylic label.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
    e. Text shall be "Gothic Normal".

2. Equipment to Be Labeled includes but is not limited to:

    a. Panelboards up to 225A: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be mechanically fastened engraved, laminated acrylic label. Each 3 phase device shall have individual nameplates adjacent to the device. All devices shall be individually numbered.
    b. Panelboards over 225A: Panelboard identification shall be mechanically fastened engraved, laminated acrylic label. Each device shall have individual nameplates adjacent to the device. All devices shall be individually numbered.
    c. Switchboards / Switchgear / Motor Control Centers / other distribution equipment: Enclosure identification shall be mechanically fastened engraved, laminated acrylic label. Each device shall have individual nameplates adjacent to the device.
    d. Enclosures and electrical cabinets.
    e. Access doors and panels for concealed electrical items.
    f. Distribution equipment (switchgear, switchboards, motor control centers, etc.).
    g. Mechanical equipment (CRAHS, chillers, pumps, etc.).
    h. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    i. Emergency system boxes and enclosures.
    j. Enclosed switches.
    k. Enclosed circuit breakers.
    l. Enclosed controllers.
    m. Variable-speed controllers.
    n. Push-button stations.
    o. Power transfer equipment.
    p. Contactors.
    q. Remote-controlled switches, dimmer modules, and control devices.
    r. Battery-inverter units.
    s. Battery cabinets.
    t. Power-generating units.

u. Monitoring and control equipment.
v. UPS equipment.
w. Receptacles
x. Disconnects include cover, also provide label indicating fuse size and class.
y. Bodine Transfer relays
z. HVAC equipment indicating circuits serving equipment (e.g. CRAH, pumps, etc)
aa. Pilot lights.
bb. Mimic Bus identify source and supply at each location.
cc. Cabinets and pull boxes: 3/8 inch (9 mm); identify system (e.g. telephone, data, fire alarm, sound, etc.).

3.3 ARC FLASH LABELS

A. Label distribution equipment with arc flash labels per the Arc Flash study.

B. Provide labels at each bus and piece of equipment in the report.

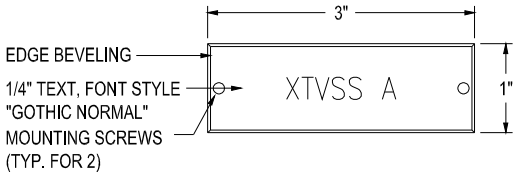
C. Provide labels at each access point to distribution equipment including rear and side access door.

3.4 COLOR CODE SYSTEM FOR LABELLING AND ENGRAVED NAMEPLATES

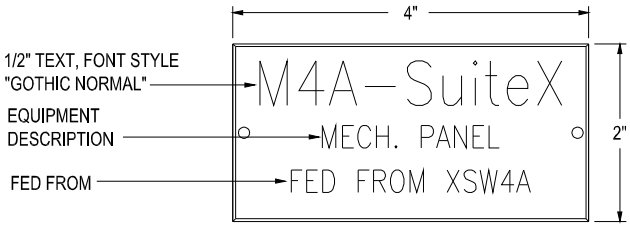
System Use	Background Color	Text Color	Remarks
Utility CB	White	Blue	Service equipment
Tie CB	White	Green	Main Swbd
Generator	White	Brown	Normal Gen
Not Assigned	White	Gray	
UPS System A	Blue	White	Swbd, UPS, PDU, Panels
UPS System B	Brown	White	Swbd, UPS, PDU, Panels
UPS System C	Green	White	Swbd, UPS, PDU, Panels
UPS System D	Gray	White	Swbd, UPS, PDU, Panels
Redundant Systems	Brushed Brass or yellow	Black	Gen and Swbds
Over 600Volts	Orange	Black	
House Loads	White	Black	
Non-UPS Base Bldg Power	Black	White	
Mechanical Power	Black	White	
DC Power	Yellow	White	
Data Center Non UPS	Black	White	Lighting, outlets, etc
Life Safety	Red	White	
Fire Alarm Safety	White	Red	
Exterior (non system)	Stainless	Black	Equip not associated with a system
Instructions	White	Black	
Safety Instruction Signs	White/Green	Black	OSHA standard (See Note 1)
Caution Signs	Yellow/Black	Yellow/Black	OSHA standard (See Note 2)
Danger Signs	Red/Black/White	White	OSHA standard (See Note 3)
HMI screen	White	Normal	Operation screen in Auto
HMI screen	Blue	Normal	Operation screen in Manual
HMI screen	Gray	Normal	Operation screen in Test
HMI screen for Gen R	Maroon		Redundant Power screen

Note 1: Safety Instruction Signs: Standard color of the background shall be white; and the panel, green with white letters. Any colors used against the white background shall be black.
Note 2: Caution Signs: Standard color of the background shall be yellow; and the panel, black with yellow letters. Any letters used against the yellow background shall be black.
Note 3: Danger Signs: The colors shall be red, black and white.

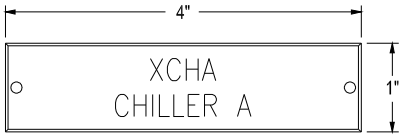
3.5 TYPICAL NAMEPLATES



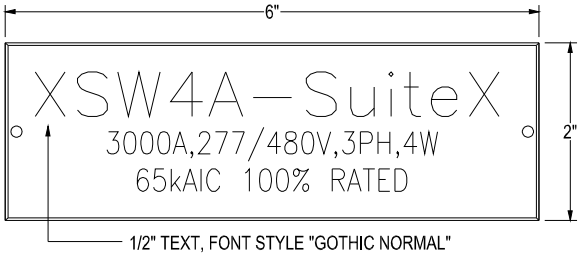
TYPICAL SMALL BREAKER NAMEPLATE
SCALE: N.T.S.



TYPICAL EQUIPMENT NAMEPLATE
SCALE: N.T.S.



TYPICAL LARGE BREAKER NAMEPLATE
SCALE: N.T.S.



1. FOR EACH SECTION OF SWITCHBOARD. SOME SECTIONS ARE 3PH, 3W

TYPICAL SWITCHBOARD NAMEPLATE
SCALE: N.T.S.

NAMEPLATE COLOR CODES BY SYSTEM		
USE	BACKGROUND	LETTERING
SYSTEM A	BLUE	WHITE
SYSTEM B	BROWN	WHITE
SYSTEM C	GREEN	WHITE
SYSTEM D	GRAY	WHITE
REDUNDANT	BRUSHED BRASS	BLACK
HOUSE LOADS	WHITE	BLACK
LIFE SAFETY	RED	WHITE
INSTRUCTIONS	WHITE	BLACK
OVER 600V	ORANGE	BLACK

NOTE:
NAME PLATES BASED ON SETON CO. WITH MULTI-PLY ACRYLIC ENGRAVED SETON FLEX PLASTIC. NAME PLATES WITH GOTHIC NORMAL LETERING.

END OF SECTION

SECTION 26 08 00
ELECTRICAL GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements that apply to implementation of the required commissioning process without regard to specific systems, assemblies, or components. This scope of work expands upon and is in addition to the scope of work and testing required and indicated on the contract drawings and individual specification sections.

B. Follow commissioning procedures and provide support throughout standard level 2, 3, 4 and 5 commissioning procedures as outlined in the contract documents.

C. Coordinate and provide appropriate technicians and manufacturer's representatives, including pre-purchased equipment, as required to meet the schedule and contract requirements.

D. Receive, inventory and check against shop drawings and contract drawings all material and equipment received on site including Owner pre-purchased equipment.

E. Complete required paperwork for each commissioning level in a timely manner and provide copies to the General Contractor and Commissioning Authority (CxA). Compliance and completeness of paper work will be reviewed regularly and a condition for approval of monthly requisitions.

F. Systems to be commissioned and performance benchmarked include all systems related to the data center including but not limited to:

1. Switchgear and switchboards.
2. Automatic transfer switches.
3. Automatic transfer control systems and all possible sequences of operation.
4. Distribution system.
5. Cabling systems.
6. Transformers.
7. Power distribution systems (PDU).
8. Emergency Power Off (EPO) systems.
9. Generators and associated control, fuel and alarm systems.
10. Uninterruptible Power Supply (UPS) systems.
11. Meters.
12. Fire Alarm System
13. Security System
14. BMS/MAS Control and Monitoring Systems.

G. Provide personnel, cooperate and assist with all testing and commissioning of project systems.

H. Provide certified qualified personnel to perform start up of equipment and systems and for testing required or specified.

I. Provide personnel to support full time, the level 5 testing schedule indicated in Section 019100. Personnel shall include the project foreman and additional personnel as required to operate equipment and support commissioning and integrated testing and the proposed schedule.

1.2 RELATED WORK

A. Section 26 00 10 – Basic Electrical Requirements is an integral part of this Section. Requirements and work indicated in Section 26 00 10 are not repeated in this Section.

B. Section 01 91 00 – General Data Center Commissioning Requirements, is an integral part of this section. Requirements and work indicated in 01 91 00 are not repeated in this Section.

C. Owner's Project Requirements (OPR) and Basis of Design (BOD) documentation are included by reference for information only.

1.3 DEFINITIONS

A. Refer to Section 01 91 00 – General Data Center Commissioning Requirements.

B. Levels of Commissioning

1. Level One – Factory Testing
2. Level Two – Component Verification
3. Level Three – System Installation Verification
4. Level Four – Individual System Operation Verification (Acceptance testing to verify all contract requirements have been completed and the systems operate as specified).
5. Level Five – Integrated System Testing –testing to verify and document system operation.

1.4 COMMISSIONING TEAM

A. Appoint Individual(s) to be part of the commissioning team, each having the authority to act on behalf of the entity he or she represents, and explicitly organized to implement the commissioning process through coordinated action with all of the project team.

B. These representatives shall review and comment where appropriate on all commissioning documents, attend all meetings and coordinate scopes of work with all team members.

1.5 OWNER'S RESPONSIBILITIES

A. Refer to Section 01 91 00 – General Data Center Commissioning Requirements.

B. Load banks and cables will be furnished through the Owner's national contract.

1.6 THIS SECTION'S RESPONSIBILITIES

A. Assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:

1. Attend commissioning team meetings held on a weekly basis at the normal meetings and more frequently as level 4 and 5 commissioning get closer and daily during level 4 and 5 commissioning.
2. Integrate and coordinate commissioning process activities with the construction schedule.
3. Review and accept construction checklists provided by the Commissioning Agent (CxA).
4. Complete paper and electronic construction checklists as Work is completed and provide to the Design Team and the Commissioning Authority on a weekly basis.
5. Review, comment and accept commissioning process test procedures provided by the Commissioning Authority.
6. Complete commissioning process test procedures.
7. Assure compliance with the commissioning schedule by organizing and planning to have appropriate personnel, equipment and material available when required. Coordinate vendor's personnel for all furnished and assigned owner's pre-purchased equipment. Provide as much advanced notice to vendors as possible.
8. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
9. Cooperate with the CxA for resolution of issues recorded in the Issues Log.

1.7 COMMISSIONING AGENT'S (CxA'S) RESPONSIBILITIES

A. Refer to Section 01 91 00 – General Data Center Commissioning Requirements.

PART 2 - PRODUCTS

2.1 LOAD BANKS AND CABLING AS REQUIRED FOR LEVEL 4 AND 5 TESTING

A. For the generator testing provide resistive load banks rated for full load of the generator.

B. For UPS and battery testing provide resistive load banks for the full load rating of the UPS system.

C. For the chiller load system provide load banks for the full load rating of the chiller system using suitcase style load banks located in the computer room. Typical load bank rating is 100kW at 240V derated to 75kW at 208V.

D. For Integrated Systems Testing (level 5) provide suitcase style load banks, located in the computer room, for the full load rating of the UPS system plus three spare load banks.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Suitcase loadbanks – maximum rating of 64kW on a 225A circuit breaker. Do not exceed 80% of CB ampacity rating.

B. Evenly space out suitcase load banks in the computer room. The loadbanks shall line up with the edge of the access floor perforated tile, with fans blowing in the opposite direction (towards the hot aisle). Generally, load banks are located at every other row of perforated tiles, blowing towards each other but offset so they blow between each other. Preferably, loadbanks are set approximately 13 ft apart (up to 20 ft if room permits) along the perforated tiles. Do not locate closer than 10 feet from an air conditioner unit.

C. Install cables and pigtails with pin and sleeve connector for all load banks. Install load banks and connect cables. Pigtails with pin and sleeve connectors shall be hardwired to CBs to allow quick relocation of load banks during testing.

D. Provide connection points and UPS (using temporary panels) power for the load bank control power and fan circuits for the suitcase load banks.

E. Coordinate delivery, cable lengths, types and schedules for load banks and testing to maximize efficient common use of the load banks.

3.2 DOCUMENTATION

A. Document location of all load banks and direction of airflow on a floor plan that also indicates raised floor tiles, perforated tiles, air conditioning units PDUs and RPPs.

END OF SECTION

SECTION 26 08 13
TESTING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Electrical acceptance tests by Independent Testing Agency.
2. Responsibilities of the Installer.
3. Test all work furnished or installed under Divisions 26, 27 or 28 of the specifications.
4. This testing is part of the owner's level 4 (project acceptance) testing. Provide all required documentation as requested by the Owner.
5. Infrared testing for all equipment, conductors, and terminations during load testing will be provided by Owner's Infrared testing firm. Provide representative color photographs of all locations tested. Test periodically during load testing. Assist and cooperate.
6. Coordinate assist and cooperate with the Owner's Commissioning Agent.
7. Provide all testing not performed by the Commissioning Agent or infrared testing firm. Provide written reports.

B. This specification covers all necessary material, equipment, labor and technical supervision to perform and complete the Electrical Acceptance Tests as required.

C. Acceptance tests as herein specified are defined as those tests and inspections required to determine that the equipment involved may be energized for final operational tests and is in accordance with the Contract documents. Final acceptance of the equipment and/or workmanship will depend upon performance characteristics as determined by the subject tests, in addition to complete operational tests, on all electrical equipment to show that it will perform the functions for which it was designed.

D. These tests are intended to insure that the workmanship, methods, inspections and materials used in erection and installation of the subject equipment shall conform with accepted engineering practices, ANI, and more specifically:

1. Specifications for the electrical work of the project.
2. Manufacturer's instructions.
3. Listing agency requirements.

E. Perform tests specified herein, required by the manufacturer, listed in individual Sections or indicated in the latest version of NETA Standards for Acceptance Testing in accordance with published guides and specifications, specifically NFPA 70B, IEEE, NEMA and other applicable publications.

F. Set and verify protective relays and overcurrent devices are adjusted according to the overcurrent device coordination study on the Architect's instructions.

1.2 RELATED WORK

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

B. Section 26 08 00 – Commissioning – Coordinate testing with the Commissioning Authority.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

B. Employ the services of a recognized Testing Agency, a member in good standing of the International Electrical Testing Association (NETA), to perform the specified tests as hereinafter covered by this section of the specifications.

C. The Testing Agency shall be responsible for all tests and test records. Testing shall be performed by and under the immediate supervision of the test agency and shall be made only by qualified personnel, specifically trained and fully experienced in this type of testing.

D. Give Architect and Owner's Representative three days written notice requesting witness before performing all tests. No test shall be done without acknowledgement from the Construction Manager, General Contractor and Owner's Representative. The Installer shall be responsible for clean-up and visual inspection of the equipment immediately prior to the testing.

E. Manufacturer's representatives shall be advised of all tests on their equipment. Reasonable cooperation shall be extended to permit witnessing by a representative of the manufacturer of the material under test, should the manufacturer so request.

F. The Construction Manager, General Contractor and Architect shall be immediately notified of any unfavorable test results or indication of faulty equipment. No piece of equipment shall be energized until the test data is evaluated and the equipment is proven acceptable.

G. If the tests and inspections should indicate deficiencies, make the necessary adjustments, corrections, modifications and replacements necessary to meet the specified requirements.

H. Upon completion of the remedial work, the Testing Agency shall repeat all the tests on components previously found deficient on the first test or any additional tests if they be required. It shall be the responsibility and obligation of the installer to have all remedial work accomplished as may be required by second and/or additional tests.

I. All equipment used shall be certified as calibrated within the last 12 months.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10.

B. Codes and Standards in addition to Section 26 00 10:

1. NFPA 70B: Electrical Equipment Maintenance.
2. IEEE Testing Guides.
3. ICEA Testing Guides.
4. NEMA Testing Guidelines.
5. NETA Acceptance Testing Specifications (ATS)

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

B. Upon completion of the work herein described, submit Four (4) bound sets of Test and Inspection Reports. Provide information required in the specification, owner’s requirements and NFPA 70B including applicable completed forms. Provide two electronic copies on CD or DVD.

C. The report shall indicate deficiencies in the operation of the equipment and installation, fuse sizes, relay settings for protective devices, fault ratings of installed equipment, impedances of equipment and cables to ground, conductor test reports, grounding system, etc.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

B. Update as-built documentation with information gathered during testing.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.1 TEST PROCEDURES AND EQUIPMENT

A. Perform tests after installation but before energizing the equipment. In addition to or as a supplement of the tests indicated in individual sections the tests and procedures apply to all equipment. Test all work furnished or installed..

B. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing specification. Certify compliance with test parameters.

C. Provide written report of all tests and findings.

D. Measure tightness of bolted connections and compare torque measurements with manufacturer's and NRTL's recommended values. Verify that bolt location, when correctly torqued, is marked with permanent marker.

E. Infrared Scanning: During load testing, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
2. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action. Include color photographs.

F. Remove and replace malfunctioning units and test as specified herein.

3.2 TRANSFORMERS

A. Verify transformer taps provide acceptable voltage at utilization equipment connected to substation. Set no load voltage as follows:

1. 480V or 480/277V systems: 492V
2. 208/120V systems: 125V

B. Instrument and Control Transformers:

1. Visually inspect for damage and improper connections.
2. Check polarity and ratio by calibration of current transformers.
3. Check mechanical operation of draw-out mechanisms.

3.3 GROUNDING

A. Ground Resistance:

1. Visually inspect for specified ground connections.
2. Perform Ground Resistance Test at all connections to switchgear, switchboards, and as specified use two point resistance test.
3. Use four-point fall-of-potential method for exterior ground testing.
4. Perform ground resistance testing of raised floor stringer to stringer and stringer to SRG conductor at locations where SRG conductor is connected to raised floor pedestal.

3.4 CIRCUIT BREAKERS

A. Circuit Breakers as Specified:

1. Visually inspect all components for damage.
2. Perform Insulation Resistance Test.
3. Perform Contact Resistance Test.
4. Check calibration of short-time and/or instantaneous devices at rated setting.
5. Check calibration of series over-current or static trip devices at pick-up and at 300 percent of rating.
6. All circuit breakers shall be tested with primary current injection in order to successfully test current transformer and associated wiring.
7. Check operation of circuit breaker and draw-out mechanism.

B. Record trip settings of units and protective relays. Verify settings match those specified in the coordination report.

3.5 SWITCHBOARD/SWITCHGEAR

A. Visually inspect for damage and improper connections.

B. Perform Insulation Resistance Tests.

C. Perform High Potential Test on bus.

D. Check all accessible bus connections and joints for proper torque.

E. Test per latest NETA specifications.

F. Verify proper conductor supports for short circuit withstand requirements and to keep stress off terminations as recommended by NEMA, NRTL and manufacturer.

3.6 METERS AND INSTRUMENTS

A. Visually inspect for damage and improper connections.

B. Check calibration of all indicating instruments

C. Check all meters for proper indication.

D. Check meter switches for proper function and connections.

E. Verify all instrument multipliers.

3.7 CABLES, LOW VOLTAGE (600 VOLTS AND LESS)

A. All cables at main switchgear/switchboards and feeders 200A and higher ampacity and all feeders to panels.

B. Visually inspect for damage and improper connections.

C. Torque test cable connections to manufacturer's recommended values.

D. Perform Insulation Resistance Test.

E. Perform Continuity Test.

3.8 MOTOR CONTROLLERS

A. Visually inspect for damage and improper connections.

B. Test as per applicable items indicated in preceding paragraphs.

C. Test overload relays and verify as to proper size.

3.9 MEDIUM VOLTAGE CABLES (ABOVE 600V)

A. Not Applicable.

3.10 MEDIUM VOLTAGE TRANSFORMERS

A. Not Applicable.

3.11 MEDIUM VOLTAGE SWITCHGEAR

A. Not Applicable.

3.12 MOTORS

A. Test and verify proper phasing connections and rotation.

B. Verify proper motor overloads are installed.

3.13 TEST REPORTS

A. Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Time Switches
2. Outdoor Photoelectronic Switches
3. Indoor Photoelectronic Switches
4. Indoor Occupancy Sensors
5. Outdoor Motion Sensors (PIR)
6. Lighting Contractors
7. Conductors and Cables

1.2 RELATED WORK

A. Section 26 00 10 – Basic Electrical Requirements, is an integral part of this Section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

B. Section 26 08 00 – Electrical General Commissioning Requirements. Provide Installer's and Manufacturer's support as required to coordinate with the Commissioning Agent and support all commissioning efforts and paperwork, Acceptance and Integrated Systems Testing.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

1.11 LEED / SUSTAINABILITY

A. Conform to requirements indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Lithonia Lighting; Acuity Lighting Group, Inc. – Switch Pak
2. Lutron SoftSwitch
3. Intermatic, Inc.
4. Leviton Mfg. Company Inc.
5. Lightolier Controls; a Genlyte Company.
6. Area Lighting Research, Inc.; Tyco Electronics.
7. Paragon Electric Co.; Invensys Climate Controls.
8. Square D; Schneider Electric.
9. TORK.
10. Touch-Plate, Inc.
11. Watt Stopper (The).
12. Substitutions: Under provisions of Section 26 00 10.

B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: SPST.
2. Contact Rating: 30-A inductive or resistive, 240-V ac.
3. Program: 8 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
4. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
5. Astronomic Time: All channels.
6. Battery Backup: For schedules and time clock.

C. Electromechanical-Dial Time Switches: Type complying with UL 917.

1. Contact Configuration: DPST
2. Contact Rating: 30-A inductive or resistive, 240-V ac
3. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
4. Astronomic time dial.
5. Eight-Day Program: Uniquely programmable for each weekday and holidays.
6. Skip-a-day mode.
7. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 24 hours.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Intermatic, Inc.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Novitas, Inc.
5. Paragon Electric Co.; Invensys Climate Controls.
6. Square D; Schneider Electric.
7. TORK.

8. Touch-Plate, Inc.
9. Watt Stopper (The).
10. Substitutions: Under provisions of Section 26 00 10.

B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
2. Time Delay: 15-second minimum, to prevent false operation.
3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 INDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Allen-Bradley/Rockwell Automation.
2. Area Lighting Research, Inc.; Tyco Electronics.
3. Eaton Electrical Inc; Cutler-Hammer Products.
4. Intermatic, Inc.
5. Lithonia Lighting; Acuity Lighting Group, Inc.
6. MicroLite Lighting Control Systems.
7. Novitas, Inc.
8. Paragon Electric Co.; Invensys Climate Controls.
9. Square D; Schneider Electric.
10. TORK.
11. Touch-Plate, Inc.
12. Watt Stopper (The).
13. Substitutions: Under provisions of Section 26 00 10.

B. Ceiling-Mounted Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit[mounted on luminaire, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.

1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
2. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
3. Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lx) with an adjustment for turn-on and turn-off levels within that range.
4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
5. Indicator: Two LEDs to indicate the beginning of on-off cycles.

2.4 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Hubbell Lighting.
2. Leviton Mfg. Company Inc.
3. Lithonia Lighting; Acuity Lighting Group, Inc.
4. Novitas, Inc.

5. RAB Lighting, Inc.
6. Sensor Switch, Inc.
7. TORK.
8. Watt Stopper (The).
9. Substitutions: Under provisions of Section 26 00 10.

B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.

1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
4. Mounting:
   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
6. Bypass Switch: Override the on function in case of sensor failure.
7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lx); keep lighting off when selected lighting level is present.

C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.

1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.

D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).

E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

F. Wall-Switch Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 6111 for 120 V, 6117 for 277 V.
   b. Hubbell; WS1277.
   c. Leviton; ODS 10-ID.
   d. Pass & Seymour; WS3000.
   e. Watt Stopper (The); WS-200.
2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

G. Wall-Switch Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Hubbell; AT120 for 120 V, AT277 for 277 V.
   b. Leviton; ODS 15-ID.
2. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).

H. Long-Range Wall-Switch Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Hubbell; ATP1600WRP.
   b. Leviton; ODWWV-IRW.
   c. Pass & Seymour; WA1001.
   d. Watt Stopper (The); CX-100.
2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

I. Long-Range Wall-Switch Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Hubbell; ATD1600WRP.
   b. Leviton; ODW12-MRW.
   c. Watt Stopper (The); DT-200.
   d. System Sensor
2. Description: Dual technology, with both passive-infrared- and [microphonic] [ultrasonic]-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft. (111 sq. m).

J. Wide-Range Wall-Switch Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Hubbell; ATP120HBRP.
   b. Leviton; ODWHB-IRW.
   c. Pass & Seymour; HS1001.
   d. Watt Stopper (The); CX-100-3.
2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft. (111 sq. m).

K. Exterior Occupancy Sensors:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Leviton; PS200-10.
   b. Watt Stopper (The); EW-100-120.

2. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot (34-m) detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

2.5 OUTDOOR MOTION SENSORS (PIR)

A. Not used.

2.6 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Allen-Bradley/Rockwell Automation.
2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
3. Eaton Electrical Inc.; Cutler-Hammer Products.
4. GE Industrial Systems; Total Lighting Control.
5. Grasslin Controls Corporation; a GE Industrial Systems Company.
6. Hubbell Lighting.
7. Lithonia Lighting; Acuity Lighting Group, Inc.
8. MicroLite Lighting Control Systems.
9. Square D; Schneider Electric.
10. TORK.
11. Touch-Plate, Inc.
12. Watt Stopper (The).
13. Substitutions: Under provisions of Section 26 00 10.

B. Description: Electrically operated and mechanically held, combination type with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.

1. Monitoring: On-off status
2. Control: On-off operation

2.7 EMERGENCY SHUNT RELAY

A. Not used.

2.8 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.2 CONTACTOR INSTALLATION

A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch (13 mm).

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify operation of each lighting control device, and adjust time delays.

B. Lighting control devices that fail tests and inspections are defective work.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.7 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

3.8 INTEGRATED SYSTEMS TESTING

A. Provide field technicians to support Integrated Systems Testing (commissioning Level 5) in addition to and after successful completion of acceptance testing (Level 4).

END OF SECTION

SECTION 26 22 00
LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufacturers
2. General Transformer Requirements
3. Distribution Transformers
4. Buck-Boost Transformers
5. Identification Devices
6. Source Quality Control

B. Meet the following performance requirements:

1. Meet Energy Code requirements.
2. Seismic Performance: In accordance with Section 26 00 10.

1.2 RELATED WORK

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

B. Store, protect, and handle products to site under provisions of Section 26 00 10.

C. Deliver transformers individually wrapped for protection and mounted on shipping skids.

D. Accept transformers on site. Inspect for damage.

E. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

F. Handle in accordance with manufacturer's written instructions. Life only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10.

B. Codes and Standards in addition to Section 26 00 10 requirements:

1. NEMA ST 1 – Specialty Transformers
2. NEMA ST 20 – Dry Type Transformers for General Applications
3. ANSI/IEEE C57.110 – K Factor ratings
4. UL 1561 – Transformers supplying non-linear loads
5. Energy Efficiency Requirements of Federal Energy Policy Act of 2005 (EPACT 05)

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

B. Confirmation of meeting EPACT 05 requirements.

C. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

D. Test Reports: Indicate loss data, efficiency at 25, 50, 75, and 100 percent rated load, and sound level. Submit no-load loss value.

E. Submit data on vibration isolators.

F. Manufacturer's certificate: certify that products meet or exceed specified requirements.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

1.11 LEED / SUSTAINABILITY

A. Conform to requirements indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. General Electric Company.
2. Controlled Power Company.
3. Eaton Electrical Inc.; Cutler-Hammer Products.
4. Siemens Energy & Automation, Inc.
5. Sola/Hevi-Duty.
6. Square D; Schneider Electric.
7. Substitutions: Under provisions of Section 26 00 10.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Aluminum or Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: Gray.

F. Taps for Transformers Smaller Than 3 kVA: One 5 percent tap above normal full capacity.

G. Taps for Transformers 7.5 to 24 kVA: Two 5 percent taps below rated voltage.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity

I. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

J. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.
2. Tested according to NEMA TP 2.

K. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.

1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
2. Indicate value of K-factor on transformer nameplate.

L. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.

1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
2. Include special terminal for grounding the shield.
3. Shield Effectiveness:
   a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
   b. Common-Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 65 dBA at 1.5 to 100 kHz.
   c. Normal-Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz.

M. Low-Sound-Level Requirements: Maximum sound levels per NEMA ST 20, when factory tested according to IEEE C57.12.91, as follows:

1. 9 kVA and Less: 40 dBA
2. 30 to 50 kVA: 45 dBA
3. 51 to 150 kVA: 50 dBA
4. 151 to 300 kVA: 55 dBA
5. 301 to 500 kVA: 60 dBA

6. 501 to 750 kVA: 62 dBA
7. 751 to 1000 kVA: 64 dBA

2.4 BUCK-BOOST TRANSFORMERS

A. Description: Self-cooled, two-winding dry type, rated for continuous duty and with wiring terminals suitable for connection as autotransformer. Transformers shall comply with NEMA ST 1 and shall be listed and labeled as complying with UL 506 or UL 1561.

B. Enclosure: Ventilated, NEMA 250, Type 2.

1. Finish Color: Gray.

2.5 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Division 26 Section "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Division 26 Section "Grounding" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Provide concrete pad under provisions of Section 26 00 10 for transformers installed directly on concrete floor.

B. Install Products in accordance with manufacturer's instructions. Provide clearance for ventilation as indicated by the Manufacturer, 6 inches (150 mm) minimum, 12 inches (300 mm) preferred.

C. Set transformer plumb and level.

D. Use flexible conduit, under the provisions of Section 26 05 48, 3 ft minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

E. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure. Refer to Section 26 05 48.

F. Provide seismic restraints as required by code or herein.

G. Provide grounding and bonding in accordance with Section 26 05 26.

H. At a minimum, provide required ventilation space indicated on nameplate.

I. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems.

J. Construct concrete bases and anchor floor-mounted transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding."

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. Refer to Section 26 08 13 “Testing of Electrical Systems”. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Remove and replace units that do not pass tests or inspections and retest as specified above.

E. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Measure primary and secondary voltages and make appropriate tap adjustments. Set for nominal single phase voltage of 125V at no load. Record tap settings on record Drawings.

B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

C. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION

SECTION 26 24 13i
SWITCHBOARDS - INSTALL

PART 1 - GENERAL

1.1 SUMMARY

A. Summary Includes

1. Installation of freestanding main and distribution switchboards with arrangement, control, monitoring and accessories as specified herein and as indicated on the drawings.

B. Meet the following performance requirements:

1. Wind, Snow, Ice, Flood and Earthquake Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
2. Environmental Limitations:
   a. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards 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.

C. System Description:

1. Install and test Owner furnished switchboards.

1.2 RELATED WORK

A. Section 26 00 10 – Basic Electrical Requirements, is an integral part of this Section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

B. Section 26 08 00 – Electrical General Commissioning Requirements. Provide support as required to coordinate with the Commissioning Agent and support all commissioning efforts and paperwork, Acceptance and Integrated Systems Testing.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

B. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager, General Contractor, and Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Construction Manager's, General Contractor’s, and Owner's written permission.
4. Comply with NFPA 70E.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

B. Coordinate delivery of products to the site under provisions of Section 26 00 10.

C. Coordinate delivery in shipping splits that can be maneuvered through the building (both size and weight), individually wrapped for protection, and mounted on shipping skids. Coordinate maximum widths and weights with the facility's ability to safely handle and accommodate. Make modifications to shipped equipment or rigging methods as required.

D. Store and protect products under provisions of Section 26 00 10. Comply with NFPA 70B storage requirements.

E. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

F. Handle in accordance with NEMA PB2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10.

B. Conform to requirements indicated in the following:

1. ANSI C12 - Code for Electricity Metering.
2. ANSI C39.1 - Requirements for Electrical Analog Indicating Instruments.
3. ANSI C57.13 - Requirements for Instrument Transformers.
4. FS W-C-375 - Circuit Breakers, Molded Case, Branch Circuit and Service.
5. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).
6. FS W-S-865 - Enclosed Knife Switch
7. NEMA AB 1 - Molded Case Circuit Breakers
8. NEMA KS 1 - Enclosed Switches.
9. NEMA PB 2 - Dead Front Distribution Switchboards.
10. NEMA PB 2.1 - Instructions for Safe Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
11. UL 489 - Protective Device Series Ratings.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

B. Submit nameplate schedule with proposed text and color coding for review.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

B. O&M manuals shall include hard copies and electronic copies of the Final control program and operating instructions.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

PART 2 - PRODUCTS

A. Refer to shop drawings for details of pre-purchased switchboards.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NECA 400, NEMA PB 2.1 and NFPA 70B. Fill out forms for commissioning level 2.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NECA 400, NEMA PB 2.1 and Manufacturer's instructions.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (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.
4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the 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 front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Install spare-fuse cabinet.

I. Comply with NECA 1.

J. Mount the final electrical one line in each electrical form under plexiglass.

3.3 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Division 26 Section "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

B. Comply with requirements for terminating cable trays specified in Division 26 Section "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

C. All feeder phase, neutral and grounding conductors connections shall be two hole, long barrel compression fittings with an inspection window.

D. Tighten accessible bus connections and mechanical fasteners after placing switchboard torque to manufacturer's and NRTL recommendations.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: A qualified testing agency shall perform tests and inspections.

B. Refer to and perform tests in accordance with Section 26 08 13 Testing of Electrical Systems.

C. Perform tests and inspections.

1. Assist the factory-authorized service representative and the commissioning agent to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

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. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, 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. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated and as specified in the Overcurrent Protective Device Coordination Study.

C. Synchronize time in all devices that have internal clocks to local time within 1/100th of a second and to match BMS systems.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Assist the factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

3.9 INTEGRATED SYSTEMS TESTING

A. Provide support for Integrated Systems Testing (commissioning Level 5) in addition to and after successful completion of acceptance testing (Level 4).

END OF SECTION

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. General Requirements for Panelboards
2. Distribution Panelboards
3. Lighting and Appliance Branch-Circuit Panelboards
4. Disconnecting and Overcurrent Protective Devices
5. Accessory Components and Features

B. Meet the following performance requirements:

1. Seismic Performance: In accordance with Section 26 00 10.
2. Environmental Limitations:
   a. Do not deliver or install panelboards until spaces are enclosed and weathertight, 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.
   b. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
      1) Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
      2) Altitude: Not exceeding 6600 feet (2000 m).
3. Service Conditions: NEMA PB 1, usual service conditions, as follows:
   a. Ambient temperatures within limits specified.
   b. Altitude not exceeding 6600 feet (2000 m).

1.2 RELATED WORK

A. Section 26 00 10 – Basic Electrical Requirements, is an integral part of this Section. Requirements and work indicated in 260010 are not repeated in this Section.

B. Section 26 08 00 – Electrical General Commissioning Requirements. Provide Installer’s and Manufacturer’s support as required to coordinate with the Commissioning Agent and support all commissioning efforts and paperwork, Acceptance and Integrated Systems Testing.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10:

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager, Contractor, and Owner no fewer than seven (7) days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Construction Manager's, Contractor’s, and Owner's written permission.
3. Comply with NFPA 70E.

C. Coordinate housekeeping pad dimensions, required openings, etc. using manufacturer's shop drawings.

D. Coordinate recessed panelboards dimensions and surface mounted panelboard support requirements and locations.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

B. Field verify measurements.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10.

B. Codes and Standards in addition to Section 26 00 10 requirements:

1. NEMA AB 1 - Molded Case Circuit Breakers.
2. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
3. NEMA KS 1 - Enclosed Switches.
4. NEMA PB 1 - Panelboards.
5. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
6. NEMA PB 1.2 - Application Guide for Ground-fault Protective Devices for Equipment.
7. UL 489 - Protective Device Series Rating.
8. FS W-C3750a - Circuit Breakers, Molded Case, Branch Circuit and Service.
9. FS W-P-115 - Power Distribution Panel.

C. Coordinate housekeeping pad dimensions, required openings, etc. using manufacturer's shop drawings.

D. Coordinate recessed panelboards dimensions and surface mounted panelboard support requirements and locations.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

B. Provide the following additional materials:

1. Six of each panelboard key.
2. Two spare circuit breaker lock-on devices for each panelboard.
3. Three spare circuit breakers for each size and type in addition to units indicated on the Drawings where space is available in the panelboards.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

B. Record actual locations of Products; indicate actual branch circuit arrangement.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

B. Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 26 00 10 and Section 26 05 48 "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Flush- and surface - mounted cabinets as indicated on drawings.

1. Rated for environmental conditions at installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   d. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250 Type 12.
2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
3. Finishes:
   a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Galvanized steel.
4. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: As indicated on drawings.

D. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
3. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box where indicated on drawings.
4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads where indicated on drawings.

E. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Compression type.
3. Ground Lugs and Bus-Configured Terminators: Compression type.
4. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device where indicated on drawings.
5. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device where indicated on drawings.
6. Gutter-Tap Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device where indicated on drawings.
7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus where indicated on drawings.

F. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices. Provide for all spaces not scheduled for devices to completely fill panelboard.

G. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

H. Minimum integrated short circuit rating: 10,000 amperes RMS symmetrical for 240 volt rated panelboards; 65,000 amperes RMS symmetrical for 480 volt panelboards, provide higher where indicated on the Drawings or the Overcurrent Protective Device Coordination study.

2.2 DISTRIBUTION PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements provide the product indicated on the Drawings or the first listed manufacturer or product below. Subject to compliance with requirements a comparable product by one of the others listed may be acceptable:

1. Panelboards for PBB (House) Electrical rooms shall match existing manufacturer within the building.
2. Panelboards for Suite shall match manufacturer of switchboard and existing suites within the building.
3. Substitutions: Under provisions of Section 26 00 10.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: As indicated on Drawings.

E. Branch Overcurrent Protective Devices for Circuit-Breakers: Bolt-on circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Basis-of-Design Product: Subject to compliance with requirements provide the product indicated on the Drawings or the first listed manufacturer or product below. Subject to compliance with requirements a comparable product by one of the others listed may be acceptable:

1. Panelboards for PBB (House) Electrical rooms shall match existing manufacturer within the building.
2. Panelboards for Suite shall match manufacturer of switchboard and existing suites within the building.
3. Substitutions: Under provisions of Section 26 00 10.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only as indicated on drawings or required by code.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 LOAD CENTERS (NOT USED)

2.5 ELECTRONIC-GRADE PANELBOARDS (NOT USED)

2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Basis-of-Design Product: Subject to compliance with requirements provide the product indicated on the Drawings or the first listed manufacturer or product below. Subject to compliance with requirements a comparable product by one of the others listed may be acceptable:

1. PBB (House) - shall match existing manufacturer within the building.
2. Suite - shall match manufacturer of switchboard and existing suites within the buildingSubstitutions: Under provisions of Section 26 00 10.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. 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. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits; type HACR for HVAC loads.
   d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   e. Shunt Trip: 120 V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
   f. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
   g. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.

C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

1. Fuses, and Spare-Fuse Cabinet: Comply with requirements specified in Division 26 Section "Fuses."
2. Fused Switch Features and Accessories: Standard ampere ratings and number of poles.

2.7 PANELBOARD SUPPRESSORS

A. Provide at dedicated panels for the primary and secondary POP rooms. Refer to Section 26 43 13 Surge Protective Devices (SPD) for low voltage electrical power circuits.

2.8 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

1. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
2. Provide permanent lockout capability per OSHA requirements on overcurrent devices.
3. Provide lock-on devices on the circuits serving the following systems.
   a. Fire Alarm System
   b. Security System
   c. ATC, BMS, BAS Control Panel
   d. Emergency Lighting
   e. EPO Systems

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407, NEMA PB 1.1 and NFPA 70B.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407 and NEMA PB 1.1.

B. Floor Mounted Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete and Miscellaneous Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
2. For panelboards, 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.
4. Install anchor bolts to elevations required for proper attachment to panelboards.
5. Securely attach panelboard to the vertical finished or structural surface behind the panelboard. Attach to solid surface, blocking or unistrut spanning multiple studs.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

E. Mount top of trim 7'-6" or 90 inches (2286 mm) maximum above finished floor unless otherwise indicated. Verify the operating handle of top-most switch or circuit breaker, in on position, is not higher than 79 inches (2000 mm) above finished floor or grade.

F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box. Provide supports.

G. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges as indicated on drawings or according to the coordination settings reports.

H. Install filler plates in unused spaces.

I. Stub four 1-inch (27-GRC) empty conduits from recessed panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade. Label each as spare.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

K. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."

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 Division 26 Section 26 05 53 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section 26 05 53 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. In accordance with Division 26 Section 26 08 13 – Testing of Electrical Systems, 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.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. 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.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as indicated and as specified in the Overcurrent Protective Device Coordination Study.

C. Load Balancing: After Substantial Completion, but not more than 30 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

B. Verify all locks on devices are installed.

3.7 SEALING

A. In computer rooms, environmental chambers, pressure controlled rooms, etc. provide seals for all conduits that leave the room. Seal conduits with pliable non-hardening material such as duc seal or an environmental seal fittings Refer to Section 26 00 05 – Provide Seal at Conduit Entry to Panelboard.

3.8 INTEGRATED SYSTEMS TESTING

A. Provide field technicians to support Integrated Systems Testing (commissioning Level 5) in addition to and after successful completion of acceptance testing (Level 4).

END OF SECTION

SECTION 26 26 00i
POWER DISTRIBUTION UNITS - INSTALL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Installation of Power Distribution Units

B. Meet the following performance requirements:

1. Wind, snow, ice, flood and earthquake Performance: In accordance with Section 26 00 10 -1.5.

C. System Description:

1. Integrated Isolation Transformer with distribution capabilities and power conditioning.

1.2 RELATED WORK

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

B. Section 26 08 00 – Electrical General Commissioning Requirements. Provide Installer's and Manufacturer's support as required to coordinate with the Commissioning Agent and support all commissioning efforts and paperwork, Acceptance with Integrated Systems Testing.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

B. The following specific requirements shall be adhered to fully:

1. Receive the PDU equipment and components properly packaged and mounted on pallets, or skids to facilitate handling of heavy items. Delivery should be coordinated to coincide with the area of final installation being ready to accept the equipment. Shipping sections shall not exceed 60"W x 42"D x 82"H, to facilitate handling.
2. The equipment shall be covered with clear plastic sheeting to prevent dust and dirt from entering the equipment during shipment and storage.
3. Handle the equipment carefully to prevent physical damage to any one of its components. Do not install damaged equipment; remove from site and replace with new.
4. The equipment shall be covered with clear plastic sheeting to prevent dust and dirt from entering the equipment during shipment and storage.

C. Comply with the requirements of NFPA 70B.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

PART 2 - PRODUCTS

A. Refer to shop drawings for details of pre-purchased power distribution units.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for conditions affecting performance of the PDU.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Arrange power distribution units to provide adequate access to equipment and circulation of cooling air.

B. Install PDU with casters on top of stands or floor leaving adequate cooling space between floor and cabinet. Lower support legs to secure PDU Location

C. Bolt floor stands to slab-bolt PDU to stand. In addition, anchor or restrain floor-mounted power distribution units according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

D. Set top of PDU stand level with raised floor. It with raised floor. Seal perimeter of stand to raised floor air tight.

E. Identify equipment and install warning signs according to Division 26 Section "Identification for Electrical Systems."

F. Provide all required control and power wiring as indicated in the contract documents.

3.3 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding."

1. Separately Derived Systems: Make grounding connections to grounding electrodes as indicated; comply with NFPA 70. Connect to the computer room ground bar.

B. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 SEALING

A. Openings below PDUs into the access flooring shall be sealed airtight using a brush type seal Refer to Section 26 05 00 – Common Work Results for Electrical and drawings.

B. Seal conduits entering PDU originating outside the room. Use pliable, non-hardening putty or sealing fittings. Refer to Section 26 05 00.

C. Seal PDU stands to access floor to minimize air escaping from under access flooring.

3.5 FIELD QUALITY CONTROL

A. Electrical Tests and Inspections – Assist the Owner's testing agent in the performing of tests and inspections according to manufacturer's written instructions and as listed below to demonstrate condition and performance of each PDU component:

1. Inspect interiors of enclosures, including the following:
   a. Integrity of mechanical and electrical connections. Check tightness of bolted bus joints using a calibrated torque wrench. Tightness shall be in accordance with manufacturer's recommended values.
   b. Component type and labeling verification.
   c. Ratings of installed components.
2. Load the system using a variable-load bank to simulate kilovolt amperes, kilowatts, and power factor of loads for unit's rating. Use instruments calibrated, within the previous six months according to NIST standards.

B. Retest - Correct deficiencies and retest until specified requirements are met.

C. Record of Tests and Inspections - Maintain and submit documentation of tests and inspections, including references to manufacturers' written instructions and other test and inspection criteria. Include results of tests, inspections, and retests.

D. Testing Agency: Assist Qualified testing agency to perform tests and inspections and prepare test reports.

E. Manufacturer's Field Service: Assist Factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections and to assist in testing. Report results in writing.

F. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification for circuit breakers, molded case; and for transformers, dry type, air cooled, low voltage, small. Certify compliance with test parameters.
2. Perform functional tests of power distribution units throughout their operating ranges. Test each monitoring, status, and alarm function.
3. Coordinate work with Section 26 08 13 – Testing of Electrical Systems and Section 26 08 00 – Electrical General Commissioning Requirements.

G. Remove malfunctioning units, replace with new units, and retest as specified above.

H. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.6 STARTUP SERVICE

A. Assist Factory-authorized service representative to perform startup service.

1. Verify that power distribution units are installed and connected according to the Contract Documents.
2. Verify that electrical wiring installation complies with manufacturer's submittal and with written installation requirements in Division 26 Sections.
3. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

B. Adjust power distribution units to provide optimum voltage to equipment served throughout normal operating cycle of loads served. Record input and output voltages and adjustment settings, and incorporate into test results.

1. Set no load output voltage to a range of 120v -125V.

3.8 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

B. Touch up scratched or massed surfaces to match original finish.

3.9 DEMONSTRATION

A. Assist Factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain power distribution units. Refer to Division 01 Section "Demonstration and Training."

3.10 INTEGRATED SUSTEMS TESTING

A. Provide support for Integrated Systems Testing (commissioning Level 5) in addition to and after successful completion of acceptance testing.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufacturers
2. Straight Blade Receptacles
3. GFCI Receptacles
4. TVSS Receptacles
5. Hazardous (Classified) Location Receptacles
6. Twist-Locking Receptacles
7. Pendant Cord-Connector Devices
8. Cord and Plug Sets
9. Snap Switches
10. Wall-Box Dimmers
11. Fan Speed Control
12. Occupancy Sensors
13. Communications Outlets
14. Wall Plates
15. Floor Service Fittings
16. Poke-Through Assemblies
17. Multi-Outlet Assemblies
18. Service Poles
19. Finishes

1.2 RELATED WORK

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

B. Verify color of Devices with Architect and Drawings prior to purchasing.

C. Coordinate location of Devices with electrical and architectural drawings, notes and details.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10 in addition to following:

1. NEMA WD 1 – General Purpose Wiring Devices – Heavy Duty Grade.
2. NEMA WD 6 – Wiring Device Configurations.
3. UL 544 – Hospital Grade.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).
5. Substitutions: Under provisions of Section 26 00 10.

2.2 STRAIGHT BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 5351 (single), 5352 (duplex).
   b. Hubbell; HBL5351 (single), CR5352 (duplex).
   c. Leviton; 5891 (single), 5352 (duplex).
   d. Pass & Seymour; 5381 (single), 5352 (duplex).

B. Hospital-Grade, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498 Supplement SD.

1. Products: Subject to compliance with requirements, provide one of the following 20 A devices:
   a. Cooper; 8300 (duplex).
   b. Hubbell; HBL8310 (single), HBL8300H (duplex).
   c. Leviton; 8310 (single), 8300 (duplex).
   d. Pass & Seymour; 9301-HG (single), 9300-HG (duplex).

C. Isolated-Ground, Duplex Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Hubbell; CR 5253IG.
   b. Leviton; 5362-IG.
   c. Pass & Seymour; IG6300.
2. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

D. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 49.:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; TR8300.
   b. Hubbell; HBL8300SG.
   c. Leviton; 8300-SGG.
   d. Pass & Seymour; 63H.
2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

2.3 GFCI RECEPTACLES

A. General Description: Straight blade, non-feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; GF20.
   b. Pass & Seymour; 2084.

C. Hospital-Grade, Duplex GFCI Convenience Receptacles, 125 V, 20 A: Comply with UL 498 Supplement SD.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; HGF20.
   b. Hubbell; HGF8300.
   c. Leviton; 6898-HG.
   d. Pass & Seymour; 2091-SHG.

2.4 TVSS RECEPTACLES

A. Not Used

2.5 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

A. Not Used

2.6 TWIST-LOCKING RECEPTACLES

A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; L520R.
   b. Hubbell; HBL2310.
   c. Leviton; 2310.
   d. Pass & Seymour; L520-R.

B. Isolated-Ground, Single Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Hubbell; IG2310.
   b. Leviton; 2310-IG.
2. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

2.7 PENDANT CORD-CONNECTOR DEVICES

A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.

1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.8 CORD AND PLUG SETS

A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.

1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.9 SNAP SWITCHES

A. Comply with NEMA WD 1 and UL 20.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following 20 A devices:
   a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
   b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
   c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
   d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).

C. Pilot Light Switches, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 2221PL for 120 V and 277 V.
   b. Hubbell; HPL1221PL for 120 V and 277 V.
   c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
   d. Pass & Seymour; PS20AC1-PLR for 120 V.
2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."

D. Key-Operated Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 2221L.
   b. Hubbell; HBL1221L.
   c. Leviton; 1221-2L.
   d. Pass & Seymour; PS20AC1-L.
2. Description: Single pole, with factory-supplied key in lieu of switch handle.

E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 1995.
   b. Hubbell; HBL1557.
   c. Leviton; 1257.

d. Pass & Seymour; 1251.

F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 1995L.
   b. Hubbell; HBL1557L.
   c. Leviton; 1257L.
   d. Pass & Seymour; 1251L.

2.10 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

1. 600 W; dimmers shall require no derating when ganged with other devices.

D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.11 FAN SPEED CONTROLS

A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.

1. Continuously adjustable slider 5 A.
2. Three-speed adjustable rotary knob, 1.5 A.

2.12 OCCUPANCY SENSORS

A. Refer to Section 26 09 23 – Light Control Devices

2.13 COMMUNICATIONS OUTLETS

A. Telephone Outlet – Coordinate with Section 27 15 00 – Communications Horizontal Cabling:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Siemon;
   b. Leviton;
   c. Cooper;
2. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 6. Comply with UL 1863.

B. Combination TV and Telephone Outlet:

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Cooper; 3562.
   b. Leviton; 40595.
2. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 6; and one Type F coaxial cable connector.

2.14 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.

2.15 FLOOR SERVICE FITTINGS

A. Not used.

2.16 POKE-THROUGH ASSEMBLIES

A. Not used.

2.17 MULTIOUTLET ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Hubbell Incorporated; Wiring Device-Kellems.
2. Wiremold Company (The).
3. Substitutions: Under provisions of Section 26 00 10.

B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with manufacturer's standard finish.

D. Wire: No. 12 AWG.

2.18 SERVICE POLES

A. Not used.

2.19 FINISHES

A. Color: Wiring device catalog numbers in Section Text do not designate device color.

1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.
3. TVSS Devices: Blue.
4. Isolated-Ground Receptacles: As specified above, with orange triangle on face.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.

B. Coordination with Other Trades:

1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted provided the outlet box is large enough.
5. Do not share neutral conductors between circuits for GFCI and AFCI outlets.

D. Device Installation:

1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the left.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 SEALING

A. Provide weatherproof seals under the device plate and around the device for outlets in exterior walls or walls between environmentally or pressure controlled rooms.

B. Provide seals for all outlets in walls or columns of computer rooms to maintain room pressure differential, and to contain any gaseous fire suppressant.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.

B. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 120 V to 130 V under no load.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, reverse polarity or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION

SECTION 26 28 13
FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manufacturers
2. Cartridge Fuses

B. Meet the following performance requirements:

1. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.
2. Seismic Performance: In accordance with Section 26 00 10.

C. System Description

1. Fuses to be provided for all equipment furnished on installed under this section as indicated on the Drawings. Provide fuse type and rating as indicated here in or on the Drawings, or as recommended by the manufacturer or required by codes or standards.

1.2 RELATED WORK

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

1.5 REGULATORY REQUIREMENTS AND REQUIREMENTS

A. Conform to requirements indicated in Section 26 00 10 in addition to following:

1. Furnish products listed and classified by NRTL acceptable to authority having jurisdiction as suitable for purpose specified and indicated.
2. Codes and Standards in addition to Section 26 00 10 requirements:
   a. NEMA FU 1 - Low Voltage Cartridge Fuses.
   b. UL 489 - Series Ratings.
   c. ANSI C97.1 - Low Voltage Cartridge Fuses (600 volts or less).
   d. UL 198 - Fuses.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

B. Submit manufacturer's technical product data on fuses, including specifications, electrical characteristics, installation instructions, furnished specialties and accessories. In addition, include voltages and current ratings, interrupting ratings, current limitation ratings, time-current trip characteristic curves, and mounting requirements.

C. Vellum (original) copies of operating curves shall be submitted for each type of fuse furnished. Photocopies are not acceptable. Electronic copies compatible with SKM software are acceptable.

D. Manufacturer's name, class voltage rating shall be submitted for each type fuse furnished.

E. Series ratings for fuses and circuit breakers shall be submitted.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

B. Provide the following additional materials:

1. 600 Ampere and Smaller: 10 percent of each rating (minimum of 3 per rating).
2. 601 Ampere and Larger: 3 of each rating.
3. Fuse Pullers: Provide 2 of each type required.

C. Locate extra materials in spare fuse cabinets. Provide number of spare fuse cabinets as required for quantity of extra materials.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

B. Record on final Drawings actual fuse sizes and types installed, adjacent to each device.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. S&C
4. Littlefuse, Inc.
5. Edison Fuse, Inc.
6. Substitutions: Under provisions of Section 26 00 10.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

B. All power fuses rated 600 volts and less shall be rejection type.

C. Class L Time-Delay Fuses: Provide NRTL Class L time-delay fuses rated 600 volts, 60 hertz, with 200,000 RMS symmetrical interrupting current rating.

D. Class RK1 or RK5 Time-Delay Fuses: Provide NRTL Class RK1 time-delay fuses rated 600 volts, 60 hertz, with 200,000 RMS symmetrical interrupting current rating.USES

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Provide heavy duty, steel or aluminum, 24 inch (600 mm) wide by 30 inch (750 mm) high by 12 (300 mm) inch deep minimum, key lock handle, baked gray enamel, hinged door and 2 keys per cabinet. Adequate for storage of spare fuses specified with **15** percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Provide Class RK5 time-delay fuses for the following types of loads (circuits with heavy in-rush currents):
   a. Motors and motor controllers.
   b. Transformers (600 volts or less).
2. Provide Class RK1 current-limiting (fast acting) fuses for the following types of loads (circuits with no heavy in-rush currents):
   a. Lighting.
   b. Non-motor loads.
   c. Feeder circuits.
   d. Panelboards.
   e. Circuit breaker protection.
3. Provide Class L time-delay fuses for the following types of loads (601 amperes or higher):
   a. Motors.
   b. Transformers.
   c. Circuit breakers.
   d. Service Entrance

4. Provide class CC fuses for the following types of loads.
   a. Control circuits.

3.3 INSTALLATION

A. Provide one complete set of fuses for all fusible equipment furnished, installed or wired under Division 26.

B. Fuses shall be of the correct rating for each installation and shall be of the classes and respective performance herein specified.

C. Install fuses in accordance with manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with standards for installation of fuses.

D. All necessary information required to permit the proper selection of fuses shall be obtained from the Architect if not indicated in the Contract Drawings, Specification, or manufacturer's shop drawings.

E. Replace, at no additional cost to the Owner, all fuses lost, damaged or destroyed during the progress of the Project. At the completion of the project, all fusible equipment shall be correctly fused and operational.

F. All fuses shall have a minimum interrupting rating of 120 percent of the maximum available system short circuit current but in no case shall they be rated less than 100,000 amperes RMS symmetrical.

G. Two or more fuses applied in series shall, whenever possible, be selected with the proper time-current and let-through energy characteristics to provide selective circuit protection for fault and overload conditions.

H. All fuses shall be high interrupting capacity type, NRTL listed and labeled, Class: L, RK1, or RK5.

I. Fuses shall be fast acting, low peak dual element, time delay type unless specifically indicated otherwise.

J. The continuous current-carrying capacity of all fuses shall not vary in total more than 10 percent from the labeled ampere rating when operated in ambient temperatures ranging from 25 degrees C to 50 degrees C. All fuses shall be certified for compliance with this equipment.

K. Provide spare fuse cabinets (in Main Electrical Room) or as indicated on Drawings or by Owner to house spare fuses required under this section.

L. Install fuse with label oriented such that manufacturer, type, and size are easily read.

M. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

3.5 FIELD QUALITY CONTROL

A. Prior to energization of fusible devices, test devices for continuity of circuitry and for short circuits. Replace malfunctioning units with new units and then demonstrate compliance with requirements.

END OF SECTION

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible Switches
2. Nonfusible Switches
3. Receptacle Switches
4. Shunt Trip Switches
5. Molded-Case Circuit Breakers
6. Molded-Case Switches
7. Enclosures

B. Meet the following performance requirements:

1. Seismic Performance: In accordance with Section 26 00 10 means "the unit will remain in place without separation of any to the seismic forces specified and the unit.
2. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   a. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
   b. Altitude: Not exceeding 6600 feet (2010 m).

1.2 RELATED WORK

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager, Contractor and Owner no fewer than five days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Construction Manager's Contractor's and Owner's written permission.
4. Comply with NFPA 70E.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10 in addition to following:

1. ANSI/UL 198C - High-Intensity Capacity Fuses; Current Limiting Types.
2. ANSI/UL 198E - Class R Fuses.
3. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).
4. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.
5. NEMA KS 1 - Enclosed Switches.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

B. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

C. Shop Drawings: For each switch and circuit breaker.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
   a. Enclosure types and details for types other than NEMA 250, Type 1.
   b. Current and voltage ratings.
   c. Short-circuit current rating.
   d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

D. Include outline drawings with dimensions, and equipment ratings for voltage, capacity, horsepower, and short circuit.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10.

B. Provide the following additional materials:

1. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   a. Spares: 10% of installed with a minimum of 3 per size, for the following:
      1) Control-Power Fuses
      2) Fuses for Fused Switches
      3) Fuses for Fused Power-Circuit Devices
   b. Spare Indicating Lights: Six of each type installed.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Square D; a brand of Schneider Electric.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.
4. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
5. Substitutions: Under provisions of Section 26 00 10.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified or indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Six Pole, Single Throw, rated for circuit voltage, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Double Throw, rated for circuit voltage, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Compression type, suitable for number, size, and conductor material.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Square D; a brand of Schneider Electric.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
4. Siemens Energy & Automation, Inc.
5. Substitutions: Under provisions of Section 26 00 10.

B. Type HD, Heavy Duty, Single Throw, rated for circuit voltage, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Six Pole, Single Throw, rated for circuit voltage, 200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Type HD, Heavy Duty, Double Throw, rated for circuit voltage, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
6. Hookstick Handle: Allows use of a hookstick to operate the handle.
7. Lugs: Compression type, suitable for number, size, and conductor material.

2.3 RECEPTACLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Square D; a brand of Schneider Electric.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
5. Substitutions: Under provisions of Section 26 00 10.

B. Type HD, Heavy-Duty, Single-Throw Fusible Switch: rated for circuit voltage, and amperage; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

C. Type HD, Heavy-Duty, Single-Throw Nonfusible Switch: rated for circuit voltage and amperage ; UL 98 and NEMA KS 1; horsepower rated, lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.

E. Receptacle: Polarized, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).

2.4 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.
4. Substitutions: Under provisions of Section 26 00 10.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from a control power of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight red ON pilot light.
3. Isolated neutral lug; 100 percent rating.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

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. Substitutions: Under provisions of Section 26 00 10.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers from sizes 250A to 400A: Magnetic trip element with front-mounted, field-adjustable trip setting.

E. Electronic Trip Circuit Breakers from sizes 600A and larger: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

J. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

2.6 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturer specified:

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. Substitutions: Under provisions of Section 26 00 10.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One NO contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.

2.7 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 CONNECTIONS

A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.

B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

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. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in the Overcurrent Protective Device Coordination Study.

3.7 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 26 32 13i
ENGINE GENERATORS - INSTALL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Installation of the engine generator.
2. Installation of the engine generator enclosure.
3. The engine generator unit shall include all essential and desirable appurtenances whether specifically mentioned in this specification or not. Provide all components and accessories required.
4. Refer to drawings, including details for additional requirements.
5. Install above enclosure generator exhaust piping furnished with enclosure.

B. Meet the following performance requirements:

1. Engine generator system to provide source of standby power.
2. Description: NFPA 110, engine generator system to provide source of power for Level 1 applications.
3. Wind, snow, ice, flood and earthquake Performance: In accordance with Section 26 00 10 1.5.

C. System Description:

1. Engine-generator system located outdoors suitable to support non linear loads and to be operated as a separately derived electrical system with the neutral grounded at the generator.
2. The operation of the units shall be automatic such that upon closing of a remote starting contact, the engines shall start and attain rated voltage and frequency within ten seconds.

1.2 RELATED WORK

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

B. Section 26 08 00 – Electrical General Commissioning Requirements. Provide Installer's and Manufacturer's support as required to coordinate with the Commissioning Agent and support all commissioning efforts and paperwork, Acceptance and Integrated Systems Testing.

C. Section 26 32 15 – Generator Field Startup Requirements.

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

B. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager, Contractor and Owner no fewer than five days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's. Contractor's and Owner's written permission.

C. Coordinate all work related to the engine generator and enclosure, provide labor and all components necessary, and schedule deliveries to provide a complete operational system within the contract schedule and requirements.

D. Coordinate delivery of diesel engine-driven generator, its enclosure and its components. Delivery should be coordinated to coincide with the area of final installation being ready to accept the equipment. Otherwise, Installer shall store equipment as recommended by the manufacturer.

E. Coordinate with the engine - generator and enclosure manufacturer performance parameters required for unit to operate at 100 percent of its capabilities.

F. Coordinate shipment of completely enclosed, factory tested generator to the enclosure manufacturer. Coordinate size and weights of shipping units with the method to lift the unit.

G. Unloading and setting in place at the job site will be the responsibility of the Installer.

1.4 QUALIFICATIONS / QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

B. Safety Features – the engine generator unit shall be installed to minimize the danger of accidents to operating and maintenance personnel.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 10:

B. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NFPA 70 pertaining to construction and installation of engine-generator systems.

C. NFPA Compliance: Comply with applicable requirements of NFPA 30 “Flammable and Combustible Liquids Code”, NFPA 37, "Installation and Use of Stationary Combustion Engines and Gas Turbines," and NFPA 110 “Standard for Emergency and Standby Power Systems” for a level 1 system.

D. UL Compliance: Comply with applicable requirements of the Underwriter's Laboratories including UL2200 – “Stationary Engine Generator Assemblies”. UL 142 “Steel Above Ground Tanks”. UL 2085 “Protected Above Ground Tanks for flammable and combustible liquids with secondary containment”.

E. ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA MG 1, "Motors and Generators," and MG 2, "Safety and Use of Electric Motors and Generators."

F. IEEE Compliance: Comply with applicable portions of IEEE Std 446, "IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications."

G. Insurance Underwriters Compliance: Comply with applicable requirements of the Owner's insurance underwriter Factory Mutual.

H. Environmental Compliance: Comply with all federal and local applicable noise, hazardous materials, and emissions control standards and any authorities having jurisdiction.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 10.

B. Submit written test results.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 10

B. Coordinate turnover to the Owner the following additional materials furnished under Section 26 32 13p:

1. One spare set of consumables such as fuses, filters, etc.
2. One spare set of air, fuel and oil filters in addition to those to be installed after acceptance and integrated systems testing.

1.8 PROJECT RECORD DOCUMENTS

A. Submit under provisions indicated in Section 26 00 10.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit under provisions indicated in Section 26 00 10.

1.10 WARRANTY

A. Provide under provisions indicated in Section 26 00 10.

PART 2 - PRODUCTS

A. Refer to shop drawings for details of pre-purchased engine generators and engine generator set enclosures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with elastomeric isolator pads and restrained spring isolators having a minimum deflection of 1 inch (25 mm) between generator and base fuel tank.

D. Install base fuel tank on elastomeric isolator pads on 4-inch- (100-mm-) thick minimum concrete base. Secure sets to anchor bolts installed in concrete bases. Concrete base construction is specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."

E. Install exhaust piping furnished with packaged engine generator from top of enclosure towards radiator exhaust.

F. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with threaded joints. Extend to outside of enclosure.

G. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

H. Provide wiring to building for alarms, controls, monitoring, etc as required and indicated herein and on drawings.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Sections. Drawings indicate general arrangement of piping and specialties.

B. Connect fuel, cooling-system, and exhaust-system piping to packaged engine generator to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding."

1. Connect neutral to frame and grounding electrode to create a separately derived power source. Refer to Section 26 05 26 - Grounding
2. Provide bonding of generator, engine frame, neutral and equipment grounds to the Building Service ground electrode, structural steel, and to three copperweld 3/4" x 20 ground rods outside the building with No. 4/0 AWG bare copper.

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

A. Identify system components according to Division 23 Section "Identification for HVAC Piping and Equipment" and Section 26 05 53 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Assist qualified testing agency to perform tests and inspections and prepare test reports. Coordinate with Sections 26 08 00 and 26 32 15.

B. Manufacturer's Field Service: Assist factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
   a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.

b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
c. Verify acceptance of charge for each element of the battery after discharge.
d. Verify that measurements are within manufacturer's specifications.

4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions. Verify all alarms are connected to generator control panel and to remote monitoring systems.
5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
6. Exhaust Emissions Test: Comply with applicable government test criteria.
7. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
8. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.
9. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.

D. Coordinate tests with tests for transfer switches or switchboard or switchgear control systems and run them concurrently.

E. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

F. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

I. Remove and replace malfunctioning units and retest and reinspect as specified above.

J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

3.6 DEMONSTRATION

A. Coordinate and assist Factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 01 Section "Demonstration and Training."

3.7 INSTALLATION AND SITE STARTUP AND ACCEPTANCE TESTING

A. Provide support for site startup and Acceptance testing as required to achieve a completed fully functional installation per startup schedule.

B. Supervise work and assemble engine- generator, base mounted fuel tank and enclosure at the site.

C. Set generator base frequency at 60.03 Hz to assist in passive paralleling with the utility source.

3.8 INTEGRATED SYSTEMS TESTING

A. After completion of satisfactory start up and acceptance testing, Installer shall provide support for Integrated Systems Testing, per the commissioning schedule. Assume two 12 hour days on site per engine generator.

3.9 RESPONSE TIME

A. During testing and startup provide any required components or repairs within 24 hours.

3.10 TRAINING

A. Training: Coordinate and assist a factory-authorized service representative to provide one man-day of on-site training per engine generator to demonstrate adjustment, operation, and maintenance of the system to Owner's personnel. An additional one man-day of on-site training per engine generator will be provided within 4-6 months after initial training. Training will be scheduled at mutually convenient dates and times with the Owner.

END OF SECTION

SECTION 26 32 15
ENGINE GENERATOR FIELD STARTUP REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes

1. Scope of Work
2. Materials and Equipment
3. Installation
4. Testing

B. Scope of Work

1. Provide factory startup at the site by the local authorized dealer for the generator, enclosure, particle filter, fuel tank including mechanical inspection, electrical installation inspection, factory documented startup, and support for site Acceptance testing (Level 4) and Integration Systems Testing (Level 5), per startup schedule.
2. Provide a separate cost for a load bank for 100% load testing for level 4. Allow 2 days for testing at Level 4 per generator
3. Assume 2 days testing at Level 5 per generator.
4. These hours are over and above the time needed to connect the generator systems.
5. Load bank cables will be connected by the electrical Installer. The electrical Installer will provide a single point of contact to work with the generator vendor's local distributor on the startup.
6. Fuel for testing is provided by Owner.
7. Comply with requirements for seismic, wind, snow, ice and flood as indicated in Section 26 00 10: 1.5 Regulatory Requirements
8. For remote batteries wire the temperature compensated feature of the battery charger. Provide wiring and sensor as required.

1.2 RELATED WORK

A. Section 26 00 10 – Basic electrical requirements, is an integral part of this section. Requirements and work indicated in 26 00 10 are not repeated in this Section.

B. Section 26 08 00 – Electrical General Commissioning Requirements. Provide Installer's and Manufacturer's support as required to coordinate with the Commissioning Agent and support all commissioning efforts and paperwork, acceptance and integrated testing.

C. Section 26 32 12p Packaged Engine Generator - PBB - Purchase

D. Section 26 32 13i – Engine Generators – Install

E. Section 26 32 13p Engine Generator - TKD – Purchase

F. Section 26 32 14p Engine Generator Set Enclosure - TKD - Purchase

1.3 COORDINATION

A. Coordinate work under provisions indicated in Section 26 00 10.

1.4 QUALIFICATIONS/QUALITY ASSURANCE

A. Conform to requirements indicated in Section 26 00 10.

B. Work shall be performed by an authorized dealer for the engine generator manufacturer.

1.5 REGULATORY REQUIREMENTS AND STANDARDS

A. Conform to requirements indicated in Section 26 00 09p.

B. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NFPA 70 pertaining to construction and installation of engine-generator systems.

C. NFPA Compliance: Comply with applicable requirements of NFPA 30 “Flammable and Combustible Liquids Code”, NFPA 37, "Installation and Use of Stationary Combustion Engines and Gas Turbines," and NFPA 110 “Standard for Emergency and Standby Power Systems” for a level 1 system. NFPA 20 “Fire Pumps”.

D. UL Compliance: Comply with applicable requirements of the Underwriter's Laboratories including UL2200 – “Stationary Engine Generator Assemblies”. UL 142 “Steel Above Ground Tanks”. UL 2085 “Protected Above Ground Tanks for flammable and combustible liquids with secondary containment”.

E. ANSI/NEMA Compliance: Comply with applicable requirements of ANSI/NEMA MG 1, "Motors and Generators," and MG 2, "Safety and Use of Electric Motors and Generators."

F. IEEE Compliance: Comply with applicable portions of IEEE Std 446, "IEEE Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications."

G. Insurance Underwriters Compliance: Comply with applicable requirements of the Owner's insurance underwriter Factory Mutual.

H. Environmental Compliance: Comply with all federal and local applicable noise, hazardous materials, and emissions control standards and any authorities having jurisdiction. Packaged Generator set shall be certified and in compliance with emissions regulations.

1.6 SUBMITTALS

A. Submit as required here in and under Section 26 00 09p.

B. General Submittals: Manufacturer shall, upon receipt of an order, proceed immediately with submittal requirements described below to meet proposed shipment date of the equipment package to the site. Submit one fully detailed, organized and marked up electronic PDF copy and three hard copies in three ring binders of the following:

1. Bill of Material - Itemized bill of materials for the major and minor systems and sub-systems.
2. Manufacturer's model numbers, brochures and system descriptions, including catalog cuts and/or data sheets describing the proposed equipment. Identify all options provided.

C. Submit oil analysis report.

1.7 EXTRA MATERIALS

A. Furnish under provisions indicated in Section 26 00 09p

B. Provide the following additional materials:

1. One spare set of consumables such as fuses, filters, etc.
2. One spare set of air, fuel and oil filters in addition to those to be installed after acceptance and integrated systems testing.

PART 2 - PRODUCTS

2.1 STARTING BATTERIES

A. Starting Batteries: Heavy duty, diesel-starting type lead-acid storage batteries SAE group 8D.. Match battery voltage to starting system. Size for at least four 30 second cranking periods at an ambient temperature of 0 degree F (assume blanket battery heater is not operational). Review requirements with engine generator specifications.

2.2 BATTERY HEATERS

A. Thermostatically controlled blanket heater shall be arranged to maintain each battery above 10 deg C (50 F) regardless of external ambient temperature within range specified in generaotor specification Section paragraph 1.1B Performance Requirements.

2.3 BATTERY TRAY

A. Provide acid resistant battery trays. Include accessories required to support and fasten batteries in place.

B. Provide weather proof non-metallic battery boxes for redundant batteries located outside the enclosure if required.

2.4 BATTERY CHARGER

A. Provide redundant battery chargers – SENS type NRG, no substitutions.

B. Static Battery Charger: SENS NRG with battery monitoring, current-limiting, automatic-equalizing and float-charging type. Provide parallel redundant 20A minimum battery chargers for each generator set battery bank. Generator sets incorporating two battery banks shall be provided with two charger sets separated by diodes so that a fault on one bank cannot effect the other. Units shall comply with UL 1236 and include the following features:

1. Operation: Equalizing-charging rate of 20 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
2. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
3. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
4. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.
5. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
6. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.
7. Output current rating of at least 1/20th of ampere-hour capacity of battery. The charger shall be capable of charging a fully discharged battery without damage to the charger. It shall be capable of returning a fully discharged battery to a fully charged condition within 24 hrs.
8. Automatic and manual switching between low rate (float) and high rate (equalize) mode.
9. Automatic cut-off switch when engine generator is operating.
10. Solid state rectifiers, DC voltmeter and ammeter, fused input and output, 120 VAC, 1 phase input and output VDC to match battery float/equalize voltage.

11. Malfunction alarm light for loss of AC voltage, low battery voltage, high battery voltage, loss of charge and battery failure or trouble. Provide two form "C" type auxiliary contacts for alarm summary remote signal.
12. Associated regulator to insure quick recharge of the batteries after an engine start.

2.5 BATTERY CABLE WITH LUGS

A. Size as recommended by engine manufacturer for cable length required. Include required interconnecting conductors and connecting accessories. Include necessary cables and clamps. Size conductors to minimize total resistance, do not exceed manufacturer's recommendation for total resistance including contacts and solenoids.

PART 3 - EXECUTION

3.1 INSTALLATION AND STARTUP

A. Included in the startup:

1. Fuel tank and annular space pressure test
2. 4 level Fuel level sensor set up wiring to panel
3. Annular space sensor wiring to panel
4. Provide a fuel gauge dip stick
5. Check all vents and secure flanges.
6. Install fuel level gauge, on site
7. Overfill devices to be connected
8. Install over fill protection around the fuel fill port.
9. Provide and Connect fuel lines, supply and return
10. Furnish Batteries, mount batteries and connect batteries. Support all cables between terminals.
11. Provide wiring to the engine control panel so all battery charger alarms can be transmitted to the BMS system through the control panel Modbus interface.
12. Install Modbus interface. Coordinate and assist BMS installer
13. Provide engine-generator control panel programming and setup as required and requested.

B. As a minimum, Level 4 acceptance testing shall include:

1. Start engine and then apply the following loads:
   a. 50% step load transient response showing frequency and voltage variation and recovery time both for application of load and for removal of load. This step load test shall be repeated a minimum of 4 times.
   b. 90% step load transient response showing frequency and voltage variation and recovery time both for application of load and for removal of load.
   c. 100% step load transient response showing frequency and voltage variation and recovery time both for application of load and for removal of load.
2. Before and after and at each step load monitor unit vibration. Record if it is out of specification.
3. 8 hours at 100% load at 1.0 power factor
4. Record amount of fuel burned during the 8 hour burn test.
5. Testing shall be conducted with the same type and constitution of coolant, oil, and other fluids as will be used in final site installation and as recommended by diesel engine generator manufacturer.
6. If engine is shut down for any component failure during the test, or if equipment does not meet performance requirements, the entire test shall be repeated after defects have been corrected.
7. Provide written report.

8. Coordinate testing with the Commissioning Agent. Cooperate and complete required testing.

C. Provide battery cables with lugs, dual batteries and starters and blanket heaters.

D. Provide wiring to generator control panel and coordinate interface with the BMS.

E. Supervise work and assemble engine- generator, base mounted fuel tank and enclosure at the site.

F. Provide a set of electrical schematics for the above equipment.

G. Provide dual fuel and oil filters and associated valves and piping to allow filters to be charged while generator is operating.

H. Provide water fuel separators with associated piping and valves to allow maintenance while generator is operating.

3.2 FIELD QUALITY CONTROL

A. Testing

1. Provide 8 hour full load test utilizing portable test bank. Simulate power failure, automatic starting cycle, and automatic shutdown and return to normal.
2. Record in 20 minute intervals during four hour test:
   a. Kilowatts.
   b. Amperes.
   c. Voltage.
   d. Power factor.
   e. DC Voltage.
   f. Jacket water temperature.
   g. Coolant temperature.
   h. Air temperature at air inlet to engine.
   i. Outdoor air temperature at source of ventilation air.
   j. Frequency.
   k. Oil pressure.
   l. Fuel pressure.
   m. Exhaust temperature.
3. Test starting, load shedding, alarm and shutdown circuits by simulating conditions. Verify BMS receives signals.

3.3 INTEGRATED SYSTEMS TESTING

A. After completion of satisfactory start up and acceptance testing, Installer shall provide support for Integrated Testing, per the commissioning schedule. Assume two 12 hour days on site per engine generator. Provide cost for a per day additional cost.

B. Manufacturer to provide field technicians to Support Integrated Systems Testing (commissioning Level 5) in addition to and after successful competition of acceptance testing (Level 4). Provide for two 12 hour day(s) of Integrated Systems Testing for each engine-generator.

3.4 TESTING CLOSEOUT

A. After acceptance and integrated systems testing is complete perform an oil analysis. Report results in writing to Owner.

B. After receiving oil analysis results replace air, fuel and oil filters. Save filters for analysis if warranted by the results of the oil analysis

END OF SECTION

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