

MOORE PUBLIC SCHOOLS

**WESTMOORE HIGH SCHOOL
FIRE DOOR REPLACEMENT**

**INDEPENDENT DISTRICT NO. 2
CLEVELAND COUNTY, MOORE, OKLAHOMA**

**12613 SOUTH WESTERN
OKLAHOMA CITY, OKLAHOMA 73170**

PROJECT MANUAL

MARCH 2026

AGP | the Abla Griffin
Partnership



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ARCHITECT:

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Engineer of Record
Division 26
Timothy Van Ostran
Electrical Engineer
Salas O'Brien, LLC
OK 32650 / EXP 03.31.2027
CA 7058 / EXP 06.30.2027



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SPECIAL CONDITIONS

TIME FOR COMPLETION AND LIQUIDATED DAMAGES:

- A. Upon execution of the contract agreement between the Owner and the Contractor, it shall become an obligation of the contractor to complete all work to be performed under this agreement for the Construction of the new Westmoore High School Fire Door Replacement to be located at 12613 South Western Avenue, Oklahoma City, OK 73170 - **within 90 Calendar Days.**
- B. Penalty for noncompliance by the above date shall be cessation of all further periodical payments until the work is completed, and can be fully used for the purpose intended.

PAYMENTS:

- A. The Owner's payment schedule indicating the payment dates established by Moore Public Schools shall be provided to the contractor to establish a monthly payment schedule.
- B. **Certificates of payment shall be submitted to the Architect on or before 7 days prior to Owner's cut-off date.**
- C. Until the Work is 50 percent complete, the Owner will pay 95 percent of the amount due the Contractor on account of progress payments. At the time the Work is 50 percent complete, any **remaining** partial payments shall be paid at 97.5 percent of amount due. The retainage shall be retained until the project is completed.

INSURANCE AND BONDS:

- A. Insurance provided shall be with a company or companies licensed to do business in the state of Oklahoma.
- B. Policies shall be provided in the following types and amounts:
 - 1. a. Workmen's Compensation-Statutory
 - b. Employer's Liability-\$500,000 each accident.
 - 2. Comprehensive General Liability:
 - a. Bodily Injury - \$1,000,000 each occurrence.
 - b. Personal Injury - \$1,000,000
 - c. Property Damage - \$1,000,000 each occurrence

3. Automobile Liability:
 - a. Bodily Injury - \$500,000 each person/\$1,000.000 each occurrence
 - b. Such Comprehensive Automobile Liability Insurance shall include all owned and non-owned hired motor vehicles.
 4. Owners Protective Liability - Same limits as above.
 5. Products and Completed Operations - Same limits as above.
 6. Contractual Liability - Same limits as above.
- C. Furnish one copy of Certificates herein required for each copy of the Agreement; specifically set forth evidence of all coverage required by Subparagraphs 11.1 and 11.2. Furnish to the Owner copies of any endorsements that are subsequently issued amending coverage or limits.
- D. **The Contractor shall provide property insurance in the amount of the initial contract sum as well as subsequent modifications thereto for the entire Work at the site on a replacement cost basis without voluntary deductibles. This insurance coverage shall be the "all-risk" form for completed value.**

TEMPORARY SERVICES:

- A. Sanitary Facilities: The Contractor shall provide and maintain necessary sanitary conveniences for the use of those employed on/or about the work. The sanitary facilities shall be properly secluded from public observation and shall be such locations as shall be approved by the Owner, and their use shall be strictly enforced.

SHOP DRAWINGS and SUBMITTALS:

- A. Unless otherwise specified, the shop drawings and product data shall be submitted **electronically**. Physical samples of materials shall be submitted to the Architect as required.
- B. Construction Manager is responsible for obtaining and distributing required prints of shop drawings to his

subcontractors and material suppliers after as well as before final approval.

- C. Shop drawings and samples shall be dated and marked to show the names of the Project, Architect, CM, originating Sub-Contractor, manufacturer or supplier, and separate detailer if pertinent. Shop drawings shall completely identify Specifications section and locations at which materials or equipment are to be installed. Reproduction of Contract Drawings are acceptable as Shop Drawings only when specifically authorized in writing by the Architect.
- D. If materials or specified items other than those specified in these Contract Documents are supplied - and approved by the Architect - it shall be the Construction Manager's responsibility to provide ALL additional materials, accessories, substrates, utility connection, etc. for a complete and operational installation at NO additional cost to the Owner.

CHANGES IN THE WORK:

- A. Cost shall be limited to the following: cost of materials, including sales tax and cost of delivery; cost of labor, including social security, old age and unemployment insurance, and fringe benefits under collective bargaining agreements; workmen's compensation insurance; bond premiums; and rental value of power tools and equipment. Overhead shall include the following; supervision, superintendence, wages of time keepers, watchmen and clerks, hand tools, incidentals, general office expense, and all other expenses not included in "cost".
- B. Change Order markups shall be limited to 10% overhead and 10% profit. No other markups shall be allowed.

Constructor Manager markups shall be limited to 7% profit UNLESS a time extension has been approved by the Owner and the Architect allowing for an increase of G.C.s as per original base agreement times the number of approved additional days. No other markups shall be allowed.

AS BUILT DRAWINGS:

- A. Provide and maintain in proper order and in good, clean

condition in the field office at the project site, one complete full-size set of all working drawings. On this set of drawing prints, in red ink, neatly and accurately inscribe any and all changes in the work.

- B. Upon completion of work, the Contractor shall furnish one set of "as built" drawings. These drawings shall be contract drawings corrected in **red ink** to show any differences between contract drawings and actual construction. All changes made during construction shall be noted. Each drawing showing changes in dimensions, details, or containing supplemental information shall be plainly marked "**As Built**" and shall contain the signature of both the Architect and the Contractor.

CLOSEOUT SUBMITTALS:

Prepare project data in the form of an instructional manual supplied electronically on media as requested by Owner (CD or flash drive). The following information shall be included and arranged under a Table of Contents:

1. Directory listing names, addresses, and telephone numbers of the Architect/Engineer(s), Construction Manager, Subcontractors, and major material/equipment suppliers.
2. Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and Suppliers. Include equipment, parts list for each, operating instructions, maintenance instructions for equipment, special finishes, etc.
3. Project documents and certificates, including shop drawings and product data, air and water balance reports, photocopies of warranties.
4. Record As-Built Drawings as described above.
5. Completed Non-Asbestos Affidavit.

DEBRIS DISPOSAL:

Waste disposal shall be the responsibility of the Contractor. The Contractor shall make arrangements with the local authorities having jurisdiction for accommodation of all waste disposal. If local facilities are not available the contractor shall be responsible for all other arrangements for waste disposal.

SUPPLEMENTARY CONDITIONS AND SPECIAL CONDITIONS:

In the following sections where the term "General Conditions" is used, it shall include the "Supplementary Conditions" and/or "Special Conditions bound in this project manual.

MISCELLANEOUS PROVISIONS:

A. TESTS AND INSPECTIONS

Not applicable.

B. EQUAL OPPORTUNITY

The Contractor shall maintain policies of employment as follows:

The Contractor and all Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, or national origin. The Contractor shall take affirmative action to insure that applicants are employed, and that employees are treated fairly during employment without regard to their race, religion, color, sex, or national origin. Such action shall include, but not be limited to the following: employment, upgrading, demotion, or transfer; recruitment advertising; layoff or termination; rates of pay or any other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

C. COOPERATION WITH BUILDING OFFICIALS

Cooperate with applicable Federal, State, City or other governmental officials and inspectors at all times. If such officials or inspectors deems special inspection necessary, provide assistance and facilities that will expedite his inspection.

Construction Manager shall be responsible for obtaining and paying for ALL building permits required for this project. This cost shall be included in the Construction Manager's General Conditions.

D. MEASUREMENTS

Before doing any work or ordering any materials, the Contractor shall verify all measurements of existing and new work, and shall be responsible for their correctness.

Quantities obtained during bidding &/or construction shall not be from the scaling of the drawings. Only dimensions obtained from dimensioned documents &/or existing on-site conditions shall be utilized for quantities determination, pricing, and ordering. Any scaling of the Construction Documents will be at the bidder's risk and any discrepancies shall be corrected by and paid for by the bidder.

If differences are found, they shall be submitted to the Architect for consideration and verification before proceeding with the work. No extra compensation will be allowed because of differences between actual dimensions and measurements indicated on the working drawings.

E. CONFLICTS BETWEEN DRAWINGS AND SPECIFICATIONS

Conflicts between the drawings and specifications shall be brought to the immediate attention of the Architect. Failure to bid item(s) noted on the drawings and omitted from the specifications **does not** remove responsibility from the Construction Manager and applicable Subcontractor(s) to provide and install such with no additional cost to the Owner.

These Contract Documents - including but not limited to the Drawings, Project Manual, and any subsequent Addenda - are issued as a "whole" and shall be bid as such. Each discipline / subcontractor shall review the entire set of Contract Documents and include applicable work in their bid **regardless of location within the Contract Documents**. Reviewing only a portion of the Contract Documents shall not absolve the construction manager or subcontractor of the requirement to perform the work of their respective disciplines and/or trade.

F. MANUFACTURER'S SPECIFICATIONS AND INSTRUCTIONS

Install all manufactured items of materials or equipment in strict accordance with manufacturer's recommended specifications, except that the specifications herein, where more stringent, shall be complied with.

At the completion of the project and prior to final acceptance by the Owner, provide the Owner with three complete sets of operating and maintenance instructions, and demonstrate to him the procedures for proper operation and maintenance of all equipment.

G. JOB MAINTENANCE

During the course of their work, all crafts and trades shall protect all work which preceded theirs from damage, and they shall make repairs or replacements to any damage caused either directly or indirectly by them.

H. COMPLIANCE WITH STATE AND FEDERAL LAWS

Contractor assumes full responsibility for the payment of all contributions and payroll taxes (state and federal) as to all

subcontractors and employees engaged in the performance of work pursuant hereto and further agrees to check and meet all requirements that might be specified under regulations of the administrative officials or board charged with the enforcement of any state or federal act on the subject referred to. CM agrees to furnish Owner, upon request, a certificate or other evidence of compliance therewith.

I. OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970 (OSHA)

The Construction Manager shall comply with the latest edition and revision of The Federal Occupational Safety and Health Act of 1970 for construction.

J. GUARANTY BONDS

1. Prior to the Owner signing the contract agreement, he will require the Contractor to furnish performance and payment bonds covering the faithful performance of the entire construction contract agreement. The performance bond and the payment bond shall each be made out in one hundred percent (100%) of the contract sum and shall be in a company or companies against which the Owner has no reasonable objection.
2. Bonds shall be signed by an official of the bonding company, and shall be accompanied by the bonding agent's written power-of-attorney in order that one copy may be attached to each copy of the contract agreement.
3. The Construction Manager shall include in his proposal amount the total premiums for all required bonds.
4. Unless noted otherwise, the Construction Manager does hereby warrant and/or guarantee against defects in all workmanship and materials performed or furnished by him directly or by his subcontractors for a period of one (1) year from the date of completion, as evidenced by the date of the Final Certificate or final acceptance of the project. Said warranty and/or guarantee shall be in the form of a good and sufficient bond in a sum equal to one hundred percent (100%) of the contract price.

End of Special Conditions

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01010-SUMMARY OF THE WORK

Part 1 - General

1.01 Work Included:

- A. The General Conditions, Bidding Requirements, and Division I are hereby made a part of each of the technical sections that follow, and shall be understood to apply and shall apply in full to all individuals or corporations who contract or subcontract to perform any part or all of the project work.
- B. Indications on the working drawings or in any section of the specifications of an article or material, operation, or method, requires that the Contractor shall provide each item or service or quality or is subject to qualifications noted; and, the Contractor shall perform each operation prescribed according to the conditions stated providing, therefore, all necessary labor, equipment, and incidentals to complete the project work.
- C. The project:
 1. Name: Westmoore High School Fire Door Replacement - Moore Public Schools.
 2. Location: 12613 South Western Avenue - Oklahoma City, Oklahoma 73170.

1.02 Summary of Work:

- A. **Base Bid:** Provide and pay for all materials, labor, services, equipment, licenses, taxes, permits, and other items necessary for the complete replacement of existing corridor hollow metal frames with new fire rated folding doors where indicated on Contract Drawings. Contractor shall maintain all barriers, guards and other environmental items required at the site during construction.
- B. Owner: Moore Public Schools
 1. Owner's Representative:
Jeff Horn, Assistant Superintendent, Operations
Moore Public Schools
1500 SE 4th Street
Moore, OK 73160
405-735-4221
- C. Design Team:
 1. Architect:
Mike Abla, Principal Architect
AGP
313 Southeast 5th Street
Moore, OK 73160
405-735-3477
 2. Electrical and Technology Engineers:
Dwayne Gordon, Mechanical Engineer
Salas O'Brien
2900 S. Telephone Rd., Suite 120
Moore, OK 73160
405-364-9926

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01010-SUMMARY OF THE WORK

3. Construction Management Team:
Joe Sherga, Project Manager
Omni Construction LLC
P.O. Box 892245
Oklahoma City, OK 73189
405-735-3992
- 1.04 Work to be Provided and Installed By Others:
Not applicable.
- 1.05 Use of the Site:
 - A. Confine operations at the site to the areas permitted under the contract. Portions of the site beyond areas on which work is indicated are not to be disturbed.
 - B. Keep facility free from accumulation of waste material, rubbish or construction debris.
- 1.06 Safety of Persons and property:
 - A. Contractor shall at all times protect the building from damage from rainwater.
 - B. Contractor shall provide barricades and clearly mark work zone areas.
 - C. Refer to Special Conditions "Temporary Services" for additional information.
 - D. During the period of construction, the OSHA Standards shall be followed as applicable by law.
 - E. The Contractor shall post emergency telephone numbers.
- 1.07 Preconstruction Conference:
 - A. A preconstruction meeting will be held at a time and place designated by the Architect or Owner's Representative, for the purpose of identifying responsibilities of the Owner=s and the Architect's personnel and explanation of administrative procedures.
 - B. The Contractor shall use this meeting for the following minimum agenda:
 1. Construction Schedule/Project Phasing.
 2. Use of areas of the site.
 3. Delivery and storage.
 4. Safety.
 5. Security.
 6. Cleaning up.
 7. Subcontractor procedures relating to:
 - a. Submittals.
 - b. Change orders.
 - c. Applications for payment.
 - d. Record documents.
 - C. The attendees shall include:
 1. The Owner's Representatives.
 2. The Architect.
 3. The Contractor and its superintendent.
- 1.08 Project Scheduling:
 - A. The Contractor is responsible for the scheduling of construction and must prepare a schedule and charting system described below. This schedule is to ensure adequate planning and execution of the work by the contractor and to

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01010-SUMMARY OF THE WORK

- assist the Architect in appraising the schedule and evaluating the progress of the work.
 - B. The project schedule shall be presented within ten (10) days after receipt of the Notice to Proceed. Three (3) copies of the schedule shall be submitted to the Architect for review and approval.
 - C. The schedule logic must be in the form of a "fenced" bar chart or Critical Path Method network indicating the planned start and completion dates of the activity, logical constraints between activities, and total float of each activity.
 - D. An updated project schedule shall be provided when requested by the Architect.
- 1.09 Environmental Controls:
- A. Water Resources:
 - 1. Oily substances: prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water.
 - 2. Mosquito abatement: prevent ponding of stagnant water conducive to mosquito breeding habitat.
 - B. Land Resources:
 - 1. Erodible soils: plan and conduct earthwork to minimize the duration of exposure of unprotected soils. Clear areas in reasonably sized increments only as needed to use the areas developed. Immediately protect side slopes and back slopes upon completion of rough grading.
 - C. Air resources:
 - 1. Prevent creation of dust, air pollution, and odors.
 - 2. Use water sprinkling, temporary enclosures, and other appropriate methods to limit dust and dirt rising and scattering in air to locate practical level.
 - 3. Store volatile liquids, including fuels and solvents, in closed containers.
 - 4. Properly maintain equipment to reduce gaseous pollutant emissions.
 - D. Comply with all applicable environmental control guidelines as required by the City of Oklahoma City.
- 1.10 Temporary Utilities:
- A. The Contractor shall provide and pay for all temporary utilities required for the complete construction of the project including, but not limited to, electricity, lighting, heating, cooling, ventilating, telephone, water, sanitary facilities, exterior and interior enclosures, access roads and parking areas, cleaning and waste removal, project identification and signs, etc.
- 1.11 Cleaning:
- A. Use cleaning materials and agents recommended by manufacturer or fabricator of surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property, or that might damage finished surfaces.
 - B. Employ experienced workers or professional cleaners for

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01010-SUMMARY OF THE WORK

final cleaning. Clean each surface or unit of work to condition expected from a commercial building cleaning and maintenance program. Comply with manufacturer's published instructions.

- C. Complete cleaning operations prior to requesting a Final / Substantial Completion Inspection.

1.12 Project Sign:
Not applicable.

End of Section

DIVISION 2 - SITE WORK

SECTION 02050 - DEMOLITION

Part 1 - General

1.01 Work Included:

- A. The General Conditions and applicable sections of Division 1 shall apply to this entire section.
- B. All materials, labor, services and incidentals necessary for the completion of this section of the work.
- C. Complete demolition of the existing paving and curbs; complete demolition of the existing curbs as necessary to construct new entry driveways; removal of existing trees; and all site materials as shown on the Drawings.
- D. Removal of all materials, debris and rubbish from site. Refer to Part 3 for ownership of materials.

1.02 Submittals:

- A. Scheduling of Alteration and Demolition Work:
 1. Before commencing any alteration removal or demolition work the contractor shall prepare and submit for approval by the Architect, a schedule showing the commencement, the order, and the completion dates of the various parts of this work.
 2. Before starting any work relating to existing utilities (electrical, heat, gas, etc.) that will temporarily discontinue or disrupt services to any existing building, the Contractor shall be required to give notice to the Architect and obtain his approval in writing before proceeding with this phase of work.

Part 2 - Materials (not applicable)

Part 3 - Execution

3.01 General Requirements:

- A. Permits, Licenses, Ordinances and Regulations:

All work shall comply with local and other governing ordinance, codes and regulations, but this requirement does not relieve the Contractor of responsibility of complying with these specifications. Complying with requirements of state, county or local laws, ordinances and regulations regarding demolition work is the responsibility of the Contractor, who shall pay any and all fees, and give any notices necessary in connection therewith.

3.02 Demolition of Work To Be Modified:

- A. Alterations and demolition shall be as indicated on the Drawings and in accordance with applicable technical sections of the specifications. The Contractor shall do all necessary demolition or removal of existing work as required in connection with this project, including shoring, bracing, etc. and removal of unwanted material and debris from the site. Demolish existing items only as necessary to tie on new construction as detailed. This work shall be done in a most careful manner, as the Contractor will be held responsible for any damage which

DIVISION 2 - SITE WORK

SECTION 02050 - DEMOLITION

- may be caused thereby to any part or parts of existing streets, neighboring buildings, and grounds.
- B. When alterations occur, or new and old work join, the immediate adjacent surfaces or so much thereof as required by the involved conditions, shall be cut, removed, patched, repaired or refinished and left in as good a condition as existed prior to the commencing of the work, and matching the remainder of the existing paving, etc.
 - C. Conduit and piping found underground on the site, or other areas involved in demolition or alteration shall be removed, re-rerouted or protected as required by the Drawings. Where these items are found; but not covered in the drawings, the Contractor shall notify the Architect for disposition instructions.
 - D. Maintain existing utility services to remain and protect from damage during demolition operations.
 - E. The Contractor shall furnish and install adequate guards, barricades and other temporary protection to prevent injury to persons.
 - F. The Contractor shall make every effort to control the amount of dust and the noise level generated by demolition operations.
- 3.03 Ownership and Disposition of Materials:
- A. Classification of removed materials (re: Drawings for applicable items):
 - 1. **Reinstalled:** Items are those items which, after removal, are to be used, reinserted, remounted or otherwise built back into the work under this contract.
 - 2. **Salvaged:** Items are those items which, after removal, are to be retained by the Owner and delivered for storage on the Owner=s premises.
 - 3. **Scrapped:** Items are all other removed materials or equipment. This includes all items which are not noted or specified for reinstallation or salvage.
 - B. Disposition by Classification:
 - 1. **Reinstalled:** Items of material or equipment shown on the work shall be jointly inspected by the Contractor and the Architect prior to dismantling or removal. An agreement shall be reached briefly setting forth the apparent condition of the material, or equipment, and approved by the Architect. Simple operating test of operative equipment will be included with this joint inspection if feasible. Such items shall be reinstalled as specified in the applicable sections of the specifications covering new items of similar categories.
 - 2. **Salvaged:** Materials and equipment noted on the Drawings or listed to be salvaged shall be carefully handled and protected and shall be delivered to storage areas, as designated by the Architect, on the Owner=s premises.
 - 3. **Scrapped:** All removed materials and equipment not noted on the drawings specified to be reinstalled, shall be considered as scrap and shall be disposed of by the

DIVISION 2 - SITE WORK

SECTION 02050 - DEMOLITION

Contractor off the Owner=s premises and credit for the value thereof, if any, shall have been reflected in the Contractor's bid price.

3.04 Clean-Up:

- A. Disposition of all material, debris and rubbish shall be the responsibility of the Contractor. Leave site clean. Completely remove all materials, debris, and rubbish from site. Absolutely no burning of debris on the site will be allowed.
- B. **The Contractor shall submit proposed refuse dumping sites to the Architect and shall receive written approval from the Architect concerning acceptable dumping sites prior to the disposition of any material, debris or rubbish generated by this project.**

End of Section

DIVISION 5 - METALS

SECTION 05400 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.01 Related Documents

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

1.02 Summary

- A. This Section includes the following:
 - 1. Exterior and interior non-load-bearing wall framing.
 - 2. Soffit joist framing.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for masonry shelf angles and connections.
 - 2. Division 9 Section "Gypsum Board Assemblies" for interior non-load-bearing, metal-stud framing and ceiling-suspension assemblies.

1.03 Performance Requirements

- A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
 - 1. Design Loads: Design loads shall be calculated components and cladding load per ASCE/SEI 7 edition indicated on the drawings.
 - 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of $1/600$ of wall height at areas backing up brick veneer, and $1/240$ of wall height at areas backing up other materials.
 - b. Soffit Joist Framing: Vertical deflection of $1/240$ of the span.
 - 3. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 1 inch.
- B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
 - 2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

DIVISION 5 - METALS

SECTION 05400 - COLD-FORMED METAL FRAMING

1.04 Submittals

- A. Product Data: For each type of cold-formed metal framing product and accessory indicated.
- B. Shop Drawings: Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
 - 1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Welding certificates.
- D. Research/Evaluation Reports: For cold-formed metal framing.

1.05 Quality Assurance

- A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.
- B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.
- C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- D. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
 - 1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
 - 2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

1.06 Delivery, Storage, And Handling

- A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

DIVISION 5 - METALS

SECTION 05400 - COLD-FORMED METAL FRAMING

PART 2 - PRODUCTS

2.01 Manufacturers

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
1. Allied Studco.
 2. AllSteel Products, Inc.
 3. California Expanded Metal Products Company.
 4. Clark Steel Framing.
 5. Consolidated Fabricators Corp.; Building Products Division.
 6. Craco Metals Manufacturing, LLC.
 7. Custom Stud, Inc.
 8. Dale/Incor.
 9. Design Shapes in Steel.
 10. Dietrich Metal Framing; a Worthington Industries Company.
 11. Formetal Co. Inc. (The).
 12. Innovative Steel Systems.
 13. MarinoWare; a division of Ware Industries.
 14. Quail Run Building Materials, Inc.
 15. SCAFCO Corporation.
 16. Southeastern Stud & Components, Inc.
 17. Steel Construction Systems.
 18. Steeler, Inc.
 19. Super Stud Building Products, Inc.
 20. United Metal Products, Inc.

2.02 Materials

- A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
1. Grade: ST33H (ST230H).
 2. Coating: G60 (Z180).
- B. Steel Sheet for Vertical Deflection Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
1. Grade: 50 (340), Class 1 or 2.
 2. Coating: G90 (Z275).

2.03 Exterior Non-Load-Bearing Wall Framing

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
1. Minimum Base-Metal Thickness: 0.0428 inches (1.09 mm).
 2. Flange Width: 1-5/8 inches (41 mm).

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- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0538 inches (1.37 mm)
 - 2. Flange Width: 1-1/2 inches.
- C. Vertical Deflection Clip Option: Manufacturer's standard head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Dietrich Metal Framing; a Worthington Industries Company.
 - b. MarinoWare, a division of Ware Industries.
 - c. SCAFCO Corporation
 - d. The Steel Network, Inc.
- D. Single Deflection Track Option: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
 - 2. Flange Width: 1 inch (25 mm) plus the design gap for 1-story structures and 1 inch (25 mm) plus twice the design gap for other applications.
- E. Double Deflection Track Option: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.
 - 1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0538 inch (1.37 mm).
 - b. Flange Width: 1 inch (25 mm) plus the design gap for 1-story structures and 1 inch (25 mm) plus twice the design gap for other applications.
 - 2. Inner Track: Of web depth indicated, and as follows:
 - a. Minimum Base-Metal Thickness: 0.0428 inch (1.09 mm).
 - b. Flange Width: Equal to sum of outer deflection track flange width plus 1 inch.

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2.04 Soffit Joist Framing

- A. Steel Ceiling Joists: Manufacturer's standard C-shaped steel sections, of web depth indicated, unpunched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: As indicated on drawings.
 - 2. Flange Width: 1-5/8 inches (41 mm) minimum.

2.05 Framing Accessories

- A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.
- B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
 - 1. Supplementary framing.
 - 2. Bracing, bridging, and solid blocking.
 - 3. Web stiffeners.
 - 4. Anchor clips.
 - 5. End clips.
 - 6. Foundation clips.
 - 7. Gusset plates.
 - 8. Stud kickers, knee braces, and girts.
 - 9. Joist hangers and end closures.
 - 10. Hole reinforcing plates.
 - 11. Backer plates.

2.06 Anchors, Clips, And Fasteners

- A. Anchor Bolts: ASTM F 1554, Grade 55, threaded carbon-steel headless bolts, with encased end threaded, and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class C or mechanically deposition according to ASTM B 695, Class 50.
- B. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.
- C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.
- D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
 - 1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- E. Welding Electrodes: Comply with AWS standards.

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2.07 Miscellaneous Materials

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.
- C. Shims: Load bearing, high-density multimonomer plastic, nonleaching.
- D. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.08 Fabrication

- A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
 - 1. Fabricate framing assemblies using jigs or templates.
 - 2. Cut framing members by sawing or shearing; do not torch cut.
 - 3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
 - 4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening

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requirements of sheathing or other finishing materials.

2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch (3 mm).

PART 3 - EXECUTION

3.01 Examination

- A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 Installation, General

- A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.
- B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).
- D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
 1. Cut framing members by sawing or shearing; do not torch cut.
 2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
 - a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
 - b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for

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which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

- G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.
- H. Install insulation, specified in Division 7 Section "Building Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.
- J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:
 - 1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.03 Exterior Non-Load-Bearing Wall Installation

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.
- B. Fasten both flanges of studs to bottom track, unless otherwise indicated. Fast both flanges to top track if required by deflection option selected. Space studs as follows:
 - 1. Stud Spacing: 16 inches (406 mm).
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Single Deflection Track Option: Install single-leg deflection tracks and anchor to building structure.
 - 2. Double Deflection Track Option: Install double deep-leg deflection tracks and anchor outer track to building structure.
 - 3. Deflection Clip Option: Connect vertical deflection clips to infill studs and anchor to building structure.

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- E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches (1220 mm) apart. Fasten at each stud intersection.
 - 1. Top Bridging for Single Deflection Track Option:
Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - a. Install solid blocking at maximum 96-inch (2440-mm) centers and as shown on approved Shop Drawings.
 - 2. Bridging Options:
 - a. Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - b. Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - c. Proprietary bridging bars installed according to manufacturer's written instructions.
 - F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.
- #### 3.04 Joist Installation
- A. Install perimeter joist track sized to match joists. Align and securely anchor or fasten track to supporting structure at corners, ends, and spacings indicated on Shop Drawings.
 - B. Install joists bearing on supporting frame, level, straight, and plumb; adjust to final position, brace, and reinforce. Fasten joists to both flanges of joist track.
 - 1. Unless shown otherwise in drawings, install joists over supporting frame with a minimum end bearing of 1-1/2 inches (38 mm).
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on drawings.
 - C. Space joists not more than 2 inches (51 mm) from abutting walls, and as follows:
 - 1. Joist Spacing: As indicated.

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- D. Frame openings with built-up joist headers consisting of joist and joist track, nesting joists, or another combination of connected joists if indicated.
 - E. Install bridging at intervals indicated. Fasten bridging at each joist intersection as follows:
 - 1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
 - F. Install miscellaneous joist framing and connections, including web stiffeners, closure pieces, clip angles, continuous angles, hold-down angles, anchors, and fasteners, to provide a complete and stable joist-framing assembly.
- 3.05 Field Quality Control
- A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - B. Field and shop welds will be subject to testing and inspecting.
 - C. Testing agency will report test results promptly and in writing to Contractor and Architect.
 - D. Remove and replace work where test results indicate that it does not comply with specified requirements.
 - E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- 3.06 Repairs And Protection
- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
 - B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer that ensures the cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

DIVISION 6 - WOOD & PLASTIC

SECTION 06100 - ROUGH CARPENTRY

Part 1 - General

1.01 Work Included:

- A. All materials, labor, services and incidentals necessary for the completion of this section of the work.

1.02 Related Work Specified Elsewhere:

- A. Wood Treatment - Section 06300

1.03 Quality Assurance:

- A. Grades specified shall conform to the most recent grading rules as established by the following bureaus and associations.
 - 1. PS 20 - American Softwood Lumber Standard.
 - 2. Western Wood Products Association
 - 3. Southern Pine Inspection Bureau
- B. Grade and trade mark each piece of lumber or bundle on bundled stock. Use only the recognized official marks of association under whose rules it is graded. Grade and trade marks will not be required if each shipment is accompanied by certificate of inspection issued by grading association.

1.04 Submittals:

- A. Product Data: for each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing and finishing treated material.
 - 2. As requested by authorities having jurisdiction include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials both before and after exposure to elevated temperatures when tested according to ASTM D5516 and ASTM D 5664.
 - 3. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

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SECTION 06100 - ROUGH CARPENTRY

4. Research / evaluation reports - for the following, showing compliance with building code in effect for Project:
 - a. Fire-retardant treated wood.
 - b. Power-driven fasteners.
 - c. Power-actuated fasteners.
 - d. Expansion anchors.
 - e. Metal framing anchors.

1.05 Delivery, Storage and Handling:

- A. Stack lumber, plywood, sheathing, and other materials: provide spacers between each bundle to provide air circulation around bundled material. Provide proper air circulation between stacks and under coverings.

Part 2 - Products

2.01 General:

- A. Provide best quality of respective grades and kinds. Lumber and plywood shall be produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship". Factory mark each piece of lumber with grade stamp of grading agency.
- B. Maximum moisture content of lumber 19%.
- C. Provide dressed lumber (S4S) unless otherwise indicated.
- D. Where nominal sizes are indicated, provide actual sized required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.

2.02 Grades and Applications of Lumber:

- A. Framing lumber for the following shall be "Standard" grade Douglas Fir (WCLIB or WWPA).
 1. Concealed blocking/nailers, cants, grounds, and miscellaneous wood items used in conjunction with the roofing work and as indicated on the Drawings.
 2. Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the Grading Agency indicated.

2.03 Fire-retardant Treated Materials:

- A. General - where fire-retardant treated materials are required by authorities having jurisdiction, provide materials that comply with performance requirements in AWPA C20 (lumber) and AWPA C27 (plywood). Identify fire-retardant treated wood with appropriate classification

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SECTION 06100 - ROUGH CARPENTRY

marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

2.04 Panel Products:

- A. Miscellaneous Concealed Plywood: shear wall sheathing, span rating to suit framing in each location, and thickness indicated. Refer to Structural Drawings.
- B. Telephone and Electrical Equipment Backing Panels: DOC PS 1, C-D Plugged, fire-retardant treated, in thickness indicated, or if not indicated, not less than ½ inch thick.

2.05 Fasteners:

- A. All nails, spikes, bolts, connectors and other fasteners used in connections with this work shall be galvanized.
 - 1. Nails, wire, brads and staples - FS-FF-N-105.
 - 2. Power-driven Fasteners - CABO NER-272.
 - 3. Wood screws - ASME B18.6.1.
 - 4. Screws for fastening to cold formed metal framing: ASTM C954 length as recommended by screw manufacturer for material to be fastened.
 - 5. Lag bolts - ASME B18.2.1.
 - 6. Bolts - steel bolts complying with ASTM A 307, Grade A with ASTM C563 hex nuts and, where indicated, flat washers.
 - 7. Expansion anchors - anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 - a. Material for interior applications: carbon steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
 - b. Material for exterior applications: stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, alloy group 1 or 2.

2.06 Metal Framing Anchors:

- A. General: provide galvanized steel framing anchors of structural capacity, type, and size indicated and acceptable to authorities having jurisdiction.
- B. Galvanized Steel Sheet: hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

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SECTION 06100 - ROUGH CARPENTRY

Part 3 - Execution

3.01 Sizes and Applications (General Framing):

- A. Members shall be accurately cut and fitted, true to line and level, avoiding shims and wedges as much as possible. Discard material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Where applicable, apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.
- C. At wood ground, blocking and nailer installation: install where indicated and required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- D. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless noted otherwise.

3.02 Rough Hardware:

- A. Provide all sufficient nails, screws, etc. to insure rigidity and structural soundness. Provide hot-dipped galvanized fasteners at all weather exposed locations.
- B. Spiking and nailing shall be done using largest size spikes and nails practicable and as indicated on the drawings. Securely attach carpentry according to applicable codes and recognized standards.
- C. Bolt nailers and blocking to steel or concrete members with bolts of proportionate strength of members attached, length required, spaced 4'-0" o.c. maximum and 4" from each end, except as otherwise indicated. Countersink fastener heads on exposed carpentry work and fill holes with wood fiber.
- D. Pre-drill members when necessary to avoid splitting of wood.

3.03 Panel Product Installation:

- A. Wood structural panels: comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential and Commercial", for types of structural-use panels and applications indicated. Comply with "Code Plus" provisions in above referenced guide.

End of Section

DIVISION 7 - THERMAL & MOISTURE PROTECTION

SECTION 07900 - SEALANTS

Part 1 - General

1.01 Work Included:

- A. All materials, labor services, and incidentals necessary for the completion of this section of the work.

1.02 Quality Assurance:

- A. Standards:
 - 1. TT-S-00230C, Sealing Compound, One Component.
 - 2. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.03 Submittals:

- A. Submit manufacturer's specifications and color chart for each type of sealant.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
 - 1. Joint-sealant application, joint location, and designation.
 - 2. Joint-sealant manufacturer and product name.
 - 3. Joint-sealant formulation.
 - 4. Joint-sealant color.
- D. Product test reports.
- E. Preconstruction compatibility and adhesion test reports.
- F. Preconstruction field-adhesion test reports.
- G. Field-adhesion test reports.

1.04 Warranty:

- A. All work done under this section of the work shall be guaranteed for a period of two years from date of final acceptance of the building. Guarantee shall include materials and workmanship required to repair any leaks or the repairs thereof.
- B. Special Warranty: Manufacturer's standard form in which joint sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section for a period of 10 years from date of final acceptance.

1.05 **Products of certain manufacturers are specified herein to simplify descriptions of design, construction, and/or materials only. Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.**

Part 2 - Products

2.01 Materials:

- A. Building Sealant: One part high performance polyurethane waterproofing sealant, FS-TT-S-00230C.
 - 1. Acceptable Manufacturer: Sonneborn NP1 Building Sealant.
 - 2. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall

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SECTION 07900 - SEALANTS

comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

- a. Architectural Sealants: 250 gIL.
 - b. Sealant Primers for Nonporous Substrates: 250 gIL.
 - c. Sealant Primers for Porous Substrates: 775 gIL.
3. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - a. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.
 4. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
 5. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.
- B. Silicone Joint Sealants:
1. Mildew-Resistant Neutral-Curing Silicone Joint Sealant: ASTM C 920.
 - 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. BASF Building Systems.
 2. Dow Corning Corporation.
 3. GE Advanced Materials - Silicones.
 4. Pecora Corporation.
 5. Sika Corporation; Construction Products Division.
 6. Tremco Incorporated.
- C. Urethane Joint Sealants: Urethane Joint Sealant: ASTM C 920.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work

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- include, but are not limited to, the following:
- a. BASF Building Systems.
 - b. Bostik, Inc.
 - c. Lyntal, International, Inc.
 - d. Pecora Corporation.
 - e. Sika Corporation; Construction Products Division.
 - f. Tremco Incorporated.
- D. Latex Joint Sealants: Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, GradeNF.
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. BASF Building Systems.
 - b. Bostik, Inc.
 - c. Pecora Corporation.
 - d. Tremco Incorporated.
- E. Preformed Joint Sealants: Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
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. Dayton Superior Specialty Chemicals.
 - b. EM SEAL Joint Systems, Ltd.
 - c. Sandell Manufacturing Co.
 - d. Schul International, Inc.
 - e. Willseal USA, LLC.
- F. Acoustical Joint Sealants: Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
1. 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. Pecora Corporation.
 - b. USG Corporation.

DIVISION 7 - THERMAL & MOISTURE PROTECTION

SECTION 07900 - SEALANTS

- G. Joint Sealant Backing: cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type 0 (open-cell material) or any of the preceding types, as approved in writing by joint sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - 1. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.
- H. Miscellaneous Materials: as recommended by sealant manufacturer.
 - 1. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
 - 2. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
 - 3. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.
 - 4. Joint Cleaner
 - 5. Joint Primer/Sealer
 - 6. Bond Breaker Tape
 - 7. Joint Backer-Rod: Closed-cell compressible rod stock, size and shape as required by application.
- I. Caulking compound: Watertight, gun consistency, conforming to FS-TT-C-598, Type 1.
- J. Accessories: As recommended by sealant manufacturer.
- K. Color: to be selected from manufacturer's standard colors.

Part 3 - Execution

- 3.01 Preparation:
 - A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
 - 1. Remove laitance and form-release agents from concrete.
 - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
 - B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to

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SECTION 07900 - SEALANTS

areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.

- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.
- 3.02 Installation: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
- A. Do not leave gaps between ends of sealant backings.
 - B. Do not stretch, twist, puncture, or tear sealant backings.
 - C. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
 - D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
 - E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 - 1. Place sealants so they directly contact and fully wet joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
 - F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 - 1. Remove excess sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
 - G. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.
 - H. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning

DIVISION 7 - THERMAL & MOISTURE PROTECTION

SECTION 07900 - SEALANTS

materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

- 3.03 Joint Sealant Schedule:
- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
 - B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
 - C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
 - D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal non traffic surfaces.
 - E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces.
 - F. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal non traffic surfaces.
- 3.04 Additional Information:
- A. Application: All sight exposed caulking, and all exterior applications.
 - B. Comply with sealant manufacturer's printed instructions.
 - C. Any surfaces requiring priming, shall be prepared according to manufacturer's recommendations.
 - D. Install sealants to depths as shown or as recommended by sealant manufacturer. Smooth uneven surfaces.
 - F. Do not disturb compound by touching, washing, or otherwise until it has cured tack free.
 - G. Excess compound shall be removed from surfaces after curing.
 - H. Follow manufacturer's recommendations for painting over sealant.

End of Section

DIVISION 8 - DOORS & WINDOWS

SECTION 08 35 13.23 - ACCORDION-FOLDING FIRE DOORS

PART 1 - GENERAL

1.01 SUMMARY

A. WORK INCLUDED:

1. Divisions 0 and 1, as indexed, apply to this section.
2. Furnish and install all horizontal-sliding, accordion-folding doors to meet manufacturer's specifications & applicable codes, shown on the drawings and specified herein at the time of purchase.

B. RELATED WORK:

1. Division 9: All track, soffit, chain guide and strikers shall be painted by Section 09900. Color shall be selected by the architect.
2. Division 26: All electrical wire, wiring, conduit and electrical boxes shall be furnished and installed by electrical section, including connections to smoke detectors and building fire & access control alarm panels.

1.02 REFERENCES

A. UNDERWRITERS LABORATORIES, WHERE APPLICABLE

1. UL 10B: Standard for Safety - Fire Tests of Door Assemblies
2. UL 10C: Standard for Positive Pressure Fire Tests of Door Assemblies
3. UL 864: Control Units and Accessories for Fire Alarm Systems
4. UL 1784: Standard for Air Leakage Tests of Door Assemblies and Other Opening Protectives

B. NATIONAL FIRE PROTECTION ASSOCIATION, WHERE APPLICABLE

1. NFPA 72: National Fire Alarm and Signaling Code
2. NFPA 80: Standard for Fire Doors and Other Opening Protectives
3. NFPA 101: Life Safety Code
4. NFPA 105: Standard for Smoke Door Assemblies and Other Protective Openings
5. NFPA 252: Standard Methods of Fire Tests of Door Assemblies

C. INTERNATIONAL BUILDING CODE (2009, 2012, 2015, 2018, 2021), WHERE APPLICABLE

D. INTERNATIONAL FIRE CODE (2009, 2012, 2015, 2018, 2021), WHERE APPLICABLE

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E. AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME), WHERE APPLICABLE

1.03 QUALITY ASSURANCE

- A. Installation shall be performed by factory trained and certified installers with experience installing electrically operated, accordion folding doors.
- B. Doors with a fire rating shall be listed by Underwriters Laboratories for ratings as indicated, when tested in accordance with the requirements of UL 10B and NFPA 252.
- C. Automatic closing system shall be listed by Underwriters Laboratories in accordance with the requirements of UL 864 and in compliance with NFPA 80.
- D. Doors used for smoke and draft control shall bear the "S" mark on the door UL label and shall have an air leakage of less than 3 CFM/ft² at 0.1 inch of water column pressure when tested in accordance with UL 1784 with an artificial bottom seal.
- E. Doors shall be capable of resisting an air pressure differential up to 0.05 inches of water column. Optional air pressure resistance up to 0.10 inches of water column available.

F. CERTIFICATIONS

- 1. International Code Council - Evaluation Service (ICC-ES)
 - a. Evaluation Service Report - 1394 (ESR - 1394)
- 2. Factory Mutual Insurance Company (FM Global)
- 3. California Department of Forestry & Fire Protection (CalFire)
 - a. Building Materials Listing Program
 - 1) FireGuard (model 90)

1.04 SUBMITTALS

- A. See Special Conditions section, for submittal procedures.
- B. Product Data: Provide manufacturer's technical literature, include UL listing data.
- C. Shop Drawings: Indicate construction and installation details and dimensions, including layout, electrical requirements, required stack depth, height of header above finished floor, and requirements for anchorage and support of each door.

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SECTION 08 35 13.23 - ACCORDION-FOLDING FIRE DOORS

- D. Operation and Maintenance Data: Operating procedures, troubleshooting and repair methods, and wiring diagrams.
- E. Closeout Submittals: Owner's manual and warranty documentation as specified herein.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's agent will deliver original, unopened packages to a location designated by the General Contractor. All packages must be stored indoors, protected from moisture damage and secure from theft or other damage. General Contractor to note any damage or shortages at time of delivery.

1.06 COORDINATION BY GENERAL CONTRACTOR

- A. Coordinate with the following:
 - 1. Electrical.
 - 2. Fire Alarm system (if required).
 - 3. Access Control wiring (if required).
 - 4. Floor and ceiling finish.
 - 5. Structural support and adjacent, rated wall construction.
- B. Assure accurate installation of header, jamb, and trim. Provide "As-Built" dimensions for opening and storage pocket. Supervise unloading and handling of materials.
- C. Store boxes flat (not more than three high) in a protected dry area.
- D. Permanent power shall be in-place and ready for final connection when doors are installed. Assure access to and proper clearance for motor operators.
- E. Access control doors shall be reset after being tested for proper security application. After testing the fire alarm system, if applicable, automatic-closing fire doors shall be re-set to the original position.

1.07 WARRANTY

- A. Materials and installation shall be warranted against defects in workmanship for a period of two (2) years from the date of substantial completion.

DIVISION 8 - DOORS & WINDOWS

SECTION 08 35 13.23 - ACCORDION-FOLDING FIRE DOORS

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Horizontal-sliding, accordion-folding, fire doors as manufactured by Won-Door Corporation shall be specified as the following:

Won-Door FireGuard Slim - FG90

1. Fire rating:

a. 90 Minutes

B. No substitutions allowed.

2.02 ACCORDION FIRE DOORS - GENERAL

A. Provide electrically powered self-closing fire doors of configurations indicated on the drawings.

1. Fire rating as required.

a. Maximum opening width for this model is 9'-0". The opening height shall be specified as indicated on the drawings.

For fire doors exceeding these sizes, requiring temperature rise rating (TR), curves or a bi-parting configuration, please refer to the FIREGUARD ACCORDION-FOLDING FIRE DOOR specification.

B. Fire Rating - Fire doors shall be listed by Underwriters Laboratory as special purpose fire doors having a **90-minute** fire protection rating in accordance with the requirements of UL 10B and NFPA 252.

C. Closing and Opening Operation: Automatic Closing System, listed to UL864 including motor operator and releasing devices shall be a Microprocessor-based system and shall commence closing upon activation by fire signal, access control signal, low battery voltage or optional low AC voltage.

1. Obstruction Detection: Contact with an obstruction shall cause the door to stop, reverse enough to remove pressure on the leading edge, pause, and then re-close when in an alarm condition.

2. Constant pressure to the leading edge while not under motor power shall prevent motor operation and allow the door to be opened manually.

D. Exit Device Operation: Provide an exit device on one or both sides of door. Location for exit devices is at the leading edge.

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1. In emergency mode, a slight pressure on the exit device will cause the door to open a field-programmable distance, up to the entire opening width, pause for a field-programmable duration between 3 and 30 seconds, and then automatically close.
2. The exit device shall have the ability when not in the emergency (fire) mode to be used to open the door and move it back into the storage pocket.

2.03 COMPONENTS

- A. Door Construction: Two parallel, accordion-type walls independently suspended with no floor tracks or pantographs.
 1. Panels: 24-gauge steel, V-grooved; modular in design; capable of in-place repair.
 2. Perimeter Seals: shall consist of continuous extruded sweeps attached to the top and bottom of the fire door to form a smoke and draft seal.
 3. Hanging Weight: 5.5 pounds per sq. ft. when extended across opening.
 4. Finish: All steel panels shall have factory-applied protective coatings.
 5. Color: Manufacturer's standard platinum.
- B. Suspension System: Two tracks, on 8-inch centers, attached to overhead structural support.
 1. Track: 1/8" extruded aluminum.
 2. Panel Hangers: Panels shall be suspended by a steel hanger pin and ball bearing roller system.
- C. Power source shall be: 120 - 240-volt AC input. System operation voltage shall be dual sourced from DC power supply and backup battery.
- D. Automatic Closing System shall be listed to UL864 including capability to send and receive signals from the Fire Control Panel and/or Access Control System, and shall consist of the following:
 1. Microprocessor based Electronic Control box with the ability to:
 - a. Monitor dual power sources continually for peak performance including:
 - 1) Detect a missing battery, bad battery, or low battery condition.

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- 2) Detect if the charging circuit is bad.
 - 3) Detect fuse failures.
 - 4) Detect high or low AC conditions.
- b. Monitor the health of the drive train.
 - c. Monitor inputs including faults associated with door block, exit device and patron hardware.
 - d. Run a "watch dog" monitoring circuit which will force a software restart in the event the software hangs, including tracking the number of resets that occur for diagnostic purposes.
 - e. Withstand aberrant voltages up to 120 volts AC on the fire alarm input circuit without damage including the ability to indicate that the alarm circuit has not been wired as a dry contact, "no voltage" circuit when errant voltages are applied to the circuit.
 - f. Communicate with other microprocessors on the system via an internal bus system.
 - g. Indicate faults or supervised information both locally and at a remote location.
 - 1) Motor Operator Assembly including a DC gear-motor, drive sprocket, clutch, and position sensors. The motor shall drive the door by means of a chain. Standard motor drive speed will be approximately 9" per second.
 - 2) Leading Edge assembly shall be pressure sensitive such that contact with an obstruction shall cause the door to stop, pause for a minimum of 3 seconds, then re-close when in alarm mode.
 - 3) Exit Device will be located on each side of the door.
- E. The header shall be provided as an integrated part of the door assembly and shall include track, threaded rods and mechanical attachment hardware.

2.04 RELATED CONSTRUCTION

- A. All headers, support structures, fire protection of support structures, surrounding insulation, jambs, storage pockets, blocking and trim shall be furnished and installed by other sections.
- B. All electrical wire, wiring, conduit and electrical boxes shall be furnished and installed by electrical section, including

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connections to smoke detectors and building fire and access control alarm panels.

- C. Drilling/placement of anchorage points into pre- or post-tensioned decks, welding/ punching/drilling steel members and all drywall work by other sections.
- D. Track Support Construction: Provide supports attached to structure and mounting surface for track including drilling/placement of anchorage points into pre or post tensioned decks, welding/punching/drilling steel members, and all drywall work; comply with door manufacturer's instructions and recommendations.
- E. Pocket Construction: Provide rated pocket as specified for storage of accordion door when open; comply with door manufacturer's instructions and recommendations.
- F. Protection: Protect installed work from damage.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that adjacent construction is suitable for installation of door.
- B. Verify that electrical utilities have been installed and are accessible.
- C. Verify clear opening dimensions and that door opening is plumb.
- D. Notify Architect of any unacceptable conditions or varying dimensions.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions, shop drawings and NFPA 80.
- B. Install doors plumb and parallel with the finished floor.
- C. Installation shall be performed by factory trained and certified installers with experience installing electrically operated, accordion-folding doors.

3.03 ADJUSTMENT

- A. Adjust door installation to provide uniform clearances and smooth, quiet, non-binding operation.

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B. Test that all operations are functional and meet the requirements of local codes.

3.04 CLEANING

A. Clean surfaces using manufacturer's recommended means and methods.

3.05 INSTRUCTION

A. Following the installation and final adjustments, the installer shall fully instruct the General Contractor as to the correct operating procedure and safety requirements of the door package.

3.06 STORAGE OF WASTE AND RECYCLING

A. Store and recycle waste in accordance with Construction Waste Management and Disposal (if applicable).

End of Section

DIVISION 9 - FINISHES

SECTION 09250 - GYPSUM WALLBOARD

Part 1 - General

- 1.01 Work Included:
 - A. All materials, labor, services and incidentals necessary for the completion of this section of the work.
- 1.02 Quality Assurance:
 - A. Standards:
 - 1. American Society for Testing and Materials:
 - a. ASTM C-36, Gypsum Wallboard
 - b. ASTM C-475, Joint Treatment for Gypsum Wallboard Construction.
 - B. Federal Specifications:
 - 1. FS-SS-L-30D, Type III, Grade X, Class 1, Gypsum Wallboard.
- 1.03 Submittals:
 - A. Provide submittals in the form of samples, and documentation, to the Architect for review.
- 1.04 Product Delivery, Storage and Handling:
 - A. All materials shall be delivered to the job site with manufacturer's labels intact and stored in an enclosed shelter providing protection from damage and exposure to the elements.

Part 2 - Products

- 2.01 Gypsum Wallboard:
 - A. Type: Fire-rated, ASTM C-36.
 - B. Size: 5/8" thick x 48" wide x 96" or as required.
 - C. Edges: Tapered.
 - D. Location: All gypsum board.
- 2.02 Fasteners:
 - A. Screws: Self-drilling, self-tapping, bugle head, Type S.
 - B. Nails: Annular ring: GWB-54.
- 2.03 Joint Treatment Materials:
 - A. Joint Tape: Perforated Tape, ASTM C-475.
 - B. Joint Compound: ASTM C-475.
- 2.04 Accessories:
 - A. Metal Edge: Similar to United States Gypsum Trim No. 402.

Part 3 - Execution

- 3.01 Installation:
 - A. Apply gypsum board to horizontal surfaces first, then to vertical.
 - B. Install gypsum board parallel to studs at vertical surfaces.
 - C. To minimize joints, use panels of maximum practical lengths.
 - D. Position all ends and edges of gypsum board over nailing or fastening members. Fit ends and edges closely; do not force

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SECTION 09250 - GYPSUM WALLBOARD

- together. Stagger end joints.
- E. Cut ends, edges, scribe or make cutouts within field of panel in a workmanlike manner.
 - F. Install trim at all intersections of gypsum board and other surfaces. Provide corner bead at all vertical or horizontal corners.
 - G. Fasteners:
 - 1. Drive fasteners in field of panel first, work toward ends and edges.
 - 2. Perimeter fasteners shall be a least 3/8" from ends and edges.
 - 3. Attach panels to wood framing members with specified nails spaced out 8" for ceiling, and 8" o.c. at ends and 12" o.c. at each support.
 - 4. Drive nail head slightly below surface of panel in a uniform dimple without breaking face paper.
 - 5. Screw fasteners shall be spaced 12" o.c. at each support in the field of the board and 8" o.c. at all edges and ends.
 - 6. Screws shall be power-driven with an electric screwdriver and screw heads shall provide a slight depression below surface of panel without breaking face paper.
- 3.02 Joint Treatment:
- A. Treat all exposed joints and trim with a three-coat approved system applied in strict accordance with manufacturer's recommendations.
- 3.03 Clean-Up:
- A. Use all necessary care during execution of the Work of this Section to prevent undue scattering of drywall scraps and dust and to prevent tracking of joint and finishing compounds onto floor surfaces. On completion of each installation segment in a room or space, promptly pick up and remove from the working area all scraps, debris and surplus material.

End of Section

DIVISION 9 - FINISHES

SECTION 09656 - TERRAZZO FLOOR TILE

PART 1 GENERAL

1.01 SUMMARY

- A. Section includes: Terrazzo floor tile covering and accessories.
- B. Related requirements:
 - 1. Drawings and General Provisions of the Contract (including General and Supplementary Conditions and Division 1 References Section)
 - 2. Concrete - existing(subfloors)

1.02 REFERENCE STANDARDS

A. ASTM International

- 1. C 1028 Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
- 2. D 2240 Standard Test Method for Durometer Hardness
- 3. E 648 Standard Test Method for Critical Radiant Flux of Flooring Systems Using a Radiant Energy Source
- 4. E 662 Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials
- 5. F 925 Standard Test Method for Resistance to Chemicals of Resilient Flooring
- 6. F 970 Standard Test Method for Static Load Limit
- 7. F 1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
- 8. F 2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes

B. Other referenced documents

- 1. National Fire Protection Association (NFPA) 253: Standard Test Method for Critical Radiant Flux of Floor Covering Systems Using a Radiant Energy Source
- 2. LEED-NC, version 3

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Install floor covering after finishing operations, including painting and ceiling operations, have been completed.
- B. Pre-installation Meetings: Meet to confirm project requirements, substrate conditions, manufacturer's

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installation instructions and warranty requirements in compliance with Division 1 requirements.

- C. Sequencing: Do not install floor covering over concrete substrates until substrates have cured and are dry to bond with adhesive as determined using test methods specified in ASTM F710 and following adhesive manufacturer's instructions.

1.04 ACTION SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures.
- B. Product Data: For specified products, submit latest edition of product supplier's technical specifications data (available from www.floorazzo.com).
- C. Samples: Submit selection and verification samples showing the required style and color for flooring as well as cove base.

1.05 INFORMATION SUBMITTALS

- A. Test and Evaluation Reports
 1. Product test reports: As required by Conditions of the Contract and Division 1 Regulatory Requirements Section, submit test certificates from an independent test laboratory showing compliance with specified performance characteristics and physical properties.
 2. Compatibility and adhesion test reports: Submit test reports confirming adhesive's effectiveness with the product(s) specified.
- B. Manufacturer Instructions: For specified products, submit latest editions of product supplier's installation and cleaning & maintenance instructions (available from www.floorazzo.com).

1.06 CLOSEOUT SUBMITTALS

- A. Warranty documentation: For specified products and accessories, submit product supplier's warranty documents (available from www.floorazzo.com).

1.07 QUALITY ASSURANCE

- A. Installer: To be qualified to install the material, installer shall fulfill one of the following requirements.

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1. The Installing company shall utilize installers that are certified on the applicable Floorazzo installation process (Butt or Fusion Technique) by the supplier. Installers must be able to provide valid Certification documentation at the time of installation start.
 2. Installer shall hire the manufacturer's representative to provide a minimum of 2 days of training and onsite supervision. Training shall be conducted prior to the start of the installation. Installing company shall provide installers ample time to participate in the training and certification process. This shall be included in the price of the installation from the Flooring Contractor.
- B. Testing Agency: Agency shall be independent and qualified to perform concrete substrate moisture and humidity testing according to ASTM F710 prior to the flooring being installed.
- C. Preconstruction Testing:
1. Concrete substrate: Reference Standard ASTM F710 for more detail. To partially summarize here, regardless of its age or grade level or history of use, perform the following concrete tests:
 - i. Concrete Moisture Test: Perform moisture tests (ASTM F1869 and ASTM F2170) on concrete with a minimum of three tests for the first 1000 square feet and one additional test for each 1000 square feet or fraction thereof. A diagram of the area showing the location and results of each test shall be dated and submitted to the architect, general contractor, and/or end user. If test results exceed the floor covering manufacturer's limits, installation shall not commence until results conform to limits.
 - ii. If test results on installations exceed the following limits, installation shall not commence until results conform to limits:

	Mapei Ultrabond ECO 373 OR ECO MS4 Adhesive
ASTM F 1869	8 lbs/1000 ft ² /24 hrs.
ASTM F 2170	90% relative humidity
 - iii. Concrete pH Test: Perform pH tests on concrete. Do not install when the pH is greater than or equal to 12. Readings below 7.0 and above 10.0 can adversely affect resilient flooring or adhesives, or both.

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1.08 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Acceptance Requirements: Comply with the product supplier's ordering and lead time requirements to avoid construction delays, and to allow material to acclimatize as required in the specified product's installation instructions. Accept delivery of materials only if they are in unopened, undamaged packaging that bears the name and brand of the manufacturer/product supplier, project identification, and shipping and handling instructions.
- B. Storage and Handling Requirements: Upon receiving floor covering, immediately remove from pallet and lay on a flat surface. Store material -- including underlayment panels, patching or underlayment compound, floor covering material and adhesive -- in the original packaging (as delivered) in areas that are enclosed and weather tight with the permanent HVAC system set at a temperature of between 65°F and 80°F for a minimum of 48 hours prior to commencement of installation. In addition, comply with storage and handling requirements listed on product packaging, and described in the latest edition of the product's installation instructions (available from www.floorazzo.com).

1.09 AMBIENT SITE CONDITIONS

The permanent HVAC system shall be operational and set at a temperature of between 65°F and 80°F for a minimum of 48 hours prior to commencement of installation, during the time of installation, and for 48 hours after installation has been completed. Thereafter, minimum temperature shall be 55°F. Refer to the latest version of the installation instructions (available from www.floorazzo.com) for additional ambient requirements (humidity, completion of related work or substrates, etc.) under which the work must be performed in order for the work results to provide the specified quality.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Supplier: **Floorazzo Tile, LLC**, 1217 Harold Andrews Road, Siler City, NC 27344, Ph: 919-663-1684, www.floorazzo.com
- B. Product shall be Precast Terrazzo Tile product made with Polyester Resins for flexibility of installation. Products made from Epoxy Resins or Cementitious Materials

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shall not be allowed. Product must be designed for installation with resilient adhesive; thin-set and grouting is not allowed.

C. Obtain all materials including tile, adhesive, Fusion, etc. from one single manufacturer

D. Product Installation Type:

1. Butt Install method: 2' x 2' Terrazzo Tile shall be installed in Butt Tile fashion, where tiles are laid next to each other without grout line.

2. Fusion: Larger 24" x 24" Terrazzo Tile (or) Larger 24" x 48" Terrazzo Panels shall be installed using Fusion Technique where tiles are bonded to each other to provide a seamless floor.

E. Substitutions: as approved by Architect.

F. Product Options

1. Floorazzo **Marble - Standard - 24" x 24**

Size: 24" x 24"
Weight: 2.15 lb/ft²
Gauge: 3/16"
Edges: Straight
Install: Butt or Fusion
Colors: As noted on Drawings.

2. Floorazzo **Tiles - Custom**

Size: 24" x 24" or 24" x 48"
Weight: 2.15 lb/ft²
Gauge: 3/16"
Edges: Straight
Install: Butt or Fusion
Colors: As noted on Drawings.

G. Performance: Physical properties of Floorazzo Tiles shall conform to the following minimums:

Safety

Critical radiant flux ASTM E648 Class 1
Smoke density ASTM E662 Pass
Slip resistance ASTM C1028 Wet: 0.7; Dry: 0.66

Durability

Static load limit ASTM F970 1,000 psi
Chemical resistance ASTM F925 No change

LEED-NC v.2.2

MR Credit 4: Recycled content

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Gem (Glass): 18% pre-consumer recycled content
18% post-consumer recycled content
Marble: 18% pre-consumer
IEQ Credit 4.1: Low-emitting adhesives Mapei Ultrabond ECO 373 Adhesive has a low VOC content
IEQ Credit 4.2: Low-emitting sealers Diversey Plaza Plus Sealer/Finish or equal
IEQ Credit 4.3: Low-emitting flooring
Floorazzo is manufactured with a mineral base

2.02 ACCESSORY PRODUCTS

- A. Cove Base: 4" or 6" (match existing) Cove Base in Matching Color
- B. Divider Strips: Consult factory
- C. Wall Protection: Wall Tiles shall be made of the same material and thickness as the floor tile material.
- D. Adhesive: as required by manufacturer.
- E. Sealer: as required by manufacturer.
- F. Cleaning Products: as required by manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Overall: Follow guidelines laid out in Division 01, Section 01 71 00 - Examination and Preparation as well as Section 01 43 00 - Quality Assurance.
- B. Verification of Conditions: Inspect all substrates and subfloors for proper tolerances and dryness and report any discrepancies to the general contractor in writing.
- C. Pre-installation Testing: Verify that concrete testing per ASTM F710 has been conducted by an independent testing agency, and that results are within the adhesive and floor covering manufacturers' requirements.
- D. Evaluation and Assessment: See the state requirements for the project location.
- E. Proper storage and acclimation of product according to manufacturer's procedures

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SECTION 09656 - TERRAZZO FLOOR TILE

3.02 SURFACE PREPARATION

- A. Prepare concrete substrates per ASTM F 710. All work required to put the concrete subfloor in acceptable condition shall be the responsibility of the general contractor. See the state requirements for the project location.
- C. Close adherence to the manufacturer requirements for floor levelness and preparation.

3.03 INSTALLATION

- A. Follow latest edition of the manufacturer's installation instructions (available from www.floorazzo.com). Only use written instructions from the manufacturer.
- B. Interface with Other Work: If transitions are required to and/or from the specified floor covering, contact the supplier for suitable transition material.

3.04 FIELD QUALITY CONTROL

- A. Field Tests: this is for installed work (after job is done).
- B. Manufacturer Services: Coordinate with supplier if an on-site manufacturer's representative is required. Installers without prior experience must have manufacturer's representative on site for training and oversight as required by the manufacturer.

3.05 CLEANING

- A. General: Clean up job site, including sweeping or dust mopping the floor to remove all dirt or grit, and put all waste in general contractor's dumpster. Follow overall cleaning guidelines described in Division 01.
- B. Initial Maintenance: Installer is responsible and must conduct the initial penetrating floor sealer and surface treatment. It must be conducted immediately after installation.
- C. Initial maintenance shall be per the latest edition of the manufacturer's maintenance instructions (available from www.floorazzo.com).

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SECTION 09656 - TERRAZZO FLOOR TILE

3.06 CLOSEOUT ACTIVITIES

Follow stated Closeout Submittal requirements for these activities.

End of Section

DIVISION 9 - FINISHES

SECTION 09900 - PAINTING

Part 1 - General

1.01 Work Included:

- A. All materials, labor, services and incidentals necessary for the completion of this entire section of the work.
- B. Consult Drawings, finish schedules, details and specification section.

1.02 Quality Assurance:

- A. All painted surfaces shall be uniform in color, texture and finish to the satisfaction of the Architect.

1.03 Submittals:

- A. Submit manufacturer's specifications, including paint label analysis and application instructions for each material specified.
- B. Submit color samples for review of color and texture.
- C. Provide samples of all natural and stained wood finishes.
- D. Final samples: Prepare samples of finishes on the job to the satisfaction of the Architect. If required, a 4' x 8' portion of wall surface finished as final sample.

1.04 Product Deliver, Storage and Handling:

- A. Materials shall be delivered to the project site in strong, undamaged, waterproof containers with manufacturer's label intact. Materials in previously opened or unsealed containers, are not acceptable.
- B. Include on label of container: Manufacturer's name, type of paint, number and application instructions.
- C. Immediately upon delivery to the project site, all painter materials shall be stored and locked in a watertight shed with floor well off the ground. The shed shall remain locked at all times except for adding or removing materials.
- D. No materials of any manufacturer will be allowed on the project site any time during construction except those of the manufacturers specified or approved by the Architect.

1.05 Job Conditions:

- A. Comply with manufacturer's recommendations as to environmental conditions under which coating and coating systems can be applied.
- B. Do not apply finishes in areas where dust is being generated or where work in progress may affect finish quality.
- C. Protect finished work of other trades, and all surfaces not being painted concurrently, or not to be painted.

Part 2 - Products

2.01 General:

- A. The following specifications for Finishes is not intended to mention every particular item which will receive painter finish, but is intended to establish type and quality of finish which shall be required on various materials.
- B. **Products of Sherwin-Williams are specified herein to simplify descriptions of types and qualities of finishes required only.**

DIVISION 9 - FINISHES

SECTION 09900 - PAINTING

Proprietary names are not intended to imply that products of named manufacturer are required to the exclusion of equivalent products of other manufacturers.

- C. Wherever the abbreviation "SW" appears in the following detailed specification, it shall be understood to mean Sherwin-Williams.
 - D. Primers shall be as specified by manufacturers of finish paint used and as approved by the Architect.
- 2.02 Acceptable Manufacturers:
- A. Sherwin-Williams.
 - B. PPG Industries.
 - C. Cook Paint and Varnish Co.
 - D. Pratt and Lambert.
 - E. Kelly-Moore.
- 2.02 Exterior Finishes:
- A. Enamel on Ferrous Metals:
 - 1. One coat SW Kem Kromik Primer, (Alkyd primer).
 - 2. Two coats SW Industrial Enamel, (Alkyd gloss enamel).
 - B. Enamel on Exterior Door Frames and Doors:
 - 1. Shop coat by others-touch up as required.
 - 2. Two coats SW Industrial Enamel, (Alkyd gloss enamel).
 - C. Enamel on Galvanized Metal:
 - 1. One Coat SW Galvite primer.
 - 2. 2 Coats SW Industrial Enamel, (Alkyd gloss enamel).
 - D. Enamel on Exterior Concrete Block:
 - 1. One coat SW Promar Latex Block Filler B25W25.
 - 2. Two coats SW A-100 Semi-Gloss Latex Enamel.
 - E. Enamel on Existing Exterior Metal Wall Panels **(to be confirmed by Paint Manufacturer)**:
 - 1. Two Coats SW Kem Kromik Universal Metal Primer (rust inhibitive).
 - 2. Two Coats SW Direct-To-Metal, (Alkyd Enamel Semi-Gloss).
- 2.03 Interior Finishes:
- A. Enamel on Metal: All miscellaneous and ornamental metal items which are left exposed, hollow metal doors and frames.
 - 1. Shop coat by others - touch up as required.
 - 2. Two coats SW Promar 200 Semi-Gloss. Enamel, (Alkyd semi-gloss enamel).
 - B. Enamel on Concrete Block:
 - 1. One coat SW Promar 200 Block Filler (vinyl acrylic latex).
 - 2. Two coats SW Promar 200 Semi-Gloss Enamel.
 - C. Enamel on Gypsum Board Ceilings/Facias/Walls
 - 1. One coat SW Promar 200 Wall Primer with Medium Texture. (Vinyl Acrylic Latex Wall Primer.)
 - 2. Two coats SW Promar 200 Semi-Gloss Latex Enamel.
 - D. Tape and Float: Joints on Gypsum Board.
 - 1. As per manufacturer's instructions.
 - 2. All joints shall be sanded ready for primer's finish.
 - E. Interior Millwork and Cabinetry:
 - 1. One coat SW Promar 200 Alkyd Enamel Primer/Undercoat.
 - 2. Two coats SW Promar 200 Semi-Gloss Latex Enamel.

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SECTION 09900 - PAINTING

- F. Enamel on Wood Trim:
 - 1. One coat SW Promar 200 Alkyd Enamel Primer/Undercoat.
 - 2. Two coats SW Promar 200 Semi-Gloss Latex Enamel.
- G. Back-Painting, Interior Work:
 - 1. Two coats SW Promar 200 Alkyd Enamel Primer/Undercoat.
- H. Enamel on Exposed Metal Piping:
 - 1. One coat SW Galvite primer.
 - 2. Two coats SW Promar 200 Semi-Gloss Latex Enamel.
- I. Intumescent on Exposed Foam-In-Place Insulation: refer to Section 07219 Foam-In-Place Insulation.

Part 3 - Execution

3.01 Inspection:

- A. Notify Contractor of any surface not in proper condition to be finished before proceeding with the work. Starting work will constitute the painter's acceptance of preceding work, and conditions under which finish will be applied and his assumption of responsibility for results to be obtained.

3.02 Preparation of Surfaces:

- A. Wood:
 - 1. Sand to a smooth even surface, then dust off.
 - 2. Touch-up knots, resinous spots, etc., on all surfaces with shellac 18 hours before applying prime coat.
 - 3. Fill nail holes, cracks and blemishes flush after priming coat has dried.
- B. Concrete Block and Concrete:
 - 1. Repair cracks and irregularities to provide uniform surface texture.
- C. Ferrous Metal Surfaces:
 - 1. Remove rust and scale, clean grease or oil surfaces with turpentine or benzine before painting.
- D. Existing Prefinished Metal Wall Panels:
 - 1. Inspect existing surface to confirm it is in a sound condition and clean the surface of all foreign material.
 - 2. Dull surface by abrading and fill all holes, cracks, and blemishes.
 - 3. Apply a test area, allowing paint to dry one week before testing adhesion. If adhesion is poor or if this product attacks the previous finish, removal of the previous coating may be necessary. Coordinate with Architect and paint manufacturer.
 - 4. If existing coating is found to be peeling, clean surface to sound substrate and treat as new surface as directed by paint manufacturer.

3.03 Application:

- A. Number of coats and quality of finish shall be in accordance with these specifications, which requires the use of material which will produce first quality finish if properly applied.
- B. Apply coats of material in strict accordance with

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SECTION 09900 - PAINTING

manufacturer's currently published specifications, except where requirements of these specifications are in excess or manufacturer's requirements.

- C. Except as otherwise approved by the Architect, the first two coats of painter's finish shall be applied by roller or brush application. Finish coats may be applied by spray application.
 - D. Comply with recommendation of product manufacturer for drying time between succeeding coats allow additional as required until finish is dry.
 - E. All work where a coat of material has been applied must be inspected and approved before application of succeeding coat, otherwise, no credit for the coat will be given. Notify Architect when a particular coat has been completed for inspection and approval.
 - F. Shellacs, oils, turpentine, etc., shall be of the highest quality and subject to approval of Architect. Materials shall be mixed in and applied directly from containers which they are purchased except when use of other containers is approved.
 - G. First Coat of all finishes, except of varnish and stains, shall be white.
 - H. Sand lightly between coats where shellac, varnish or enamel is used.
 - I. Remove all hardware, accessories, machined surfaces, and similar items in place and not to be finish-painted or provide surface-applied protection prior to surface preparation and painting operations.
- 3.04 Clean-up:
- A. Clean and paint spots from work and touch-up or otherwise repair any defective or damaged work.
 - B. Remove all surplus materials and equipment after work is completed.
 - C. Leave entire job clean and acceptable to the Architect.

End of Section

SECTION 26 05 00

ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Except as modified in this Section, General Conditions, and Supplementary Conditions, applicable provisions of Division 1 General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 26 Electrical.
- B. Applicable provisions of this section apply to all sections of Division 26, Electrical.

1.2 CODE REQUIREMENTS AND FEES

- A. Perform work in accordance with applicable statutes, ordinances, codes and regulations of governmental authorities having jurisdiction.
- B. Electrical work shall comply with applicable inspection services:
 - 1. Underwriters Laboratories.
 - 2. National Fire Protection Association.
 - 3. State Health Department.
 - 4. Local Municipal Building Inspection Department adopted codes with amendments.
 - 5. National Electrical Code with local amendments.
 - 6. State Regulatory Agencies.
 - 7. Where the project is located outside a municipal jurisdiction, and has no municipal inspection services, the National Electrical Code with amendments of the municipality with extraterritorial jurisdiction shall govern.
 - 8. Where the project is located outside any municipal jurisdiction, including extraterritorial jurisdictions, the National Electrical Code with local adopted amendments of the largest municipality located in the same county or parish shall govern.
 - 9. International Energy Conservation Code.
 - 10. National Electrical Safety Code.
- C. Resolve any code violations discovered in contract documents with the Engineer prior to award of the contract. After Contract award, any correction or additions necessary for compliance with applicable codes shall be made at no additional cost to the Owner.
- D. This Contractor shall be responsible for being aware of and complying with asbestos NESHAP regulations, as well as all other applicable codes, laws and regulations.
- E. Obtain all permits required.

1.3 CONTRACTOR'S QUALIFICATIONS

- A. An approved contractor for the work under this division shall be:
 - 1. A specialist in this field and have the personnel, experience, training, and skill, and the organization to provide a practical working system.
 - 2. Able to furnish evidence of having contracted for and installed not less than 3 systems of comparable size and type that has served their Owners satisfactorily for not less than 3 years.

1.4 REFERENCE SPECIFICATIONS AND STANDARDS

- A. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, APWA, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date proposals are received. Referenced specifications and standards are minimum requirements for all equipment, material and work. In instances where specified capacities, size or other features of equipment, devices or materials exceed these minimums, meet specified capacities.
- B. Use electrical materials and equipment that is constructed and tested in accordance with the standards of NEMA, ANSI, ASTM, or another recognized commercial standard. If materials and equipment is labeled, listed, or recognized by any Nationally Recognized Testing Laboratory (NRTL) acceptable to the Occupational Safety and Health Administration (OSHA), then provide NRTL-labeled, listed, or recognized material and equipment. Acceptable NRTLs include but are not limited to:
1. Underwriters Laboratories, Inc. (UL).
 2. Factory Mutual Research Corp. (FMRC) (also referred to as "Factory Mutual Global," or "FM Global").
 3. Intertek Testing Services NA, Inc. (ITSNA, formerly ETL).
 4. Canadian Standards Association (CSA).
 5. A complete listing of acceptable NRTLs is published on the OSHA website at <http://www.osha.gov/dts/otpca/nrtl/>.
- C. Where material and equipment are not labeled, listed, or recognized by any NRTL, provide a manufacturer's Certificate of Compliance indicating complete compliance of each item with applicable standards of NEMA, ANSI, ASTM, or other recognized commercial standard.
- D. Do not install or use electrical material or equipment for any use other than that for which it was designed, labeled, listed, or identified unless formally approved for such use by the Owner's AHJ. This *National Electrical Code*® requirement is re-stated for emphasis.
- E. Codes and Standards applicable to this Division:
1. ANSI – American National Standards Institute
 - a. ANSI Z535.1, Safety Colors
 - b. ANSI Z535.2, Environmental and Facility Safety Signs
 - c. ANSI Z535.3, Criteria for Safety Symbols
 - d. ANSI Z535.4, Product Safety Signs and Labels.
 2. ASHRAE – American Society of Heating, Refrigeration, and Air Conditioning Engineers:
 - a. ASHRAE Standard 90.1, *Energy Standards for Buildings Except for Low Rise Residential Buildings* [ANSI, IESNA].
 3. ASTM – American Society for Testing and Materials.
 4. CBM – Certified Ballast Manufacturers.
 5. ICC – International Code Council
 - a. International Building Code® (IBC)
 - b. International Existing Building Code® (IEBC).
 6. ICEA – Insulated Cable Engineers Association
 - a. ICEA S-93-639, *Shielded Power Cables 5-46kV* (NEMA WC-74).
 7. IEEE® - Institute of Electronics and Electrical Engineers
 - a. IEEE C2™, *National Electrical Safety Code* (NESC) [ANSI]
 - b. IEEE Std 141™, *Recommended Practice for Electric Power Distribution for Industrial Plants* ("Red Book")
 - c. IEEE Std 143™, *Recommended Practice for Grounding of Industrial and Commercial Power Systems* ("Green Book")

- d. IEEE Std 241™, *Recommended Practice for Electric Power Systems in Commercial Buildings* (“Gray Book”)
- e. IEEE Std 242™, *Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems* (“Buff Book”)
- f. IEEE Std 315™, *Graphic Symbols for Electrical and Electronics Diagrams*
- g. IEEE Std 399™, *Recommended Practice for Power Systems Analysis* (“Brown Book”)
- h. IEEE Std 446™, *Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications* (“Orange Book”)
- i. IEE Std 493™, *Recommended Practice for the Design of Reliable Industrial and Commercial Power Systems* (“Gold Book”)
- j. IEEE Std 519™, *Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems*
- k. IEEE Std 739™, *Recommended Practice for Energy Management in Industrial and Commercial Facilities* (“Bronze Book”)
- l. IEEE Std 902™, *Guide for Maintenance, Operation, and Safety of Industrial and Commercial Power Systems* (“Yellow Book”)
- m. IEEE Std 1015™, *Recommended Practice Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems* (“Blue Book”)
- n. IEEE Std 1100™, *Recommended Practice for Powering and Grounding Electronic Equipment* (“Emerald Book”)
- o. IEEE Std 1584™, *Guide for Performing Arc-Flash Hazard Calculations.*
- 8. IESNA – Illuminating Engineering Society of North America
 - a. IESNA *Lighting Handbook*, Ninth Edition
 - b. IESNA RP-1, *American National Standard Practice for Office Lighting*
 - c. IESNA RP-7, *American National Standard Practice for Lighting Industrial Facilities.*
- 9. NECA – National Electrical Contractors Association:
 - a. NECA 1, *Good Workmanship in Electrical Construction* [ANSI]
 - b. NECA 90, *Recommended Practice for Commissioning Building Electrical Systems* [ANSI]
 - c. NECA 100, *Symbols for Electrical Construction Drawings* [ANSI]
 - d. NECA 101, *Standard for Installing Steel Conduits (Rigid, IMC, EMT)* [ANSI]
 - e. NECA 104, *Recommended Practice for Installing Aluminum Building Wire and Cable* [ANSI]
 - f. NECA / NEMA 105, *Recommended Practice for Installing Metal Cable Tray Systems* [ANSI]
 - g. NECA 111, *Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC)* [ANSI]
 - h. NECA / NACNA 120, *Standard for Installing Armored Cable (Type AC) and Metal-Clad Cable (Type MC)* [ANSI]
 - i. NECA 202, *Recommended Practice for Installing and Maintaining Industrial Heat Tracing Systems* [ANSI]
 - j. NECA 230, *Standard for Selecting, Installing and Maintaining Electric Motors and Motor Controllers* [ANSI]
 - k. NECA 331, *Standard for Building and Service Entrance Grounding and Bonding*
 - l. NECA 400, *Standard for Installing and Maintaining Switchboards* [ANSI]
 - m. NECA 402, *Standard for Installing and Maintaining Motor Control Centers* [ANSI]
 - n. NECA / EGSA 404, *Standard for Installing Generator Sets* [ANSI]

- o. NECA 407, *Recommended Practice for Installing and Maintaining Panelboards* [ANSI]
- p. NECA 408, *Recommended Practice for Installing and Maintaining Busways* [ANSI]
- q. NECA 409, *Recommended Practice for Installing and Maintaining Dry-Type Transformers* [ANSI]
- r. NECA 410, *Recommended Practice for Installing and Maintaining Liquid-Filled Transformers* [ANSI]
- s. NECA 411, *Recommended Practice for Installing and Maintaining Uninterruptible Power Supplied (UPS)* (ANSI)
- t. NECA 420, *Standard for Fuse Applications* [ANSI]
- u. NECA 430, *Standard for Installing Medium-Voltage Metal-Clad Switchgear* [ANSI]
- v. NECA / IESNA 500, *Recommended Practice for Installing Indoor Lighting Systems* [ANSI]
- w. NECA / IESNA 501, *Recommended Practice for Installing Exterior Lighting Systems* [ANSI]
- x. NECA / IESNA 502, *Recommended Practice for Installing Industrial Lighting Systems* [ANSI]
- y. NECA / MACSCB 600, *Recommended Practice for Installing and Maintaining Medium-Voltage Cable* [ANSI]
- z. NECA / NEMA 605, *Installing Underground Nonmetallic Utility Duct* [ANSI].
- 10. NEMA – National Electrical Manufacturers Association.
- 11. NETA – International Electrical Testing Association, Inc.:
 - a. NETA ATS, *Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems*
 - b. NETA MTS, *Maintenance Testing Specifications for Electrical Power Distribution Equipment and Systems*
 - c. NETA ETT, *Standard for Certification of Electrical Testing Technicians* [ANSI].
- 12. NFPA – National Fire Protection Association:
 - a. NFPA 20®, *Standard for the Installation of Stationary Pumps for Fire Protection*®
 - b. NFPA 70™, *National Electrical Code*® (NEC®)
 - c. NFPA 70E, *Standard for Electrical Safety in the Workplace*.
 - d. NFPA 101®, *Life Safety Code*®
 - e. NFPA 110, *Standard for Emergency and Standby Power Systems*
 - f. NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*
 - g. NFPA 780, *Standard for the Installation of Lightning Protection Systems*
 - h. All other NFPA codes and standards except NFPA 5000.
- 13. OSHA – Occupational Safety and Health Administration.
- 14. IECC – International Energy Conservation Code.
- 15. ISO – International Organization for Standardization.
- 16. State and Local Energy Conservation Code.
- 17. Applicable County and Municipal Codes.

1.5 CONTRACT DRAWINGS

- A. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work. Determine exact locations from field measurements.
- B. Every effort has been made by the Engineer to indicate wiring of all receptacles, light fixtures, switches, telephone outlets, HVAC equipment, other equipment, elevator equipment, and all other devices / appliances requiring electrical power. It is the intent of

the Engineer that all light fixtures be powered and controlled unless specifically noted on the plans; that all wiring devices (receptacles and direct connected equipment) be circuited to a power source of the correct voltage and that all HVAC, elevator equipment and other equipment be properly wired to the correct voltage power source; that all communications and security systems devices and equipment and all fire alarm system devices and equipment are installed, wired and systems are fully operational.

- C. It is the responsibility of the Contractor to review the construction drawings (reflected ceiling plans) for light fixtures, casework elevation details for electrical devices which are not indicated on the electrical drawings; to review the mechanical and plumbing documents and all other drawings to determine the electrical rough-ins for all equipment requiring power connections, and to include in their proposals the correct and complete electrical rough-ins for all of these items which were inadvertently not indicated on the electrical drawings, OR the Contractor shall specifically enumerate each item requiring electrical rough-in which is not specifically shown on the electrical drawings, and indicate the electrical provisions of these items as specifically excluded from his proposal.
- D. It is the responsibility of the Contractor to compare the scale of all electrical drawings with the scale of the architectural drawings and make adjustments to all electrical drawings which have the incorrect drawing scale so that his material takeoffs are not in error due to an incorrectly labeled drawing scale and his proposal is complete.
- E. No proposal shall be accepted which specifically excludes any of the provisions of paragraphs B, C, or D above.

1.6 PROJECT RECORD DOCUMENTS

- A. Maintain at the job site a separate set of white prints (black line) of the contract drawings for the sole purpose of recording the "as-built" changes and diagrams of those portions of work in which actual construction is significantly at variance with the contract drawings. Mark the drawings with a colored pencil. Prepare, as the work progresses and upon completion of work, reproducible drawings clearly indicating locations of various major and minor feeders, equipment, and other pertinent items, as installed. Record underground and under slab service and feeders installed, dimensioning exact location and elevation of such installations.
- B. At conclusion of project, obtain without cost to the Owner, electronic PDF and AutoCAD 2014 and / or Revit CAD files of the original drawings and transfer as-built changes to these. Provide the following as-built documents including all contract drawings regardless of whether corrections were necessary and include in the transmittal: "2 sets of CDs and prints for Owner's use, one set of CDs, prints, and mylars for Architect / Engineers Records". Delivery of these as-built electronic, reproducible and prints is a condition of final acceptance.
 - 1. 3 sets of electronic AutoCAD (2014 dwg) and / or Revit CAD drawing files, on CD-ROM media, of each contract as-built drawing.
 - 2. One reproducible Dayrex Mylar film positive of each contract as-built drawing.
 - 3. Three sets of blue-line prints of each contract as-built drawing.
 - 4. Three sets of pdf prints of each contract as-built drawing on CD.
- C. As-Built Drawings should indicate the following information as a minimum:
 - 1. Indicate all addendum changes to documents.
 - 2. Remove Engineer's Seal, name, address, and logo from drawings.
 - 3. Mark documents RECORD DRAWINGS.
 - 4. Clearly indicate: DOCUMENT PRODUCED BY: .
 - 5. Indicate all changes to construction during construction. Indicate actual routing of all conduits, etc. that was deviated from construction drawings.

6. Indicate exact location of all underground electrical raceways, and elevations.
7. Correct schedules to reflect (actual) equipment furnished and manufacturer.
8. During the execution of work, maintain a complete set of Drawings and specifications upon which all locations of equipment, devices, and all deviations and changes from the construction documents in the work shall be recorded.
9. Exact location of all electrical equipment in building. Label panel schedules to indicate actual location.
10. Exact location of all electrical equipment in and outside of the building.
11. Exact location of all outdoor lighting poles and equipment.
12. Location, size and routing of all feeder conduits, equipment, etc. shall be accurately and neatly shown to dimension.
13. Exact location of all roof mounted equipment, wall, roof and floor penetrations.
14. Cloud all changes.
15. Update all panel schedules with all additional circuits added or deleted through construction. Identify each circuit to include all information specified for directory cards for circuit identification in panelboards.

1.7 SPACE REQUIREMENTS

- A. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material that is not suitable in this respect.

1.8 RELATION WITH OTHER TRADES

- A. Carefully study all matters and conditions concerning the project. Submit notification of conflict in ample time to prevent unwarranted changes in any work. Review other Divisions of these specifications to determine their requirements. Extend electrical services and final connections to all items requiring same.
- B. Because of the complicated relationship of this work to the total project, conscientiously study the relation and cooperate as necessary to accomplish the full intent of the documents.
- C. Provide sleeves and inserts in forms as required for the work. Stub up and protect open ends of pipe before any concrete is placed. Furnish sizes of required equipment pads. Furnish and locate bolts and fittings required to be cast in them.
- D. Locate and size openings required for installation of work specified in this Division in sufficient time to prevent delay in the work.
- E. Refer to other Divisions of the specifications for the scope of required connections to equipment furnished under other Division. Determine from the General Contractor / Construction Manager for the various trades, the Owner, and by direction from the Architect / Engineer, the exact location of all items. The construction trades involved shall furnish all roughing-in drawings and wiring diagrams required for proper installation of the electrical work.
 1. Make final electrical connections to all electrically operated equipment indicated on the drawings, except as noted.
 2. The responsibility for alignment of motor and driven equipment is specified in the related division.
- F. Request all Shop Drawings required in ample time to permit proper installation of all electrical provisions.

- G. Extend services as indicated to the various items of equipment furnished by others. Rough-in for the various items and make final connections ready for operation upon placing of the equipment.

1.9 CONCEALED AND EXPOSED WORK

- A. When the word "concealed" is defined as hidden from sight as in chases, furred spaces or above ceilings. "Exposed" is defined as open to view, in plain sight.

1.10 GUARANTEE

- A. Guarantee work for 1 year from the date of substantial completion of the project. During that period make good any faults or imperfections that may arise due to defects or omissions in material, equipment or workmanship. Replacement of failed parts or equipment shall be provided.

1.11 MATERIAL AND EQUIPMENT

- A. Furnish new and unused materials and equipment meeting the requirements of the paragraph specifying acceptable manufacturers. Where two or more units of the same type or class of equipment are required, provide units of a single manufacturer.

1.12 NOISE AND VIBRATION

- A. Select equipment to operate with minimum noise and vibration. If noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, and judged objectionable by the Owner, Architect, or Engineer, rectify such conditions at no additional cost to the Owner. If the item of equipment is judged to produce objectionable noise or vibration, demonstrate at no additional cost that equipment performs within designated limits on a vibration chart.

1.13 ACCEPTABLE MANUFACTURERS

- A. Manufacturers names and catalog number specified under sections of Division 26 are used to establish standards of design, performance, quality and serviceability and not to limit competition. Where equipment or accessories are used which differ in arrangement, configuration, dimensions, ratings, or engineering parameters from those indicated on the Contract Documents, the Contractor is responsible for all costs involved in integrating the equipment or accessories into the system and for obtaining the intended performance from the system into which these items are placed. Any redesign costs associated with the integration of substitute equipment into the existing Contract Documents, shall be billed by the Architect/Engineers, on an hourly basis, to the substituting contractor. Resulting change orders from the redesign are the sole responsibility of the substituting contractor.
- B. Written notification of intent to use manufacturers other than those specified is required ten days prior to bid. Submittals shall be reviewed only after bidding and may be rejected if any aspect of the equivalent product is deemed lesser than that of the specified product by the specifier. The contractor shall be responsible for ensuring alternates are equivalent to those specified. Submit a marked-up set of the relevant specification section indicating all variances, a comparison to the specified product, and of construction and performance criteria, complete design and performance data for the specified product and the proposed substitution for comparison to the Engineer. The Architect issues approvals of acceptable manufacturers as addenda to the Construction Proposal Documents.

1.14 UTILITIES, LOCATIONS AND ELEVATIONS

- A. Locations and elevations of the various utilities included within the scope of this work:
 - 1. Obtained from utility maps and other substantially reliable sources.
 - 2. Are offered separate from the Contract Documents as a general guide only without guarantees to accuracy.
- B. Examine the site and verify the location and elevation of all utilities and of their relation to the work. Existing utilities indicated on the site plans are for reference only and shall be field verified by the Contractor with the respective public or private utility.

1.15 OPERATING TESTS

- A. After all electrical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequencing and operation throughout the range of operation. Tests shall be made in the presence of the Architect / Engineer and Owner. Provide minimum 24-hour advance notice of scheduling of all tests. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections. Submit 3 copies of all certifications and test reports adequately in advance of completion of the work to allow for remedial action as required to correct deficiencies discovered in equipment and systems.

1.16 WARRANTIES

- A. All normal and extended warranties shall include parts, labor, miscellaneous materials, travel time, incidental expenses, normal freight / shipping, refrigerant, oils, lubricants, belts, filters and any expenses related to service calls required to diagnose and correct warranty problems.
- B. Manufacturer's warranty shall be from one year from date of substantial completion. Contractor shall be responsible for extending the warranties regardless of date of installation or commissioning.
- C. Submit 3 copies of all warranties and guarantees for systems, equipment, devices and materials. These shall be included in the Operating and Maintenance Manuals.

1.17 BUILDING CONSTRUCTION

- A. It shall be the responsibility of the sub-contractor to consult the Contract Drawings, details and specifications and thoroughly familiarize himself as to the construction and all job-related requirements. All construction trades shall cooperate with the General Contractor / Construction Manager Job site superintendent and lay out work so that all raceways and other items are placed in the walls, furred spaces, chases, etc., so that there shall be no delay in the job.

1.18 TEMPORARY FACILITIES

- A. General: Refer to Division 1 for general requirements on temporary facilities.
- B. Temporary Wiring: Temporary power and lighting for construction purposes shall be provided under this Division. Installation of temporary power shall be in accordance with NEC Article 527.
- C. Temporary facilities, wire, lights and devices are the property of this Contractor and shall be removed by this Contractor at the completion of the Contract.

PART 2 - PRODUCTS – NOT USED

PART 3 - EXECUTION

3.1 IDENTIFICATION OF EQUIPMENT

A. Identification of Equipment:

1. All major equipment shall have a manufacturer's label identifying the manufacturer's address, equipment model and serial numbers, equipment size, and other pertinent data. Take care not to obliterate this nameplate. The legend on all nameplates or tags shall correspond to the identification shown on the Operating Instructions. All panels, cabinets, or equipment requiring 120 volt or higher power shall be labeled as required which includes circuit designation and circuit panelboard location, regardless of which discipline installs the equipment.
2. Three layer laminated plastic engraved identifying nameplate shall be permanently secured to each switchboard, distribution panel, motor control center, transformer, panelboard, safety disconnect switch, enclosed circuit breaker, transfer switches, remote generator transfer devices not installed inside light fixtures, wireway, busduct plug, terminal cabinet, surge protective device, capacitor, individual motor controller, contactor, fire alarm panels (main and remote booster), and communications (voice, data, video) cabinet or rack, security panels, time clocks, BMCS cabinets, sound reinforcement cabinets and racks, miscellaneous control cabinets, equipment integral disconnect switches, toggle or motor switches, disconnects for equipment, exterior junction boxes, exterior pull boxes, exterior wireways and gutters, and rooftop equipment (i.e.: supply and exhaust fans, rooftop HVAC equipment) with stainless steel screws.
 - a. Utility Power: White letters on black background.
Generator Power (White letters on red background.
UPS Power: White letters on blue background.
Load Bank Circuits: White letters on green background
Solar or Wind Power Generation: White on orange background.
 - b. Identifying nameplates shall have 1/2-inch high, engraved letters for equipment designation and 1/4-inch letters indicating source circuit designation, (i.e.: "PANEL HA –fed from MDP-6 located in Mech. Rm. 100"). The words "fed from" and "located" shall be included in the labeling.
Example: Panel HA
 Fed From MSB
 Located Main Elec. RM 100
Example: Disconnect for Panel LK
 Location: Kitchen
 Fed From Transformer TLK
 Located Main Elec. RM 100
 - c. Each switchboard, distribution panel, transfer switch, generator transfer device (GTD) for emergency lighting, and motor control center feeder or branch circuit device shall have a nameplate showing the load and location of load served in 1/4-inch high, engraved letters. Circuit breaker name and kirk key designation if applicable.
 - d. Each section of multiple section panelboards shall also indicate panelboard section number (i.e.: Panel "HA-Section 2 – fed from MDP-6 located in Mech. Rm. 100").
 - e. Motor Controllers, starters, and contactors: Provide neatly typed label inside each motor controller and contactor enclosure door identifying motor or load served, nameplate horsepower, full load amperes, code letter, service factor, and voltage / phase rating.

- f. Individual motor controller and contactor nameplates shall include load served, location of load served, panel and circuit numbers serving load, location of panel serving load, panel and circuit number serving control circuit, location of panel serving control circuit (if different from panel serving load), description and location (if applicable) of control controlling contactor (i.e. Controlled: Switch in RM 100, and Controlled: BMCS). Contactor nameplate is to include whether it is a lighting or receptacle contactor and name of contactor. i.e., C-1.

Lighting Contactor Example	Receptacle Contactor Example
Lighting Contactor C1 West Parking Lot Pole Lights Fed From Panel HA-2,4,6 Located Main Elec. Rm. 100 Control Circuit-Panel LA 42 Located Main Elec. Rm. 100 Controlled-BMCS	Receptacle Contactor C2 Table Recpts Lab Rm 100 Fed From Panel LA-2,4,6,8 Located Mech. Rm. 110 Control Circuit-Panel LA-42 Controlled-Emer Shut Off Mushroom Switch Rm 101
GTD Example	
Exterior lighting wall packs / north soffit / west metal canopy Fed from Panels EHA-2 located in Elec. RM 105 and HA-1 via Lighting Contactor controlled by BMCS located in Elec. RM 200.	

- g. Exterior J-boxes, pull boxes, and gutters shall have panel identification, circuit numbers, and location of panel listed on name plate. Low voltage shall be identified per contents, examples: DATA, BMCS, F/A
- h. Name plates on equipment served from switchboards, distribution panels, I-Line panels, and motor control centers are not to include circuit numbers shown on drawings as the circuit numbers are for construction drawing purposes only.
- i. Panel names for 277/480v shall start with the letter "H" and 120/208v, 120/240v shall start with the letter "L". No panel shall be named to include a number other than multi sectional panels, example HA-section 2. New panels installed in renovation or site additions shall have names approved or designated by Owner's electrical representative. Panel names shall not include the letter "I". Transformer names shall start with the letter "T" followed by the panel name it serves, i.e., TLA.
- j. Main service ATS label shall include equipment name, emergency source and location, normal power source and location, panel served and location. Wall mounted ATS serving lighting loads shall include type of lighting and location, emergency panel and circuit ID and location of panel, normal panel and circuit ID and location of panel.
- | | |
|---|---|
| Main Service ATS Example | Wall Mounted Lighting ATS Example |
| ATS-1 | ATS |
| Emer Power-Emer Generator
Located Chiller Yard | Exterior Wall Packs/Soffit Lights
North/West Metal Canopy Lights |
| Normal Power-MSB
Located-Mech Rm 100 | Fed from EHA-2
Located Mech Rm 200 |
| Serves Panel EHA
Located-Mech Rm 100 | Fed From HB-4
Located Mech Rm 150 |
- k. Name plates shall include rated bus amperage, voltage, number of phases, number of wires and type of essential electrical system as applicable.
- l. Switchgear, switchboards, panelboards, motor control centers, or service equipment available fault current labeling: Provide a 2x3 inch

permanently affixed (notice) label with white lettering on contrasting blue background permanently affixed to the equipment prior to energizing the equipment. The label shall include the date of installation and the date of calculation and comply with ANSI Z535.4 current standards design and durability. The date of calculation shall be the date indicated by the Engineer of Record's seal on the Construction Documents. Example:

AVAILABLE FAULT CURRENT: ##, ### AMPS
DATE OF INSTALLATION: MM/DD/YY
DATE OF CALCULATION: MM/DD/YY

3. Cardholders and directory cards shall be furnished for circuit identification in panelboards. Cardholder shall be located on inside of panel door and shall be in a metal frame with clear plastic front. Circuit lists shall be typewritten. Circuit descriptions shall include explicit description and identification of items controlled by each individual breaker, including final graphics room number or name designation and name of each item served. If no building appointed room number or name is given, list locations per the following examples – A. Storage in Rm 100 – B. Office in Rm 100 – C. Storage west of Rm. 100. List corridors as "corridors". Identify circuits controlled by contactors using a separate notation for each contactor used. List notation at bottom of schedule stating the circuits are controlled by a contactor, list exact location of contactor, and how switched. Do not use architectural room number designation shown on plans. Obtain final graphics room number identification from Architect's final room number graphics plan. All locations served by breakers shall be listed on schedule. Panel schedule shall be large enough to contain all information required. Also refer to Section 26 24 16.
 4. Permanent, waterproof, black markers shall be used to identify each lighting and power grid junction box, gutter and wireway. Clearly indicate the panel and branch circuit numbers available at that junction box, gutter or wireway. Where low voltage relay panels are used for lighting control, identify the low voltage relay panel and number in addition to the branch circuit panel and number.
 5. Pull Boxes, Transformers, Disconnect Switches, etc.: Field work each with a name plate showing identity, voltage and phase and identifying equipment connected to it. The transformer rating shall be shown on the panels or enclosures. For an enclosure containing a motor starter, the nameplate shall include the Owner's motor number, motor voltage, number of motor phases, motor load being serviced, motor horsepower, and motor full load current. Nameplates shall also indicate where panel is fed from.
- B. Prohibited Markings: Markings intended to identify the manufacturer, vendor, or other source from whom the material has been obtained are prohibited for installation in public, tenant, or common areas within the project. Also prohibited are materials or devices that bear evidence that markings or insignias have been removed. Certification, testing (example, Underwriters Laboratories), and approval labels are exceptions to this requirement.
- C. Warning Signs: Provide warning signs where there is hazardous exposure associated with access to or operation of electrical facilities. Provide text of sufficient size to convey adequate information at each location, mount permanently in an appropriate and effective location. Comply with industry standards for color and design.
- D. Wire and Cable Markers: Provide vinyl cloth markers with split sleeve or tubing type, except in manholes provide stainless steel with plastic ties.

- E. Wire and Cable Labeling: Provide wire markers on each conductor in all boxes, pull boxes, gutters, wireways, contactors, and motor controllers and load connection. Identify with panelboard / switchboard branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.
- F. Underground Warning Tape: Thomas and Betts or approved equal. Six-inch wide plastic tape, colored red for 50 volts or above electrical, or orange for communications and control with suitable warning legend describing buried electrical lines; telephone lines and data lines per APWA recommendations. All underground electrical conduits shall be so identified. Tape shall be buried at a depth of 6-inches below grade and directly above conduits or ductbanks. Provide magnetic marking tape below all underground electrical conduits.
- G. Lighting Controls and Equipment: Provide self-adhesive machine typed tape labels with ¼" high white letters on ½" tall black background for digital lighting modules as "DLM". Modules or relays located above ceiling: adhere label to bottom of ceiling T-grid below relay location. Modules or relays located in mechanical or electrical rooms or other areas other than above ceiling: Adhere label to the cover of the module or relay and identify the area they control as "MAIN GYM", "BAND HALL", or "CORRIDOR 100", etc. Remote lighting control switches or push-button stations located remotely from the area they control: Adhere label to device face plate, not obstructing screw fasteners, and intuitively identify function such as "GYM LTG LOW-HIGH" or "CAFE LTG DIM", etc.

3.2 CUTTING AND PATCHING

- A. General: Comply with the requirements of Division 1 for the cutting and patching of other work to accommodate the installation of electrical work. Except as authorized by the Architect / Engineer, cutting and patching of electrical work to accommodate the installation of other work is not permitted.

3.3 INSTRUCTION OF OWNER'S PERSONNEL

- A. Prior to substantial completion, conduct an on-site training program to instruct Owner's operating personnel in the operation and maintenance of the electrical systems.
 1. Provide the training during regular working day.
 2. The instructors shall be experienced in their phase of operation and maintenance of the electrical systems and with the project.
 3. Refer to other specification sections for additional training and commissioning requirements.
- B. Time to be allocated for instructions.
 1. Minimum of 20 hours dedicated instructor time.
 2. 4 hours on each of 5 days.
 3. Additional instruction time for specific systems as specified in other Sections.
- C. Before on-site training, submit the program syllabus; proposed time and dates; for review and approval, minimum 48 hours prior to proposed training time and date.
 1. One copy to the Owner.
 2. One copy to the Architect / Engineer.
- D. The Owner shall provide a list of personnel to receive instructions and shall coordinate their attendance at the agreed upon times.
- E. Use operation and maintenance manuals as the basis of instruction. Review manual with personnel in detail. Explain all aspects of operation and maintenance.

- F. Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, maintenance, and shut down of each item of equipment.
- G. Demonstrate equipment functions (both individually and as part of the total integrated system).
- H. Prepare and insert additional data in the operating and maintenance manuals when the need for additional data becomes apparent during instructions.
- I. Submit a report within one week after completion of training. List time and date of each demonstration, hours devoted to the demonstration, and a list of people present, with their respective signatures.
- J. At the conclusion of the on-site training program, have the person designated by the Owner sign a certificate to certify that he / she has a proper understanding of the system, that the demonstrations and instructions have been satisfactorily completed, and the scope and content of the operating and maintenance manuals used for the training program are satisfactory.
- K. Provide a copy of the report and the certificate in an appropriately tabbed section of each Operating and Maintenance Manual.

3.4 OPENINGS

- A. Framed, cast or masonry openings for boxes, equipment or conduits are specified under other divisions. Drawings and layout work for exact size and location of all openings are included under this division.

3.5 HOUSEKEEPING PADS

- A. Provide concrete equipment housekeeping pads under all floor and outdoor mounted electrical equipment.
- B. Concrete and reinforcing steel shall be as specified in Division 3, or as indicated or noted.
- C. Concrete pads:
 1. 6-inches thick minimum indoors; 8-inches thick minimum outdoors or match existing if indicated on the drawings to extend existing pads, or in other sections of the specifications.
 2. Chamfer strips at edges and corner of forms.
 3. Smooth steel trowel finish.
 4. Extend 3-inches minimum indoors beyond perimeter of equipment unless otherwise shown.
 5. 6-inch x 6-inch #8 wire reinforcement mesh.

3.6 OBSTRUCTIONS

- A. The drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.
 1. Before any cutting or trenching operations are begun, verify with Owner's representative, utility companies, municipalities, and other interested parties that all available information has been provided.
 2. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise

perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

- B. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.7 VANDAL RESISTANT DEVICES

- A. Where vandal resistant screws or bolts are employed on the project, deliver to the Owner 2 suitable tools for use with each type of fastener used, and 25 percent spare fasteners.
- B. Proof of delivery of these items to the Owner shall be included in the Operating and Maintenance Manuals.

3.8 PROTECTION

- A. Protect work, equipment, fixtures, and materials. At work completion, work must be clean and in original manufacturer's condition.
- B. Do not deliver equipment to this project site until progress of construction has reached the stage where equipment is actually needed or until building is closed in enough to protect the equipment from weather. Equipment allowed to stand in the weather shall be rejected, and the contractor is obligated to furnish new equipment of a like kind at no additional cost to the Owner.

3.9 COORDINATION OF BRANCH CIRCUIT OVERCURRENT AND PROTECTION DEVICES

- A. Review with equipment specified which requires electrical connections. Review equipment shop drawings and manufacturer's nameplate data and coordinate exact branch circuit overcurrent protective device and conductors with equipment provided.
 1. Provide equipment manufacturer's recommended overcurrent protective device indicated on nameplate at no additional cost to the Owner.
 2. If branch circuit conductors and / or conduit sizing is less than the minimum required by equipment manufacturer, notify the Architect / Engineer immediately, prior to rough-in.
 3. If equipment manufacturer is a substitution to the specified equipment manufacturer, provide the greater of the conductors specified or those required for the installed equipment manufacturer's minimum circuit conductors, at no additional cost to the Owner.
 4. If conductors indicated on plans are in excess of that permitted by equipment manufacturer, notify Architect / Engineer immediately, prior to rough-in.
 5. If conductors indicated on plans are in excess of that permitted by the equipment manufacturer, provide the maximum conductors permitted by the equipment manufacturer based on NEC ampacity tables, either in a single set, or as a set of parallel conductors as permitted by the NEC. Conductor size and quantity entering the equipment enclosures shall not exceed the equipment manufacturer's maximum recommendations.

3.10 FAULT CURRENT AND ARC FLASH STUDY FOR OVERCURRENT DEVICE COORDINATION

- A. Contractor shall provide a coordination study, fault current analysis, and Arc-Flash study report for new electrical distribution equipment downstream to the last new overcurrent device in each feeder or branch circuit, conducted and prepared by the switchgear manufacturer. The coordination study and fault current analysis shall include the manufacturer's recommendations for all adjustable overcurrent devices specified or provided. Study does not require inclusion of existing switchgear, except it shall include

existing or new overcurrent devices in existing switchgear serving new switchgear. Contractor shall submit the report results prior to submitting switchgear submittals to allow changes or modifications to equipment selection.

- B. Contractor shall adjust all overcurrent device settings based on manufacturer's recommendations, or as directed by Owner / Architect at no additional cost to Owner. Settings for GFI shall be set at maximum as permitted by the NEC.
- C. Arc-Flash & Shock-Hazard Warning Labels: Provide arc-flash and shock hazard-warning labels that comply with ANSI Z535.4 on switchgear, switchboards, transformers, motor control centers, panelboards, motor controllers, safety switches, industrial control panels and other equipment that is likely to require examination, adjustment, servicing, or maintenance while energized. Locate the marking to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment. On renovation projects, install arc-flash warning labels on existing equipment where lock-out / tag-out will be required for the renovation work. Provide the information listed below on each label. Specify that arc-flash warning label information be produced by the electrical equipment manufacturer or supplier as a part of the final power system studies to be submitted by the Contractor in accordance with the electrical acceptance testing.
 - 1. Note: In addition to the final arc-flash analysis, the final power system studies include load flow and fault-current calculations, and an overcurrent protective device (OCPD) coordination study based on the actual equipment to be installed for the project.
- D. Information to be determined and applied to electrical equipment:
 - 1. Arc-Flash Protection Boundary.
 - 2. Arc-Flash incident energy calculated in accordance with IEEE Std 1584TM
 - 3. Working distance calculated in accordance with IEEE Std 1584aTM
 - 4. NFPA 70E Hazard / Risk Category Number or the appropriate personal protective equipment (PPE) for operations with doors closed and covers on.
 - a. Typical operations include operating circuit breakers, fused switches, and meter selector switches.
 - 5. System phase-to-phase voltage.
 - 6. Condition(s) when a shock hazard exists (e.g., "With cover off").
 - 7. Limited Approach Boundary as determined from NFPA 70E, Table 130.2(C).
 - 8. Restricted Approach Boundary as determined from NFPA 70E, Table 130.2(C).
 - 9. Prohibited Approach Boundary as determined from NFPA 70E, Table 130.2(C).
 - 10. Unique equipment designation or code (described under "Component Identification").
 - 11. Class for insulating gloves based on system voltage (e.g., Class 00 up to 500V).
 - 12. Voltage rating for insulated or insulating tools based on system voltage (e.g., 1000V).
 - 13. Date that the hazard analysis was performed.
 - 14. "Served from" circuit directory information including the serving equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
 - 15. If applicable, the "serves" circuit directory information including the served equipment designation, location (e.g., room number), circuit number, and circuit voltage / number of phases / number of wires.
 - 16. An abbreviated warning label may be used where it has been determined that no dangerous arc-flash hazard exists in accordance with IEEE 1584aTM, paragraph 9.2.3.
 - 17. Use a "DANGER" label where the calculated arc-flash incident energy exceeds 40 cal/cm.

- E. Submittals: Submit four copies of coordination study and certified fault current study results to the Architect for review.

3.11 EQUIPMENT BACKBOARDS

- A. Backboards: ¾ inch, fire retardant, exterior grade plywood, painted gray, both sides.
 - 1. Provide minimum of two 4-ft. by 8-ft. sheets of plywood for each new telephone equipment terminal location.
 - 2. Provide minimum of two 4-ft. by 4-ft. sheets of plywood for each new data / voice / video / communications equipment location / cable TV head end equipment, or security equipment location.

3.12 TESTING

- A. The contractors for the various sub-systems shall submit proposed testing procedures for their systems, subject to review and approval and Owner acceptance. The contract will not be declared to be substantially complete until the functional operation of the subsystems have been demonstrated and verified and reports have been provided, reviewed and accepted.
- B. The project will not be declared substantially complete until the following has taken place.
 - 1. The "As-Built" drawings have been submitted, reviewed and accepted by the Architect / Owner / Owner's Construction Representative.
 - 2. The building emergency lighting system and other systems including but not limited to those listed below have been tested, completed factory start-up and programming and adjusting as required for a complete and fully operational system acceptable to the Architect and Owner.
 - a. Occupancy Sensor and Lighting Controls.
 - b. Surge protective device equipment.
 - c. Overcurrent devices.
 - d. Motor Controllers.
 - e. Emergency Lighting.
 - f. Building Fire Alarm System.
 - g. Clock System.
 - h. Television Distribution System.
 - i. Building Data / Voice Cabling System.
 - j. Surveillance and Security System.
 - k. Intercom / Telephone.
 - l. Sound Reinforcement Systems.
 - m. Building Lightning protection System.

3.13 LOAD BALANCING

- A. Balance the loads on each low-voltage feeder so that the voltage on each phase is within +/- 1.0% of the average voltage of the three phases. Refer to the DOE Office of Industrial Technologies, "Motor Tip Sheet #7" dated September 2005 available for download to PDF format at no charge at:
http://www1.eere.energy.gov/industry/bestpractices/pdfs/eliminate_voltage_un_balanced_motor-systemts7.pdf .

END OF SECTION

SECTION 26 05 12

ELECTRICAL SHOP DRAWINGS, COORDINATION DRAWINGS & PRODUCT DATA

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Prepare submittals as required by Division 01 and as outlined below.
- B. Provide individual submittals based on the project specification section number and description and only items specified or required in that specific project specification section.
- C. Submit product data shop drawings only for the following items indicated below when included as part of the project specifications, and for items specifically requested elsewhere in the Contract Drawings and Specifications. Architect / Engineer reserves the right to refuse shop drawings not requested for review, typically for basic materials and commodity off-the-shelf materials, and/or to imply that materials shall be provided as specified without exception.
- D. The term submittal, as used herein, refers to all:
 - 1. Shop Drawings.
 - 2. Coordination Drawings.
 - 3. Product data.
- E. Submittals shall be prepared and produced for:
 - 1. Distribution as specified.
 - 2. Inclusion in the Operating and Maintenance Manual, in the related O&M manual section.

1.2 ARCHITECT / ENGINEER REVIEW OF SUBMITTALS

- A. The Architect / Engineer will:
 - 1. Review requested submittals with reasonable promptness. Specific equipment submittal within a materials specification section that may be required to be expedited shall be submitted separately without other submittal items not requiring the same prompt attention.
 - 2. Affix stamp and initials or signature and indicate requirements for resubmittal or exceptions to submittal as submitted.
 - 3. Return submittals to Contractor for distribution or for resubmission.
- B. Review of submittals will not extend to design data reflected in submittals that is peculiarly within the special expertise of the Contractor or any party dealing directly with the Contractor.
- C. Architect / Engineer's review is only for conformance with the design concept of the project and for compliance with the information given in the contract.
 - 1. The review shall not extend to means, methods, sequences, techniques or procedures of construction or to safety precautions or programs incident thereto.
 - 2. The review shall not extend to review of quantities, dimensions, weights or gauges, fabrication processes, or coordination with the work of other trades.
- D. The review of a separate item as such will not indicate approval of the assembly in which the item functions.

1.3 SUBSTITUTIONS

- A. Do not make requests for product or material substitution employing the procedures of this Section. The procedure for making a formal request for substitution is specified in Division 01.

PART 2 - PRODUCTS

- A. Each individual submittal shall be an individual specific electronic data file with the file name resembling the product specification section number and title. Refer to Division 01 for additional data file format and media requirements.

PART 3 - EXECUTION

3.1 SPECIFICATION COMPLIANCE REVIEW

- A. Do not submit an outline form of compliance, submit a complete copy with the product data.
- B. Mark up a complete copy of the complete specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect / Engineer / Owner (Does Not Comply, Explanation:).
- C. Variances for product or materials typically include updated model numbers or updated versions of the specified product from the same manufacture or an equal or better product from the approved manufactures list. Substitutions from manufacture's not on the approved manufacture's will not be reviewed unless prior approval using one of the procedures for substitutions or changes in the contract documents are followed as required in Division 01.

3.2 COMPOSITE COORDINATION DRAWINGS

- A. Produce a set of composite coordination drawings for above ceiling, below ceiling, and below floor of electrical, mechanical, and technology equipment rooms and equipment yards for review and comment within four (4) weeks of receipt of Owner's official Notice to Proceed. Show coordination of items including but not limited to structural and architectural elements, all mechanical and plumbing piping, ductwork, equipment, electrical conduit, low voltage communications and safety/security systems cabling, cable trays, lighting, electrical switchgear, generators and UPSs, and any public or private building utility services.
 1. Prepare the composite plans at one-quarter inch (1/4") equals one-foot scale. Include larger scale sections with vertical elevations of elements as required to confirm coordinate of all elements.
 2. For each room containing major electrical switchgear and each outside equipment area with major electrical switchgear and other equipment also include NEC working space, NEC equipment space, and NEC access to NEC working space, and housekeeping pad location and dimensions.
 3. Prepare coordination drawings to coordinate installations for efficient use of available space allowing for future additional equipment wherever possible, for proper sequence of installation, and to resolve conflicts. Coordinate with work specified in other sections and other divisions of the specifications.
 4. Identify field dimensions. Show relation to adjacent or critical features of work or products.

- B. Submit composite coordination shop drawings in plan, elevation and sections, showing receptacles, outlets, electrical and telecommunication devices in casework, cabinetwork and built-in furniture.
 - 1. Verify location of wiring devices and outlets, communication devices and outlets, safety and security devices, and other work specified in this Division.
 - 2. Coordinate with drawing details, site conditions, composite coordination drawings, and millwork other equipment shop drawings prior to installation.
 - 3. Submit coordination and shop drawings prior to rough-in and fabrication.

3.3 EQUIPMENT SHOP DRAWINGS AND PRODUCT DATA

- A. Submittals shall not be combined or bound together with any other material submittal. Do not submit entire product catalogs, submit only specific data sheets indicating required product information and available product options or accessories.
- B. Submittal Specification Information:
 - 1. Every submittal document shall bear the following information as used in the project manual:
 - a. The related specification section number.
 - b. The exact specification section title.
 - c. Additional identifiers as required in Division 01.
 - 2. Submittals delivered to the Architect / Engineer without the specified information will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been submitted or delivered.
- C. All product options specified shall be clearly indicated on the product data submittal. All options listed on the standard product printed data not clearly identified as either part of or not part of the product data submitted shall become part of the Contract and shall be assumed to be provided with the product submitted.
- D. Mark each copy of standard manufacturer's printed data to identify pertinent products, referenced to specification section and article number.
- E. Show reference standards, performance characteristics and capacities; wiring diagrams and controls; component parts; finishes; dimensions and required clearances.
- F. Modify manufacturer's standard schematic drawings and diagrams to supplement standard information and to provide information specifically applicable to the work. Delete or strike through information not applicable.
- G. Submit drawings in a clear and thorough manner. Identify details by reference to sheet and detail, schedule, or room numbers shown on Contract Drawings.
- H. Show all dimensions of each item of equipment in its to be installed assembled condition with all components assembled. Include a series of drawings of individual components as necessary for reference.
- I. Identify field dimensions; show relation to adjacent or critical features or work or products.
- J. Submit individually bound shop drawings and product data for the following when specified or provided.
- K. The Fault Current and Overcurrent Device Coordination Analysis shall be submitted prior to other electrical switchgear dependent on the results of the study for specific product selection by the vendor or contractor for compliance with the study.
 - 1. The emergency life safety power system equipment shall be fully coordinated as

- required by the NEC.
 - 2. The AIC and WCR ratings of all products meet or exceed the available fault current at that equipment's location.
 - 3. Electrical systems other than life safety power systems shall be coordinated as much as practicable while reducing arc flash energy as much as practical.
- L. Required submittals when products are indicated or specified:
1. Fault Current and Overcurrent Device Coordination Analysis. Submit this analysis at a minimum of three (3) weeks prior to any overcurrent device submittal to allow review for modifications to overcurrent device product selection submittal based on the manufacture's analysis and recommendations. Manufacture's recommendations for code compliance equipment fault tolerance are a project requirement and shall be provided at no additional cost to the Owner. Manufacture's recommendations for arc flash reduction that result in no additional cost to the Owner shall be provided. Manufacture's recommendations for arch flash reduction which would result in additional cost to the Owner are considered recommendations only and will be reviewed by the Engineer during the submittal review and may or may not result in changes to the specified or submitted equipment.
 2. Enclosed Switches, non-fused, fused, or circuit breaker.
 3. Panelboards.
 4. Load centers.
 5. Wiring devices.
 6. Lighting fixtures.
 7. Lighting Controls.
 8. Surge Protection Devices.
 9. Transformers.
 10. Electrical Contactors.
 11. Enclosed Motor Controllers.
 12. Site Lighting Photometrics, Poles, and Fixtures.
 13. Switchboards, including renewal components for existing switchboards.
 14. Elevator Power Module fused switches.
 15. Fuses.
 16. Recessed floor boxes and fittings.
 17. Metering equipment for building management energy monitoring, usage, IECC compliance.
 18. Modular metering equipment for multi-tenant utility electrical services.
 19. Emergency/Standby generators.
 20. Automatic transfer switches.
 21. Manual transfer switches with or without integral generator docking stations.
 22. Remote generator docking stations.
 23. Emergency lighting inverters.
 24. Theatrical Lighting Systems.
 25. Architectural Dimming Systems.
 26. Electrical cable trays.
 22. Sports Lighting Equipment, Photometrics, Fixtures, and Poles.
 27. Surface Raceways.
 28. Electrical controls and time switches.
 29. Motor control centers, including renewal components for existing motor control centers.
 30. Busway.
 31. Uninterrupted Power Supply systems.
 32. Power quality improvement filters or capacitors.
 33. Lightning protection system.
 34. Fire Rated Cables and Connectors.
 35. Low Voltage Switchgear.

- 36. Medium Voltage Cable and Connectors.
- 37. Medium Voltage Switchgear.

3.4 MANUFACTURERS INSTRUCTIONS

- A. Submit Manufacturer's instructions for storage, preparation, assembly, installation, start-up, adjusting, calibrating, balancing and finishing.

3.5 CONTRACTOR RESPONSIBILITIES

- A. Review, make corrections or annotations for clarification of manufacturer supplied data, stamp and sign submittals prior to transmittal.
- B. Determine and verify:
 - 1. Field measurements.
 - 2. Field construction criteria.
 - 3. Manufacturer's catalog numbers.
 - 4. Conformance with the Contract Documents.
- C. Coordinate submittals with requirements of the work and of the Contract Documents.
- D. Notify the Architect / Engineer in writing at time of submission of any deviations in the submittals from requirements of the Contract Documents.
- E. Do not fabricate products, or begin work for which submittals are required, until such submittals have been produced and bear contractor's stamp of acceptance or approval. Do not fabricate products or begin work until return of reviewed submittals with Architect / Engineer's acceptance.
- F. Contractor's responsibility for errors, omissions, or un-approved substitutions in submittals is not relieved whether Architect / Engineer reviews submittals or not.
- G. Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved whether Architect / Engineer reviews submittals or not, unless Architect / Engineer gives written acceptance of the specific deviations identified by the Contractor on reviewed documents.
- H. Submittals shall show sufficient data to indicate complete compliance with Contract Documents:
 - 1. Proper sizes and capacities.
 - 2. That the item will fit in the available space in a manner that will allow proper service; manufacture's and code required clearances.
 - 3. Construction methods, materials and finishes.
- I. Schedule submissions at least 15 days before date reviewed submittals will be needed by the Contractor for processing or for making corrections for re-submittal.
- J. General and Electrical Contractor's Stamp of Approval
 - 1. The general contractor and the electrical contractor shall stamp and sign each document certifying to the review of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
 - 2. Contractor's stamp of approval on any submittal shall constitute a representation to Owner and Architect / Engineer that Contractor has either determined and verified all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data or assumes full responsibility for doing so, and that

Contractor has reviewed or coordinated each submittal with the requirements of the work and the Contract Documents.

3. Do not deliver any submittals to the Architect / Engineer that do not bear the Contractor's stamp of approval and signature.
4. Submittals delivered to the Architect / Engineer without Contractor's stamp of approval and signature will not be processed. The Contractor shall bear the risk of all delays, as if no submittal had been delivered.

3.6 SUBMISSION REQUIREMENTS

- A. Make submittals promptly in accordance with approved schedule, and in such sequence as to cause no delay in the Project or in the work of any other Contractor. Product and equipment related to site work or other trades which require extensive rough-in, foundations, or structural support shall be submitted as soon as possible after given notice to proceed with construction.
- B. Number of submittals required:
 1. Coordination Drawings: Submit one electronic data file (pdf) and three opaque reproductions or coordination drawings.
 2. Product Data: Submit electronic data PDF files. Refer to Division 01 for specific requirements. PDF files that are 20MB or larger may indicate that a submittal includes information not specifically relevant to the specific product being provided, information not required for the review of the specific product such as a complete product catalog or catalog section. Contractor shall include only the product data required to review the specific products characteristics for compliance with the contract documents.
- C. Accompany submittals with transmittal letter containing:
 1. Date.
 2. Project title and number.
 3. Contractor's name, address and contact information.
 4. The number of each Shop Drawing, Project Datum and Sample submitted.
 5. Other pertinent data as required in Division 01.
- D. Submittals shall include:
 1. The date of submission.
 2. The project title and number.
 3. Contract Identification.
 4. The names of:
 - a. Contractor.
 - b. Subcontractor.
 - c. Supplier.
 - d. Manufacturer.
 5. Identification of the product.
 6. Field dimensions, clearly identified as such.
 7. Relation to adjacent or critical features of the work or materials.
 8. Applicable standards.
 9. Identification of deviations from contract documents.
 10. Suitable blank space for General Contractor and Architect / Engineer stamps.
 11. Contractor's signed and dated Stamp of Approval.
- E. Coordinate submittals into logical groupings to facilitate interrelation of the several items.
 1. Finishes which involve Architect / Engineer selection of colors, textures or patterns.
 2. Associated items requiring correlation for efficient function or for installation.

3.7 RESUBMISSION REQUIREMENTS

- A. Make resubmittals under procedures specified for initial submittals. Re-submittals shall be a complete submittal as if it were the initial submittal unless otherwise instructed in the review comments on the original submittal.
 - 1. Indicate that the document or sample is a resubmittal.
 - 2. Identify changes made since previous submittals.
- B. Indicate any additional changes which have been made by the contractor other than those requested by the Architect / Engineer.

END OF SECTION

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SECTION 26 05 19

CONDUCTORS AND CONNECTORS – 600 VOLT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide electrical conductors, wire and connector work as shown, and specified.
- B. Types: The types of conductors and connectors required for the project include the following:
 - 1. 600V building conductors.
 - 2. 600V building conductor connectors.
- C. Application: The applications for conductors and connectors required on the project are as follows:
 - 1. Power distribution circuitry.
 - 2. Lighting branch circuitry.
 - 3. Appliance, receptacle, and equipment branch circuitry.
 - 4. Motor branch circuitry.
 - 5. Control wiring.
 - 6. Line voltage.
- D. Refer to other specific specification sections for voice, video, data, alarm and instrumentation cables.

1.2 QUALITY ASSURANCE

- A. UL Label: Conductors and connectors shall be UL labeled.

1.3 REFERENCES

- A. Refer to other specific specification sections regarding specialized wiring and connections.

PART 2 – PRODUCTS – Provide products manufactured in the USA

2.1 CONDUCTORS AND CONNECTORS

- A. General: Except as indicated, provide conductors and connectors of manufacturer's standard materials, as indicated by published product information, designed and constructed as instructed by the manufacturer, and as required for the installation.
- B. Cable Lubricant: Fire resistant, nonflammable, water-based type for standard building conductors. Provide cable lubricants for fire rated cables as recommended by the cable manufacturer.
- C. Conductors: Provide factory-fabricated conductors of the size, rating, material, and type as indicated for each use. Conductors shall be soft or annealed copper wires meeting, before stranding, the requirements of ASTM B 3, Standard Specification for Soft or Annealed Copper Wire for Electrical Purposes, latest edition.
 - 1. Conductors for control wiring sized #14 AWG through #10 AWG shall be stranded.
 - 2. Conductors for power and lighting shall be stranded. Stranding shall be Class B meeting the requirements of ASTM B 8, Standard Specification for Concentric-

Lay-Stranded Copper Conductors, Hard, Medium Hard, or Soft.

- D. Insulation for standard building conductors: Insulation shall meet or exceed the requirements of UL 83, Standard for Thermoplastic Insulated Wires.
1. All wiring inside lighting fixtures shall be temperature rated per NEC.
 2. Insulation for copper conductors shall be UL Type THHN/THWN, 90 degrees C.

2.2 COLOR CODES FOR CONDUCTORS FOR BRANCH CIRCUITS AND FEEDERS

- A. Color coding for conductors as required by NEC 210.5. Color coding for phase and voltage shall be as required by local codes and local standards. Where such standards do not exist, color coding shall be as follows:

Color Code Table	USE CONTINUOUS COLOR CODED INSULATION THROUGHOUT					
	A	B	C	N	G	IG
120/208 3 Ph	Black	Red	Blue	White	Green	Green/Yellow Stripe
120/240 3 Ph	Black	Orange	Blue	White	Green	Green/Yellow Stripe
120/240 1 Ph	Black	N/A	Blue			
277/480	Brown	Purple	Yellow	Gray	Green	Green/Yellow Stripe

Notes to Color Code Table:

1. 120/208, 120/240, and 277/480 Volt Systems shall be routed in separate raceways.
2. Switched legs of phase conductors for lighting and appliance branch circuits shall be of the same color as described above throughout the entire circuit.
3. Conductors shall be the same color from breaker to device or outlet.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install electrical conductors and connectors as shown, in accordance with the manufacturer's written instructions, the requirements of NEC, the NECA Standard of Installation, and industry practices.
- B. Coordination: Coordinate conductor installation work with electrical raceway and equipment installation work, as necessary for interface.
- C. Conductors:
1. Provide a grounded (neutral) conductor for each branch circuit. Do not share grounded (neutral) conductors.
 2. No more than six phase conductors shall be installed in a single raceway. Any combination of phase conductors and grounded (neutral) conductors in any raceway shall not exceed nine.
 3. When any combination of four or more phase and grounded (neutral) conductors are installed in a raceway, the minimum size for all conductors including equipment ground conductor shall be #10 AWG, and they shall be de-rated accordingly.
 4. When more than four (4) conductors are size #10 AWG, they shall be installed in

- a one-inch conduit.
5. Pull conductors together when more than one is being installed in a raceway. Whenever possible, pull conductors into their respective conduits by hand. Use pulling lubricant when necessary.
 6. Before any conductor is pulled into any conduit, thoroughly swab the conduit to remove foreign material and to permit the wire to be pulled into a clean, dry conduit.
 7. Run feeders their entire length in continuous section without joints or splices.
 8. No wire smaller than #12 AWG shall be permitted for any lighting or power circuit. No wire smaller than #14 AWG shall be used for any control circuit, unless shown otherwise.
 9. Provide the same size wire from the panelboard to last outlet on circuit. For 20 amp branch circuits operating at 150V or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating at 150 to 600 volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
 10. Branch circuit voltage drop shall not exceed 3% of rated voltage.
 - a. Total voltage drop from the point of service to the last outlet or utilization equipment of the same voltage shall not exceed five-percent of rated voltage.
 - b. Total voltage drop from the point of service to transformers with adjustable taps, buck-boost transformers, uninterruptable power supplies (UPS), or voltage regulators shall not exceed five-percent of rated voltage.
 - c. Total voltage drop from a separately derived system, transformer with adjustable taps, buck-boost transformer, uninterruptable power supply (UPS), or voltage regulator to the last outlet or utilization equipment of the same voltage shall not exceed five-percent of rated voltage.
 - d. Total voltage drop from the point of service to distribution equipment of the same voltage shall not exceed two-percent of rated voltage.
 - e. Branch circuit voltage drop from distribution equipment to the last outlet or utilization equipment shall not exceed three-percent of rated voltage.
 - f. Provide the same size branch circuit conductors to last outlet on circuit unless specifically noted or indicated otherwise on the drawings. For 20 amp branch circuits operating at 150-Volts or less, provide #10 AWG wire when the first outlet is over 75-feet from the panelboard. For branch circuits operating above 150-Volts to 600-Volts, provide #10 AWG wire when the first outlet is over 150-feet from the panelboard.
 11. No tap or splice shall be made in any conductor except in outlet boxes, pull boxes, junction boxes, splice boxes, or other accessible locations. Make taps and splices using an approved compression connector. Insulate taps and splices equal to the adjoining conductor. Make splices or taps only on conductors that are a component part of a single circuit, protected by approved methods. Taps or splices in feed through branch circuits for connection to light switches or receptacles shall be made by pigtail connection to the device.
 12. Support conductors in vertical raceways, as required by the NEC.
 13. Do not permit conductors entering or leaving a junction or pull box to deflect to create pressure on the conductor insulation.
 14. Make joints in branch circuits only where circuits divide. These shall consist of one through circuit to which the branch from the circuit shall be spliced.
 15. Make connections in conductors up to a maximum of one #6 AWG wire with two #8 AWG wires using twist-on pressure connectors of required size.
 16. Make connections in conductors or combinations of conductors larger than specified using cable fittings of type and size required for specific duty.
 17. After a splice is made, insulate entire assembly with UL-approved insulating tape to a value equivalent to the adjacent insulation.

18. Make splices and connections in control circuit conductors using UL-approved solderless crimp connectors.
 19. All conduits shall be installed with an insulated grounding conductor per NEC 250.122. Where green conductor insulation is not available, the ground conductor shall be identified with green phasing tape at all accessible locations.
 20. Neatly train and lace wiring inside boxes, equipment and panelboards. Provide tie-straps around conductors with their shared neutral conductor where there are more than two neutral conductors in a conduit.
 21. Clean conductor surfaces before installing lugs and connectors.
 22. Make splices, taps and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 23. Provide stranded conductors connected with pressure type connectors / compression fittings and terminal lugs UL listed for the type of conductor used (AL-CU) and correctly sized to the diameter of the bare conductors.
 24. Run mains and feeders their entire length in continuous pieces without splices or joints.
 25. Color code conductors.
 26. Do not install a pull string in conduits containing conductors.
 27. Conductors shall be the same color from load side of overcurrent protection device to outlet or utilization equipment.
 28. Spare conductors shall not be installed in any conduit, gutter, raceway, panel or enclosure unless noted otherwise.
- D. Identification: Label each phase conductor in each junction box with corresponding circuit number, using self-adhesive wire markers.
- E. Splices and Joints:
1. In accordance with UL 486A, C, D, E, and NEC.
 2. Aboveground Circuits (No. 10 AWG and smaller):
 - a. Connectors: Solderless, screw-on, reusable pressure cable type, rated 600 V, 220° F, with integral insulation, approved for copper and aluminum conductors.
 - b. The integral insulator shall have a skirt to completely cover the stripped wires.
 - c. The number, size, and combination of conductors, as listed on the manufacturers' packaging, shall be strictly followed.
 3. Motor connections:
 - a. All AHU motors connections shall be split bolt connectors.
 - b. All non-AHU motors 10 HP and larger shall be split bolt connectors.
 - c. All non-AHU motors less than 10 HP shall be split bolt connectors or as recommended by the manufacturer.
- F. Aboveground Circuits (No. 8 AWG and larger):
1. Connectors shall be indent, hex screw, or bolt clamp type of high conductivity and corrosion resistant material, listed for use with copper and aluminum conductors.
 2. Provide field-installed compression connectors for cable sizes 250 kcmil and larger with not less than two clamping elements or compression indents per wire.
 3. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Splice and joint insulation level shall be not less than the insulation level of the conductors being joined.
 4. Plastic electrical insulating tape: Per ASTM D2304, flame-retardant, cold and weather resistant.

- G. Underground Branch Circuits and Feeders:
 1. Submersible connectors in accordance with UL 486D, rated 600 V, 190°F, with integral insulation.

3.2 TESTING

- A. Pre-Energization Check: Before energizing, check cable and conductors for circuit continuity and short circuits. Correct malfunctions.
- B. Service Entrance and Feeder Insulation Resistance Test: Each main service entrance conductor and each feeder conductor shall have its insulation resistance tested after the installation is complete except for connection at its source and point of termination. Testing shall be performed by qualified technicians who have been trained in testing procedures and in the use of all test equipment.

1. Make tests using a Biddle Megger or equivalent test instrument at a voltage of not less than 1000 VDC; measure resistance from conductor to conductor, conductor to neutral (if present) and from conductor to ground. Insulation resistance shall not be less than the following:

Wire Size (AWG)	Insulation Resistance (Ohms)
#8	250 K
#6 through #2	100 K
#1 through #4/0	50 K
Larger than #4/0	25 K

2. Conductors that do not meet or exceed the insulation resistance values listed above shall be removed, replaced, and retested.
- C. Submittals: Contractor shall furnish instruments and personnel required for tests. Submit 4 copies of certified test results to Architect for review. Test reports shall include conductor tested, date and time of test, relative humidity, temperature, and weather conditions.
 - D. Voltage and Current Values: The voltage and current in each conductor shall be measured and recorded after connections have been made and the conductor is under load.

SAMPLE DC HIGH VOLTAGE CABLE TEST REPORT
(Specification Paragraph 3.2, C)

Date _____

Contract and Work Location: _____

Contract (Project) No.: _____

Circuit Identification: _____

(Dwg., Title, Number and Ckt. Number)

Test Equipment: _____

(Make, Model, Serial No., Etc.)

Applied Test Voltage _____

Normal Oper. Voltage _____

Cable Installation: New _____ Used _____

(Date) _____ (No. Years)

Cable Size _____ AWG

Cable Length _____ Ft.

Cable Material _____ Cu _____ Al

Temperature _____ Humidity _____

TEST DATA - RESISTANCE IN KILO OHMS

CONDUCTOR PER PHASE	A-N	B-N	C-N	A-G	B-G	C-G	A-B	B-C	A-C

END OF SECTION

SECTION 26 05 26

ELECTRICAL GROUNDING

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Grounding shall conform to the requirements of:
 - 1. National Electrical Code.
 - 2. Governing local codes.
 - 3. All Local Utility Companies.
- B. Ground effectively and permanently.
 - 1. Neutral conductor at the main service disconnect and other separately derived systems.
 - 2. All conduit systems.
 - 3. All electrical equipment and related current carrying supports or structures.
 - 4. All metal piping systems.
 - 5. All building structural metal frames.
 - 6. All telephone/voice/video/CATV/data utilities.

1.2 REFERENCE STANDARDS

- A. ANSI/IEEE Standard 142 - "Recommended Practice for Grounding of Industrial and Commercial Power Systems."
- B. ANSI/UL 467 - "Safety Standard for Grounding and Bonding Equipment."
- C. Article 250 of the NEC (NFPA 70) for grounding.
- D. NECA – Standard of Installation.
- E. NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- F. EIA / TIA 607.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Copperweld.
- B. nVent ERICO.
- C. Burndy.
- D. O. Z Gedney.
- E. Eaton.

2.2 GROUNDING ELECTRODES

- A. Driven Rod Electrode.
 - 1. 3/4" x 10'-0" copper clad grounding electrode.
 - 2. UL listed.
 - 3. Approved thermal fusion connector methods (exothermic).
- B. Metal frame of building or enclosure.
- C. Foundation concrete encased rebar.

2.3 DATA / VOICE COMMUNICATIONS CLOSET GROUND BAR

- A. MDF closets/head end rooms: Erico Cadweld #B544A028 ground bar with 7/16-inch holes.
- B. IDF closets, Erico Cadweld #B542A004 ground bar with 7/16-inch holes.
- C. Heavy-duty, two bolt type, copper alloy or bronze for grounding and bonding applications, in configurations required for particular installation.

2.4 EXOTHERMIC CONNECTIONS

- A. Exothermic type for underground and structural steel; Cadweld.
- B. Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

2.5 WIRE

- A. Stranded, copper cable.
- B. Foundation Electrodes: 4/0 AWG.
- C. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 - EXECUTION

3.1 GROUNDING AND BONDING

- A. In the service equipment, provide a separate (dedicated) ground bus.
 - 1. Bond the ground bus with copper bus bar or cable, of equal or greater current carrying capacity of the service grounding conductor, to the neutral bar.
 - 2. Resistance of neutral to ground shall not exceed 10 Ohms.
 - 3. Connect the electric service grounding electrode conductors to the incoming metal water pipe system (when available, using a suitable ground clamp) and to a supplemental electrode such as a ground rod or ground ring.
 - 4. Provide grounding and bonding at the power company's metering equipment.
 - 5. Provide access and cover for access to the ground grid and removable connections for testing the system.
- B. Connect the grounding electrode conductor between the ground bus and the grounding electrode system.
 - 1. In rigid PVC conduit.
 - 2. Provide thermo fusion connection for each rod ground electrode.
 - a. All rod electrodes shall be located outside the building in non-paved

- areas where available. Access cover top shall be flush with finish grade or floor.
- b. Install rod electrodes as required. Install additional rod electrodes as required to achieve specified resistance to ground.
 - c. The minimum distance between driven ground rod electrodes shall be 10'.
3. The total ground resistance shall not exceed 10 Ohms for service entrance grounds and 25 Ohms for equipment grounds.
 - a. Where this condition cannot be obtained with one electrode, install a longer electrode, deep-driven sectional electrodes, or additional grounding electrodes until the required ground resistance is obtained.
- C. Provide an insulated equipment grounding conductor inside all conduits, raceways, surface raceways, gutters and wireways. The ground wire shall be bonded to each box to suitable lug, bus, or bushing. All bonding jumpers shall be routed inside conduit or raceway.
 - D. Provide an insulated isolated equipment grounding conductor in addition to the insulated equipment grounding conductor for all isolated grounding feeders, branch circuits, outlets and isolated grounding receptacles.
 - E. Provide all conduit terminating in switchgear, transformers, switchboards, panelboards and voice/data outlets with grounding bushings, where required, and ground wire extended to ground bus in equipment. Install grounding bushings where reducing washers are used and concentric and eccentric knock-outs are used.
 - F. Main bus and building grounding electrode conductor installation shall be witnessed by the Architect / Engineer.
 - G. Provide bonding to meet Regulatory Requirements.
 - H. Interface with lightning protection system when lightning protection system is specified.
 - I. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".
 - J. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
 - K. Do not use spring steel clips and clamps.
 - L. Do not use powder-actuated anchors.
 - M. Do not drill or cut structural members.
 - N. Do not use compression or mechanical connectors underground.
 - O. Do not use sheetmetal or self-drilling screws for bonding connections. Provide listed or approved connectors.
 - P. Provide grounding access well for each driven ground electrode, not located in manholes or pull boxes.
 1. Access well top shall be flush with finish paved surfaces.
 2. Ground access wells located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.

3. Provide thermal fusion (exothermic) connectors approved for direct burial.

3.2 METAL FRAME OF BUILDING OR STRUCTURE

- A. Effectively ground the building steel or structure per NEC 250-52 (2).

3.3 UFER GROUND

- A. Provide a UFER ground at bottom of building slab per NEC 250.52 (3), bond to building steel.

3.4 MISCELLANEOUS REQUIREMENTS

- A. Continuity of the equipment grounding system shall be maintained throughout the project. Equipment grounding jumpers shall be installed across conduit expansion fittings, liquid-tight flexible metal and flexible metal conduit, and other non-electrically continuous raceway fittings.
- B. Equipment grounding conductors and grounding electrode conductor shall be stranded copper conductors and run in a suitable raceway. Grounding conductors and grounding electrode conductor shall be continuous, without joints or splices over their entire length, except as allowed by NFPA 70/NEC.
- C. For separately derived alternating current system grounds, bond the case and neutral of each transformer secondary winding directly to the nearest available effectively grounded structural metal member as required in NEC 250.
- D. Exterior Electrical Equipment Racks:
 1. Provide driven ground electrode.
- E. Technology/Data/Voice Communications, CATV, CCTV, and MATV Equipment Grounding: Provide grounding electrode conductor from the communications service equipment to the building grounding system as required. Grounding shall conform to ANSI/TIA/EIA 607(A) – Commercial Building Grounding and Bonding Requirements for Telecommunications, National Electrical Code®, ANSI/NECA/BICSI-568 and manufacturer's grounding requirements as minimum. Bonding shall be of low impedance to assure electrical continuity between bonded elements.
 1. MDF Closets Telecommunications Main Ground Bar (TMGB): Provide Erico #EGBA14424MM ground bar, wall mounted to the telecommunications plywood backboard. Provide one #3 AWG insulated ground conductor from ground bar to building steel. Provide #2/0 AWG insulated ground conductor to the building electrical service ground at the nearest electrical switchboard or panelboard.
 2. IDF Closets Telecommunications Ground Bar (TGB): Provide Erico #EGBA14410FF ground bar mounted to the telecommunications plywood backboard. Provide one #6 AWG insulated ground conductor from ground bar to building steel and to ground bus of nearest electrical panelboard or switchboard.
 3. Provide #2/0 AWG insulated ground conductor between each TMGB and all TGBs.
 4. Provide #2/0 AWG insulated ground conductor from TMGB to electrical service ground bus at main electrical service switch.
 5. Bond each equipment rack, cabinets, frames, together and with #6 AWG insulated ground conductor to the local TMGB / TGB. Bond and ground equipment racks, housings, messenger cables, raceways, and rack-mounted conduit.

- 6. Route TMGB – TGB ground conductor using the shortest, straightest, route practical with long radius curves.
 - 7. All conduits terminating to cable trays, wireways, and racks shall be mechanically fastened. When connected to a cable tray or rack, it must be connected with ground bushings, wire bonded to the tray or rack, and grounded to the main building grounding system or IDF room grounding bar using #6 AWG copper.
- F. Ground lighting fixture bodies to the conduit grounding system.
 - G. Bond receptacle ground to the box and conduit ground system, except where and insulated/isolated grounding receptacle or outlet is specified.
 - H. Ground connections to building steel, grounding electrodes and all underground connections shall be by thermal fusion (exothermic).
 - I. Provide OZ Type “BJ” bonding jumper at all expansion joints, points of electrical discontinuity or connections in conduit where firm mechanical bond is not possible, such as flexible connections, insulating couplings, etc.
 - J. Ground each lighting and power panelboard by connecting the grounding conductors to the grounding stud.
 - K. Ground each secondary dry-type transformer to the ground bus of the primary side panelboard. Provide a bonding jumper between the ground stud and the neutral. Ground transformer ground stud to ground ring if a ground ring is installed or the nearest structural steel member.
 - L. Bond every item of equipment served by the electrical system to the building equipment ground system. This includes, but is not limited to, switchboards, panelboards, disconnect switches, receptacles, cable trays, controls, fans, air handling units, pumps and flexible duct connections.
 - M. Ground each light pole, power distribution poles, and metal conduit stub-ups at each light pole base.
 - N. Ground all metal conduit including metal conduit used for bends and penetrations through concrete.
 - O. Bond hot water and cold water piping together at each domestic water heater.

3.5 MANHOLE AND/OR PULL BOX GROUNDING

- A. Provide a driven ground rod and ground bond ring in each power and telephone manhole or pull box. Bond cable racks and medium voltage cable shields at splices and terminations, ductbank conduit ground bushings and all other metal components in manholes or pull box to the ground ring.

3.6 COORDINATION

- A. General: Coordinate installation of grounding connections for equipment with equipment installation work.

3.7 TESTING

- A. Ground Resistance Test: Perform a ground resistance test for comparison to future inspection and testing data by the Owner. Test shall be performed using a Biddle Megger

Earth Tester or equivalent test instrument. The test shall not be performed within 48 hours after the last rainfall.

1. Inspect and test in accordance with NETA ATS except Section 4.
 2. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
- B. True Root Mean Square (RMS) AC measurements: The True RMS AC Measure test should be performed for all bonding conductors. The recommended maximum AC current value on any bonding conductor should be less than 1 ampere (A). The recommended maximum DC current value should be less than 500 milliamperes (mA). If abnormally high AC current levels are present on any bonding conductor, a dangerous faulty wiring condition likely exists within the room.
- C. Two-Point Bonding Measurements: The Two-point Bonding test should be performed for all bonding conductors. This test should be performed using an earth grounding resistance tester configured for a continuity test. The test is performed by connecting the meter leads between the nearest available grounding electrode (e.g., structural steel) and the TMGB or TGB. The recommended maximum value for the bonding resistance between these two points is 0.1 Ohms (100 milliohms).
- D. Submittals: Furnish instruments and personnel required for tests. Personnel shall be trained in all aspects of testing grounding systems and shall be formally trained on using all test equipment required. Submit 2 copies of certified test results for Owner's record and submit 4 copies of certified test results to Architect / Engineer for review. Test reports shall include date and time of tests, relative humidity, temperature, and weather conditions.

END OF SECTION

SECTION 26 05 33

CONDUIT SYSTEMS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Furnish and install a complete system of electrical conduits and fittings.

1.2 REFERENCE STANDARDS

- A. National Electrical Code.
- B. Local codes and ordinances.
- C. UL.
- D. ETL.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS – Provide products manufactured in the USA

- A. Raceways:
 - 1. Allied, International Metal Hose, Ipex, Heritage Plastics, Wheatland, Can-Tex, Carlon, Certain-Teed, Anamet, Inc., Electri-Flex Co., Western Tube and Conduit, Sentinel Conduit.
 - 2. PVC Coated RGC: Robroy Perma Cote, Robroy Plasti-Bond, or Calbond – no exceptions.
 - 3. Stainless Steel: Robroy, Calbrite, Gibson.
 - 4. Aluminum: Penn Aluminum, American Conduit, Wheatland, Eaton B-Line, Patriot Aluminum Products.
 - 5. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass, United Fiberglass.
- B. Fittings:
 - 1. Appleton, Crouse Hinds, Topaz, Steel City, O.Z. Gedney, Carlon, Heritage Plastics, Raco, Ipex, International Metal Hose, Lew Electric Fittings Co.
 - 2. PVC Coated ferrous fittings: Robroy Perma Cote, Robroy Plasti-Bond, or Calbond – no exceptions.
 - 3. Stainless Steel: Robroy, Calbrite, Gibson, Crouse Hinds.
 - 4. Aluminum: Penn Aluminum, American Conduit, Wheatland, Eaton B-Line, Patriot Aluminum Products.
 - 5. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass.
- C. Condulets and Conduit Bodies:
 - 1. Appleton, Form 85.
 - 2. PVC Coated: Robroy Perma-cote or Plasti-Bond, – no exceptions.
 - 3. Stainless Steel: Robroy, Calbrite, Gibson, Crouse Hinds.
 - 4. Reinforced Thermosetting Resin Conduit (RTRC): FRE Composites, Champion Fiberglass.
- D. Steel MC Cable for light fixture whips:
 - 1. AFC.

2. Southwire.
3. General Cable.
4. Kaf-Tech.

2.2 GENERAL

- A. The minimum conduit size shall be ¾-inch unless indicated otherwise in Divisions 26, 27 or 28.
 1. Branch Circuits: Minimum conduit size shall be ¾-inch.
 2. Feeder Circuits: Minimum conduit size shall be ¾-inches.
 3. Technology, telecommunications, and low voltage systems: The minimum conduit size shall be ¾-inches unless noted or indicated otherwise.
 4. The minimum conduit size between buildings for technology, voice, data, fire alarm, video, security, surveillance, BMCS, and other telecommunications shall be 2-inch unless indicated otherwise.
- B. The minimum conduit size for flexible metallic conduit for tap connections to individual light fixtures shall be ½ inch, or steel metal clad (MC) cable with insulated ground conductor maximum 6 feet.
- C. Electrical nonmetallic tubing, flexible polyethylene or PVC tubing shall not be used on this project.
- D. BX and AC cable shall not be used on this project.
- E. PVC elbows shall not be used on this project.
- F. Intermediate metal conduit (IMC) shall not be used on this project.

2.3 RIGID METAL CONDUIT

- A. UL labeled, Schedule 40:
 1. Mild steel pipe, zinc coated inside and out.
 2. Aluminum Alloy 6063, T-1 temper.
 3. Threaded ends.
 4. Insulated bushings.
- B. Fittings shall meet the same requirements as rigid metal conduits.
 1. UL labeled.
 2. Threaded fittings.

2.4 ELECTRICAL METALLIC TUBING (EMT)

- A. UL labeled, standard weight:
 1. Cold rolled steel tubing, zinc coated inside and out.
 2. Aluminum Alloy 6005, 6063. Temper T-1.
- B. Fittings shall meet the same requirements as EMT conduits.
 1. UL labeled.
 2. Insulated throat connectors.
 3. Steel fittings with setscrews with lock nuts on threaded ends, no snap locks.
 4. Cast metal fittings are not approved.
 5. Uni-couple type connectors are not approved.
 6. Split ring, anti-short bushings are not approved.

2.5 RTRC CONDUIT FITTINGS AND CONDUIT BODIES

- A. UL listed.
- B. Standard wall thickness sizes ¼-inch through 4-inch.
- C. Underground medium wall thickness sizes 5 and 6-inch.
- D. Conduit interface joints above grade, gasket joint below grade.
- E. Extra heavy wall for above ground and/or UL Class 1 Division 2 and Class 1 Zone 2 applications.

2.6 PVC COATED RIGID STEEL WITH URETHANE INTERIOR COATING

- A. The PVC coated galvanized rigid conduit and fittings must be ETL Listed and Verified. The PVC coating must have been investigated and verified by ETL as providing the primary corrosion protection for the rigid metal conduit. Ferrous fittings for general service locations must be ETL Listed with PVC as the primary corrosion protection. Hazardous location fittings, prior to plastic coating must be UL listed for the hazard conditions to which they are to be used. All conduit and fittings must be new, unused material. Applicable UL standards may include UL 6 Standard for Safety, Rigid Metal Conduit, and UL514B Standard for Safety, Fittings for Conduit and Outlet Boxes.
- B. The PVC coated galvanized rigid conduit and fittings must be ETL Verified to the Intertek ETL SEMKO High Temperature H₂O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.
- C. The conduit shall be hot dip galvanized inside and out with hot galvanized threads.
- D. A PVC sleeve extending one pipe diameter or two inches, whichever is less, shall be formed at every female fitting opening except unions. The inside sleeve diameter shall be matched to the outside diameter of the conduit.
- E. The PVC coating on the outside of conduit couplings shall have a series of longitudinal ribs 40 mils in thickness to protect the coating from tool damage during installation.
- F. Form 8 Condulets, ½-inch through 2-inch diameters, shall have a tongue-in-groove gasket to effectively seal against the elements. The design shall be equipped with a positive placement feature to ease and assure proper installation. Certified results confirming seal performance at 15 psig (positive) and 25 inches of mercury (vacuum) for 72 hours shall be available.
- G. Form 8 Condulets shall be supplied with plastic encapsulated stainless-steel cover screws.
- H. A urethane coating shall be uniformly and consistently applied to the interior of all conduit and fittings. This internal coating shall be a nominal 2 mil thickness. Conduit or fittings having areas with thin or no coating shall be unacceptable.
- I. The PVC exterior and urethane interior coatings applied to the conduit shall afford sufficient flexibility to permit field bending without cracking or flaking at temperatures above 30°F (-1°C).
- J. All male threads on conduit, elbows and nipples shall be protected by application of a

urethane coating.

- K. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.
- L. Independent certified test results shall be available to confirm coating adhesion under the following conditions
 1. Conduit and conduit exposure to 150°F (65°C) and 95% relative humidity with a minimum mean time to failure of 30 days. (ASTM D1151)
 2. The interior coating bond shall be confirmed using the Standard Method of Adhesion by Tape Test (ASTM D3359).
 3. No trace of the internal coating shall be visible on a white cloth following six wipes over the coating which has been wetted with acetone (ASTM D1308).
 4. The exterior coating bond shall be confirmed using the methods described in Section 3.8, NEMA RN1. After these tests the physical properties of the exterior coating shall exceed the minimum requirements specified in Table 3.1, NEMA RN1.
- M. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit. All U bolts shall be provided with plastic encapsulated nuts that cover the exposed portions of the threads.
- N. All fittings, clamps, straps, struts, and hardware used with PVC coated conduit shall be PVC coated or 316 stainless steel.

2.7 STEEL FLEXIBLE CONDUIT

- A. Steel flexible metallic conduit:
 1. Zinc coated inside and out.
 2. 18-inches minimum length, 24-inches maximum length.
- B. Steel flexible metallic conduit for tap connections to light fixtures where steel MC Cable fixture whips are not used:
 1. 18 inches minimum length; 6 feet maximum length.
- C. Liquid tight flexible steel conduit
 1. Type L.A. - Grounded - UL Approved.
 2. 18-inches minimum length, 24-inches maximum length.

2.8 PVC CONDUIT

- A. UL labeled Schedule 40 and Schedule 80 .
- B. PVC fittings and solvent welded joints.
- C. Acceptable PVC conduit manufacturer: Ipex, Cantex.

2.9 CONDULETS AND CONDUIT BODIES

- A. UL Labeled.
- B. Form 85.
- C. PVC Coated: Form 8.
- D. LBC Condulets shall be used for size 2 inch and above.

- E. LL and LR Condulets shall not be used for 2 inch and above.

2.10 ROOF MOUNTED CONDUIT AND BOX SUPPORTS

- A. Conduit supports and pads suitable for direct sunlight, conduit size, weight, quantity and roof system with unistrut supports and accessories. Conduit supports shall allow for conduit expansion and contraction.
- B. Refer to roofing specifications for additional information. The limitations and restrictions contained in any roofing specification shall prevail and supercede these specifications for roof mounted supports for conduits and boxes.
- C. Approved Manufacturer:
 - 1. Portable Pipe Hangers.
 - 2. Eaton B-Line.
 - 3. Miro Industries, Inc.

2.11 ALUMINUM CONDUIT

- A. UL Labeled.
- B. Aluminum fittings shall meet the same requirements of aluminum conduits, compatible steel fittings.
 - 1. UL Labeled for use with aluminum conduit.

2.12 STAINLESS STEEL CONDUIT

- A. UL Labeled
- B. Rigid Stainless Steel:
 - 1. Type 304 Stainless Steel.
 - 2. Threaded ends.
 - 3. Insulated Bushings.
- C. EMT:
 - 1. Type 304 Stainless Steel.
 - 2. Compression Fittings.
 - 3. Insulated Bushings.
- D. Fittings, elbows, nipples, strut, device box, clamps straps, etc.
 - 1. Type 304 Stainless Steel.

2.13 ELECTRICAL NON-METALLIC TUBING (ENT)

- A. UL labeled Schedule 40.
- B. PVC fittings and solvent welded joints.
- C. Acceptable manufacture: Carlon .

2.14 EXTERIOR IN-GRADE PULL BOXES

- A. Enclosures, boxes and covers are required to conform to all test provisions of the most current American Association of State Highway and Transportation Officials (AASHTO) standards for H-20 loading applications.
 - 1. AASHTO H-20 certified precast concrete, cast iron or other AASHTO recognized materials, rated for deliberate traffic.
 - 2. Conduit entry knock-outs as required.
 - 3. Bolt down galvanized steel/cast iron covers.
 - 4. Thin wall knocks outs as required .
 - 4. Integral bottom.
 - 5. Box height as required for specified conduit depth and required top elevation.
 - 6. Concrete design strength of minimum 5,500 PSI at 28-days.
 - 7. Place enclosures on a minimum of 6 inches of coarse gravel with a border of 6-inches beyond the enclosures exterior dimension.
 - 8. Size and volume as required for application.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install electrical conduits and fittings for all wiring of any type unless specifically specified or instructed to do otherwise. Install conduits and fittings in accordance with local codes and applicable sections of the NECA "Standard of Installation", concealed where possible.
 - 1. Fasten conduit supports to building structure and surfaces; do not support to roof deck.
 - 2. Arrange supports to prevent misalignment during wiring installation.
 - 3. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports.
 - 4. Do not attach conduit to ceiling support wires.
 - 5. Arrange conduit to maintain head room and present neat appearance.
 - 6. Maintain 4-inch clearance between conduit and rooftop surfaces.
 - 7. Cut conduit square using saw or pipe cutter; de-burr cut ends.
 - 8. Bring conduit to shoulder of fittings; fasten securely.
 - 9. Conduit penetrations to all individual motor controllers, VFDs, and motor control cabinets shall only be made at the bottom of the enclosure. For other equipment, provide listed water sealing conduit hubs to fasten conduit to sides or tops of electrical equipment enclosures, device box, gutter, wireway, disconnect, etc.
 - 10. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
 - 11. Ground and bond conduit as required.
 - 12. Identify conduit as required.
 - 13. Route all conduits above building slab perpendicular or parallel to building lines.
 - 14. Do not use no-thread couplings and connectors for galvanized steel, PVC coated galvanized steel, or aluminum rigid conduit.
- B. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- C. In areas where raceway systems are exposed and acoustical or thermal insulating material is to be installed on walls, partitions, and ceilings, raceways shall be blocked out proper distance to allow insulating material to pass without cutting or fitting. Also provide Kindorf galvanized steel channels to serve as standoffs for panels, cabinets and gutters.
- D. Securely fasten conduits, supports and boxes, to ceiling (not roof deck), walls, with Rawl

Plugs or approved equal anchors. Use lead cinch anchors or pressed anchors. Use only cadmium plated or galvanized bolts, screws. Plastic anchors and lead anchors shall not be used for overhead applications.

- E. Provide separate raceway systems for each of the following when specified, indicated or required:
1. 120/208 volt circuits.
 2. 277/480 volt circuits.
 3. Emergency
 - a. Life safety branch.
 - b. Critical branch.
 - c. Equipment branch.
 4. Voice/Data.
 5. Sound reinforcement.
 6. Theatrical and Architectural Dimming Controls.
 7. MATV/CATV.
 8. Security CCTV.
 9. Security System.
 10. Communications / PA Systems / Sound System Line Input and Speakers.
 11. Fire Alarm.
 12. Lighting Control Systems.
 13. Building Management Control Systems.
- F. Unless shown otherwise, do not install conduit in or below concrete building slabs.
- G. Unless shown otherwise, do not install conduit horizontally in concrete slabs.
- H. Roof penetrations shall be made in adequate time to allow the roofing installer to make proper flashing. Conduit for equipment mounted on roof curbs shall be routed through the roof curb. Conduit, gutters, pull boxes, junction boxes, etc. shall not be routed on roof unless specified otherwise. Where specifically indicated to be routed or mounted on the roof, supports shall be as specified, as recommended by roofing manufacturer and roof support manufacturer and as required by NEC. Place supports every five feet along conduit run and within 3 feet of all bends, condulets, and junction boxes. Provide roofing pad under stands as directed by Architect and as recommended by roofing manufacturer and roof support manufacturer. Provide additional unistrut supports and accessories as required.
- I. PVC coated conduit shall have all nicks and cuts to the protective coating repaired using manufacturer's approved touch-up material as recommended by manufacturer. Provide a minimum of two-wraps of 3M-50 type tape over touch-up.
- J. Installation of the PVC Coated Conduit System shall be performed in accordance with the Manufacturer's Installation Manual. To assure correct installation, the installer shall be certified by Manufacturer to install coated conduit. Submit copies of training certification with submittal. Contractor shall coordinate installation with manufacturer's representative for field training and observation of installed PVC coated rigid galvanized conduit and fittings. Manufacturer's representative shall certify the installation is in accordance with manufacturer's installation instructions. Submit copies of installation certification prior to cover-up of underground installation.
- K. All conduit terminations at locations including but not limited to, switchgear, pull boxes, outlet boxes, stub-up, and stub-outs:
1. Provide insulated throat connectors for EMT conduits.
 2. Provide insulated bushing on all rigid conduit terminations.

3. Provide locknuts inside and outside of all boxes and enclosures.
 4. Provide threaded type plastic bushing at all boxes and enclosures.
- L. In suspended ceilings, support conduit runs from the structure, not the ceiling system construction.
1. Do not support from structural bridging.
 2. Do not support from metal roof deck.
- M. Completely install each conduit run prior to pulling conductors. All boxes are to be accessible after completion of construction.
- N. All conduits must be kept dry and free of water or debris with approved pipe plugs or caps. Cap or plug conduit ends prior to concrete pours.
- O. Ream ends of conduits after cutting and application of cutting die to remove rough edges.
- P. Install all above concrete slab conduits perpendicular or parallel to building lines in the most direct, neat and workmanlike manner.
1. Cable Tension:
 - a. 0.008 lb./cmil for up to 3 conductors, not to exceed 10,000 pounds.
 - b. 0.0064 lb./cmil for more than 3 conductors, not to exceed 10,000 pounds
 - c. 1000 lbs. per basket grip.
 2. Sidewall pressure: 500 lbs./ft.
 3. Conduit runs within the following limits of bends and conduit length between pull points shall not exceed the above installation pulling tension and sidewall pressure limits.
 - a. Three (3) equivalent 90-degree bends: not more than fifty feet (50') between pull points.
 - b. Two (2) equivalent 90-degree bends: not more than one hundred feet (100') between pull points.
 - c. One (1) equivalent 90-degree bend: not more than one hundred fifty feet (150') between pull points.
 - d. Straight pull: not more than two hundred feet (200') between pull points.
 4. Indicate sizes of conduits, wireway sections, and cable tray sections on the as-built drawings.
 5. Hold horizontal and vertical conduits as close as possible to walls, ceilings and other elements of the building construction. Conduits shall be kept a minimum of 6 inches clear of roof deck / insulation, and 2 inches clear of above floor deck / insulation.
 6. Install conduits to conserve building space and not obstruct equipment service space or interfere with use of space. Conduit shall not be routed on floors, paved areas or grade.
 7. Where a piece of equipment is wired from a switch or box on adjacent wall, the wiring shall go up the wall from the box, across at or near the ceiling, and back down to the equipment. Wiring shall not block the walkway between wall and equipment.
 8. Horizontal runs of conduit on exposed walls shall be kept to a minimum.
 9. Conduit for mechanical / plumbing equipment installed outdoors shall be routed with the associated mechanical / plumbing pipe support rack system where practical, coordinate with Divisions 22 and 23.
 10. Conduits installed in public areas, not concealed by architectural ceilings, shall be supported by galvanized steel channel racks to bottom of roof deck or floor deck. Conduits shall be grouped for neat workman-like appearance.
- Q. Install expansion and deflection fittings and bonding jumpers on straight runs which exceed 200-feet, on center, and at 200-feet maximum, on center, on straight runs which

exceed 400-feet, and where conduits cross building expansion joints.

- R. Provide grounding bushings at concentric/eccentric knockouts or where reducing washers are used.
- S. Run conduit to avoid proximity to heat producing equipment, piping surfaces with temperatures exceeding 104 degrees F., and flues, keeping a minimum of 13-inches clear.
- T. Install conduit as a complete system, without conductors, continuous from outlet to outlet and from fitting to fitting. Make up threaded joints of conduit carefully in a manner to ensure a tight joint. Fasten the entire conduit system into position. A run of conduit between outlet and outlet, between fitting and fitting, or between outlet and fitting shall not contain more than the equivalent of four quarter bends, including those bends located immediately at the outlet or fitting.
- U. Conceal conduit systems in finished areas. Conduit may be exposed in mechanical and electrical rooms, and where otherwise shown or indicated only. Run the conduit parallel and perpendicular to the structural features of the building and support with malleable iron conduit clamps at intervals as required by NEC or on conduit racks, neatly racked and bent in a smooth radius at corners.
- V. Conduit bends shall be factory elbows or shall be bent using equipment specifically designed to bend conduit of the type used to maintain the conduit's UL listing. Conduit hanger spacing shall be 10 feet or less and as required by the NEC for all conduit. Beam clamp attachments to steel joist chords is prohibited. Beam clamps may only be used at beams, no exceptions. Connections to joists shall be made with galvanized channel extended between joist chords or with galvanized channel bearing on the vertical legs of joist chord angles.
- W. Support conduit on galvanized channel, using compatible galvanized fittings (bolts, beam clamps, and similar items), and galvanized threaded rod pendants at each end of channel and secure raceway to channel and channel to structure. Where rod pendants are not used, channel supports are to be secured to structure at each end. Conduit supports are to be secured to structure using washers, lock washers, nuts and bolts or rod pendants; use of toggle bolt "wings" are not acceptable. Support single conduit runs using a properly sized galvanized conduit hanger with galvanized closure bolt and nut and threaded rod. Raceway support system materials shall be galvanized and manufactured by Kindorf, Unistrut, Superstrut, Caddy, or Spring Steel Fasteners, Inc. Provide chrome or nickel-plated escutcheon plates on conduit passing through walls and ceilings in finished areas. Do not support conduit from other conduit, structural bridging or fire rated ceiling system. Do not support more than one conduit from a single all-thread rod support. Provide electrical insulating sleeve or wrapping for aluminum conduit supported by zinc coated supports or fasteners. Channel supports shall have cut ends filed smooth. When installed outside of the building, or in areas subject to moisture, the cut ends shall be painted with ZRC galvanized paint or equivalent.
- X. Terminate all motor connection conduits in mechanical room spaces with a floor pedestal and with "Tee" conduit at motor outlet height for flexible conduit.
- Y. Where conduit is not embedded in concrete or masonry, conduit shall be firmly secured by approved clamps, half-straps or hangers. Tie wire and short pieces of conduit used as supports and or hangers are not approved.
- Z. Where "LB" condulets are used, 2-inches and larger shall be type "LBD".

- AA. No more than 12 conduits containing branch circuits may be installed in junction boxes, pull boxes or gutters.
- BB. Flexible metal conduit and liquid tight flexible metal conduit shall only be used for final connections from junction box to equipment, light fixtures, power poles, etc. They are not to be used in lieu of conduit runs. They shall not be used for wall or roof penetrations unless they are installed in a PVC coated RGC conduit sleeve at least one size larger than the OD of the flexible conduit.
- CC. Where 3-1/2-inch conduit is specified and the required or specified material is Schedule 80 PVC, provide 4-inch conduit.
- DD. "Daisy Chaining" light fixtures installed for lay-in ceiling areas is not allowed. Each light fixture shall have its own fixture whip from junction box. The only exception being light fixtures installed end to end using chase nipples between them, or light fixtures recessed in non-accessible ceilings.
- EE. In above ceiling applications, do not install raceways, junction boxes, gutters, disconnects, etc. within 36 inches directly in front of HVAC control boxes or other equipment requiring access from a point starting from the top of control box / equipment down to ceiling.
- FF. Do not install conduit, junction boxes, etc. within 18 inches of outside edges of roof access openings.
- GG. Install minimum size 2-inch nipple, at least one, between multi-sectional panels for branch circuit independent of feeder conductors.

3.2 CONDUITS

- A. Conduit above grade indoors:
 - 1. Concealed Conduits: EMT with set screw fittings.
 - 2. Exposed conduits:
 - a. Below nine feet AFF where not directly attached and against building walls, ceiling, or structure: Rigid metal conduit or x-wall RTRC.
 - b. Where subject to physical damage: Rigid metal conduit or x-wall RTRC.
 - c. Wet locations: PVC coated galvanized rigid steel or aluminum conduit
 - d. Damp Locations: Aluminum rigid conduit or x-wall RTRC.
 - e. Exposed conduits in mechanical rooms or electrical rooms shall be rigid galvanized steel or x-wall RTRC when installed below 18-inches above finished floor.
- B. Conduit installed above grade outdoors:
 - 1. Galvanized rigid steel or x-wall RTRC for conduits up utility poles and where subject to physical damage or where located less than four feet above finished floor.
 - 2. Aluminum or x-wall RTRC where not subject to physical damage and where located four feet above finished floor.
- C. Conduit where indicated underground:
 - 1. PVC Coated Galvanized rigid steel or RTRC conduit elbows and Schedule 80 PVC, RTRC, or PVC coated galvanized steel straight run conduits. PVC conduits for underground branch circuits shall be Schedule 80 or Schedule 40 PVC.
 - a. PVC conduit and fittings shall be used only for straight horizontal runs and for vertical risers at site lighting pole bases. Bending straight sections of PVC conduit to less than 25-foot radius or the use of PVC

- factory bends is not allowed.
 - b. Change in direction of conduit runs, either vertical or horizontal, shall be with RTRC or PVC coated galvanized steel elbows or long sweep bends of straight PVC conduit sections. Long sweep bends of straight PVC 20-foot sections shall have a minimum radius of curvature of 25 feet and a maximum arc of 22.5degrees. Multiple long sweep bends of straight PVC sections shall be separated by a minimum of 20-feet of straight, linear, PVC sections.
 - c. Provide RTRC or PVC coated rigid galvanized steel conduit elbows and fittings with urethane interior coating at all changes in direction with radius of less than 25-feet and at all vertical runs to 18 inches above finished floor elevation. For interior slab penetrations, provide continuous RTRC or PVC coated rigid galvanized steel conduit and fittings with urethane interior coating from change in direction to 18 inches above finished floor elevation, except where stubbed-up under and inside equipment or switchgear where conduit shall be terminated at minimum two inches above concrete housekeeping pad.
 - d. Elbows for underground electrical service entrance, feeders, transformer primary / secondary, telecommunication, and low voltage conduits shall be RTRC or PVC coated rigid galvanized steel with long radius as follows:
 - 1) Up to 1-inch conduit, minimum 12-inch radius.
 - 2) 1.5-inch conduit, minimum 18-inch radius.
 - 3) 2-inch conduit, minimum 24-inch radius.
 - 4) 2.5-inch conduit, minimum 30-inch radius.
 - 5) 3-inch conduit, minimum 36-inch radius.
 - 6) 3.5 to 6-inch conduit, minimum 48-inch radius.
 - e. Conduit for all floor boxes shall be routed below building slab from floor box to nearest column, wall, or as indicated.
 - f. Conduits shall not be routed horizontally in building slab, grade beams or pavement.
2. Encase all underground conduits in concrete.
- a. Concrete shall be tinted red throughout with a ratio of 10 pounds of dye per yard of concrete unless prohibited by utility for utility conduits. Concrete encasement for utility installed conductors shall be as specified by the utility and comply with their standards and specifications. Where utility does not require but allows concrete encasement of conduits, provide concrete encasement as specified herein.
 - b. Provide minimum 3-inch concrete encasement around conduits.
 - c. Provide conduit spacers for parallel branch/feeder conduits.
 - d. When prior written approval from Owner and Architect to omit concrete encasement of conduits below building slab is given, conduits either specified or approved in writing to be routed under building slab without concrete encasement for electrical branch circuits or voice / data / video / communications horizontal drops or outlets shall be installed 18 inches below finished floor and on select fill. All other conduits, including but not limited to electrical feeders, voice / data / video / communications vertical, riser, tie, trunk, or service cable conduits shall be installed 48-inches below finished floor and on select fill.
 - e. Use suitable manufactured separators and chairs installed 4 feet on centers. Securely anchor conduit at each chair to prevent movement during backfill placement.
3. Install building voice / data / video / communications main service conduits and electrical service transformer primary and secondary conduits with top of concrete encasement minimum 48-inches below finished grade or pavement. Voice / data / video / communications conduits and electrical service primary

conduits for utility owned electrical service transformers shall also comply with the respective utility company requirements and standards. All other underground conduits outside of building other than voice / data / video / communications main service conduits and electrical service transformer primary and secondary conduits shall have top of concrete encasement at 36 inches minimum below finished grade or pavement.

4. Provide two "caution" plastic tapes at 6-inches and 18-inches below finished slab, grade, or pavement; identify as specified in Section 26 05 00.
 5. Conduits located outside building, provide magnetic locator tape at top of first compacted layer of backfill or concrete.
 6. During construction, partially completed underground conduits shall be protected from the entrance of debris such as mud, sand, and dirt by means of conduit plugs. As each section of the underground conduit is completed, a testing mandrel with diameter ¼-inch smaller than the conduit, shall be drawn through each conduit. A brush with stiff bristles shall be drawn through until conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.
 7. Utility underground conduit for Utility Company cable shall be installed per Utility Company standards, and their specifications for this project.
 8. Concrete shall be Portland Cement conforming to ASTM-C-150, Type 1, Type III or Type V if specified. Cement content shall be sufficient to product minimum strength of 2,500 PSI.
 9. Contractor shall stake out routing and location of underground conduits using actual field measurements. He shall obtain approval of the Owner and Architect before beginning trenching, horizontal drilling, and excavation.
 10. Verify location and routing of all new and existing underground utilities with the Owner and Architect on the job site. Stake out these existing utilities so that they will not be damaged. Stake out new utilities to provide coordination with other trades and with new and existing utilities, easements, property lines, restricted land use areas, and right-of-ways. Verify existing public utilities with Call811.
- D. Conduit shown in concrete walls, floor or roof slab:
1. PVC Coated Galvanized Rigid steel.
- E. Conduits that penetrate concrete slab, or within 100 feet of cooling towers, or at designated corrosive locations.
1. RTRC.
 2. PVC coated galvanized rigid steel.
- F. Connections to equipment mounted on roof, rotating equipment, transformers, and kitchen or food processing equipment, or where flexible conduit is required outdoors.
1. Liquid tight flexible metal conduit (1/2 inch may be used for roof top supply / exhaust fans only).
 2. Liquid tight flexible metal conduit for 24-inch maximum length.
 3. Conduit for roof-mounted equipment shall be routed inside the roof curb assembly roof opening. Provide permanent lock-off device at panelboard circuit breakers serving roof equipment and accessories to enable tag-out procedures for all power routed through roof curb and to the roof mounted equipment and accessories.
- G. Light fixture whips:
1. Accessible ceilings and open structure: ½-inch flexible steel conduit or steel MC cable, length not to exceed 6-feet.
 2. Non-accessible ceilings: ½-inch flexible steel conduit. Length as required to make a tap at an accessible j-box. Recessed light fixtures in non-accessible ceilings may be daisy chained using the light fixture's integral, UL listed j-box or internal wire way that is accessible through fixture from below the ceiling.

3. Dedicated insulated ground wire.
 4. Light fixture whips shall not rest on ceiling grid or tile.
 5. Light fixture whips shall not be supported from the ceiling suspension system. Support from the structure with #13 AWG galvanized iron wire pendants and Caddy clips. Do not support conduit from structural bridging. Flexible conduit and steel MC cable shall be kept a minimum of 2 inches clear of roof deck.
- H. Conduits at Natatorium or therapeutic pool areas:
1. Underground conduit shall be as specified in this section.
 2. Exterior conduits and boxes within 100 feet of exhaust openings shall be x-wall RTRC or PVC coated galvanized rigid steel or stainless steel.
 3. Exposed conduits in chemical storage rooms, pool mechanical equipment (pump rooms, and pool equipment storage rooms shall be Schedule 80 PVC. Boxes shall be PVC, or 304 Stainless Steel.
 4. Exposed conduits and boxes in indoor pool areas and all other indoor public areas shall be Type 304 Stainless Steel.
- I. Conduits located inside greenhouses and natatorium pump and water treatment rooms:
1. X-wall RTRC.
 2. Schedule 80 PVC.
 3. PVC coated galvanized rigid steel conduit and fittings.
- J. Conduits in classified hazardous (Classified) locations:
1. Conduit fittings and seals UL listed for the classification.
- K. Conduits embedded in parking structure traffic wearing surface and concrete support structures:
1. Schedule 40 PVC, RTRC, PVC coated rigid galvanized conduit.
 2. Schedule 40 ENT may only be used for flat runs embedded in traffic wearing surface concrete topping.
 2. Solvent welded fittings only for PVC conduit and ENT.
 3. Verify with Structural Engineer prior to construction for any additional limitations for raceway installation restrictions installed in parking structure including but not limited to maximum outside diameter of raceways permitted to be used in the wearing surface, and field cutting or drilling through parking structure structural members or support structures.
 4. All raceways shall be securely fastened to prevent floating during concrete installation. ENT raceways shall be completely embedded in concrete material to maintain fire and smoke integratory as required by the NEC.
 5. When using ENT or PVC conduits, provide transition to x-wall RTRC or PVC coated rigid galvanized conduit elbows and vertical risers to ensure that only flat horizontal runs of PVC conduit or ENT are used along the top of the parking structure structural support deck and that they are completely concealed and embedded by the wearing surface concrete material topping.

3.3 CONDUIT PENETRATIONS, SLEEVES AND ESCUTCHEONS

- A. Furnish sleeves for placing in construction for all conduit passing through concrete or masonry walls, partitions, beams, all floors other than grade level, and roofs. A conduit sleeve shall be one size larger than the size of conduit, which it serves except where larger sizes are required for manufactured water, fire, or smoke stop fittings.
1. Sleeves set in concrete floor construction shall be minimum Schedule 40 galvanized steel.
 2. Sleeves shall extend 3-inches above the finished floor.
- B. Sleeves in concrete or masonry walls shall be RTRC or Schedule 40 galvanized steel.

Sleeves shall be set flush with finished wall.

- C. Install manufactured UL listed water, fire, and smoke stop fittings, or caulk around conduit or cables in sleeves with sufficient UL listed fire safe insulation or foam to maintain wall or floor slab fire or smoke rating. Refer to Architecture drawings for locations of rated walls.
- D. Provide Linkseal Mechanical Seals around conduit penetrations through walls below grade. Provide a pull box to install a water stop inside wall penetration. Internally seal low voltage cabling conduit penetrations with waterproof caulking.
- E. Sleeves penetrating walls below grade shall be Schedule 40 black steel pipe with ¼-inch thick steel plate secured to the pipe with continuous fillet weld. The plate shall be located in the middle of the wall and shall be 2-inches wider all around than the sleeve that it encircles. The sleeve should extend a minimum of 24-inches on either side of the penetration. The entire assembly shall be hot-dipped galvanized after fabrication. Do not sleeve or penetrate grade beams.
- F. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with a threaded steel bushing. Route conduit through roof openings, for piping and ductwork or through suitable roof jack, with pitch pocket. Coordinate location with roofing installation as required.
- G. Conduit passing through fire rated wall shall be sealed with Fire Stop. Route conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division 7.

3.4 POWER DISTRIBUTION UNDERGROUND FEEDER CONDUIT AND UNDERGROUND SERVICE ENTRANCE CONDUIT

- A. Power underground feeder and service entrance shall be of individual conduit encased in concrete. Unless shown otherwise, the type of conduit used shall not be mixed in any one underground conduit and shall be the size indicated on the drawings. The concrete encasement surrounding the underground conduit shall be rectangular in cross-section, having a minimum concrete thickness of 3-inches, except that conduit for 120V and above shall be separated from control and signal conduits by a minimum concrete thickness of 3-inches. Encasement concrete shall be tinted in red.
- B. During construction, partially completed underground conduits shall be protected from the entrance of debris such as mud, sand, and dirt by means of conduit plugs. As each section of the underground conduit is completed, a testing mandrel shall be drawn through until each conduit is clear of particles of earth, sand, or gravel. Conduit plugs shall then be installed.
- C. Furnish the exact dimensions and location of power underground conduit to be encased in time to prevent delay in the concrete work.
- D. Conduit for service entrance underground conduits shall be as indicated on the drawings.
- E. Primary power underground conduit shall be installed in accordance with utility company standards and the utility company specifications for this project.

3.5 TELECOMMUNICATIONS, LOW VOLTAGE AND EMPTY CONDUIT SYSTEM RACEWAYS

- A. Conduit shall be installed in accordance with the specified requirements for conduit and with the additional requirements that no length of run shall exceed 100-feet for 1 inch or smaller trade sizes and shall not contain more than two 90-degree bends or the

equivalent. Pull or junction boxes shall be installed to comply with these requirements. Provide plastic bushings at all conduit terminations. Provide a grounding bushing on each data and voice conduit.

- B. Conduits shall be installed from outlet box to above an accessible ceiling. All cables routed through open spaces (no-ceiling below roof deck or above floor deck) shall be routed in conduit. Telecommunications systems, CATV, CCTV, fire alarm and BMCS cables can be installed above accessible ceilings without conduit. Cables installed above accessible ceiling shall be plenum rated. Conduit rough in of these cables shall include a 90-degree turn-out to an accessible location with insulated bushings on the end of the conduit.
1. Provide conduit from each telecommunications outlet box to accessible ceiling plenum.
 2. Provide conduit from each security / surveillance device outlet box to accessible ceiling plenum.
 3. Provide two conduits for each multi-media outlet box and each outlet box indicated to contain more than four data, audio, or video drops to accessible ceiling plenum.
 4. Provide the following minimum conduits for telecommunications and multi-media wall, floor, and ceiling mounted outlet boxes. Use the largest diameter conduit indicated below unless instructed otherwise in writing from the Architect:
 - a. Non-masonry outlet box: Two 1-inch conduits.
 - b. Masonry outlet box: Two 1-inch conduits, or three 3/4-inch conduits.
 - c. Where indicated differently on plans or where conflicts arise, notify the Architect / Engineer prior to installation.
- C. All conduit in which cable is to be installed by others shall have pull string installed. The nylon pull string shall have not less than 200 lb. tensile strength. Not less than 12-inches of slack shall be left at each end. Provide blank cover plate before substantial completion if box is for a future installation after substantial completion of the project. Conduit shall extend to a minimum six inches above nearest accessible ceiling and be turned horizontally with plastic bushing at terminations.
- D. Conduits for Building Entrance Facilities:
1. Underground Outside Plant: Install a pull box every 300-feet or after 180 degree turns.
 2. Inside Plant: Install a pull box every 150-feet or after 180 degree turns. All turns shall be large sweeps, not sharp 90s, with the radius of the sweep at least 10X the diameter of the conduit. Hence, a 4-inch conduit requires a 40-inch minimum radial sweep. If field conditions absolutely mandate a sharp 90-degree bend to be installed, then a pull box shall be installed at that location regardless of distance.
 3. Building entrance facilities shall not terminate in an IDF or any other space except the MDF.
 4. Coordinate the termination location of the building entrance facilities in the MDF with the room layout and equipment configuration.
 5. Provide 4-inch conduit unless indicated otherwise. Provide (3) fabric innerducts in each 4-inch conduit.

3.6 EXTERIOR IN-GRADE PULL BOXES

- A. Provide pull boxes where specified and as required.
- B. Pull boxes located in pavement shall be set with proper extensions so that top of cover is flush with pavement.

- C. Pull boxes located in non-paved areas shall be set two-inches above surrounding finished grade. Provide 12-inch wide by 8-inch deep reinforced concrete crown around neck or opening and sloped down away from pull box opening.

3.7 ALUMINUM ALLOY CONDUCTORS

- A. Where aluminum alloy conductors are specified, approved and substituted for copper conductors, provide the required conduit size based on conduit fill using NEC or recognized cable manufacturer's conduit fill tables for aluminum alloy compact conductors.

3.8 IDENTIFICATION

- A. Conduit Systems: Provide adequate marking of conduit larger than one inch exposed or concealed in interior accessible spaces to distinguish each run as either a power (120/208V or 277/480V) or signal / telecommunication conduit (Fire Alarm, BAS, BMCS, Security, CCTV, Access Control, Intrusion Detection, Telecom, etc.). Except as otherwise indicated, use orange banding with black lettering. Provide self-adhesive or snap-on type plastic markers. Locate markers at ends of conduit runs, near switches and other control devices, near items of equipment served by the conductors, at points where conduit passes through walls or floors or enters non-accessible construction, and at spacing of not more than 50-feet along each run of exposed conduit. Switch-leg conduit and short branches for power connections need not be marked, except where conduit is larger than 1-inch.

END OF SECTION

SECTION 26 05 35

ELECTRICAL CONNECTIONS FOR EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Electrical connections as required and scheduled, and as specified.

1.2 RELATED WORK

- A. Refer to other Divisions for specific individual equipment electrical requirements.

1.3 QUALITY ASSURANCE

- A. UL Label: Products shall be UL listed to the extent possible.

PART 2 - PRODUCTS

2.1 MATERIALS AND COMPONENTS

- A. General: For each electrical connection indicated, provide a complete assembly including, but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories needed to complete splices and terminations.
- B. Raceways: Refer to related sections.
- C. Conductors and Connectors: Refer to related section. Conductors at equipment terminations shall be copper.
- D. Terminals: Provide electrical terminals as indicated by the terminal manufacturer for the application.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL CONNECTIONS

- A. General: Install electrical connections as shown, in accordance with applicable portions of the NECA Standard of Installation, and industry practices.
- B. Conductors: Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Where possible, match conductors of the electrical connection for interface between the electrical supply and the installed equipment.
- C. Splice Insulation: Cover splices with electrical insulation equivalent to, or of a higher rating than, insulation on the conductors being spliced.
- D. Appearance: Prepare conductors by cutting and stripping covering, jacket, and insulation to ensure a uniform and neat appearance where cables and wires are terminated.
- E. Routing: Trim cables and wires to be as short as practical. Arrange routing to facilitate inspection, testing, and maintenance.

- F. Motor Connections: Where possible, terminate conduit in conduit boxes at motors. Where motors are not provided with conduit boxes, terminate the conduit in a suitable conduit, and make motor connections. Conduit passing through the housing on connected equipment shall pass through a cleanly cut hole protected with an approved grommet. For all AHU or fan motors and all other motors 10 HP and larger, at the motor connection do not use wire nuts. Provide copper alloy split bolt connectors or compression lugs and bolts. Insulate connection with Scotch Super 88 vinyl electrical tape over rubber tape, or Tyco Gelcap Motor Connection Kit.
- G. Conduit connections to equipment including, but not limited to, Variable Frequency Drives, Manual and Automatic Transfer Switches, Surge Suppression Devices, motor controllers, electrical disconnects, food service / processing equipment, electronics, control panels and Owner furnished equipment:
1. Make conduit penetrations only at the bottom flat surface of the equipment and only where permitted by the equipment manufacturer to avoid un-intentional water entry. Coordinate installation of electrical connections for equipment with equipment installation work. Where equipment manufacture does not permit a bottom conduit entry, verify with Owner/Engineer and locate the conduit entry at the side surface as close as possible to the bottom of the enclosure.
 2. Where conduit originates from an elevation above the conduit entry, provide a "T" conduit below the enclosure's bottom elevation. Provide conduit from the conduit up to the enclosure bottom horizontal surface for electrical connection.
- H. Identification: Refer to Electrical General Provisions for identification of electrical power supply conductor terminations with markers approved as to type, color, letter and marker size by the Architect. Fasten markers at each termination point, as close as possible to each connecting point.
- I. Equipment and Furnishings: Refer to other Divisions. Coordinate power and control provisions shown for equipment and furnishings with the provisions required for the furnished equipment and furnishings. Where the power and control requirements are less than or equal to those specified, modifications to power and control provisions shall be made at no cost as a part of coordination. Where power and control requirements are in excess of those shown, notify the Architect in writing of the requirements.

END OF SECTION

SECTION 26 05 37

ELECTRICAL BOXES AND FITTINGS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide electrical box and fitting work as required, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

- A. UL Label: Electrical boxes and fittings shall be UL listed.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS

- A. Interior Outlet Boxes: Provide galvanized steel interior outlet wiring boxes, of the type, shape, and size, including depth of box, to suit respective locations and installation. Construct with stamped knockouts in back and sides. Provide gang boxes where devices are shown grouped. Single box design; sectional boxes are not acceptable, except for wall mounted electronic displays.
 - 1. Type of Various Locations:
 - a. Wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations; recessed wall mounted box for power and/or multi-media (low voltage) outlets: Arlington Industries #TVBS 613, 4-gang steel box with white trim plate.
 - b. Technology, data, voice, video and multi-media outlet boxes at locations other than wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations: minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes. Raco #260H large capacity box with ½ through 2-inch knockouts.
 - c. Security, access control, and video surveillance outlet boxes: single gang, 3-inch deep outlet boxes mounted long axis vertically.
 - d. All other applications: minimum 4-inch square (2-gang) 2-1/8-inch deep boxes.
 - e. Masonry Walls: Galvanized switch boxes made especially for masonry installations; depths of boxes must be coordinated for each installation.
 - f. Surface: Type FS or FD box with surface cover.
 - g. Corrosive locations or natatorium areas: 316 stainless steel construction suitable for the installation.
 - h. Hazardous (Classified) Locations: Explosion proof boxes, seals and fittings.
 - i. Special: Where above types are not suitable, boxes as required, taking into account space available, appearance, and Code requirements
 - 2. Interior Outlet Box Accessories: Outlet box accessories required as for installation, including covers or wall device plates, mounting brackets, wallboard hangers, extension rings, plaster rings for boxes in plaster construction, fixture studs, cable clamps and metal straps for supporting outlet boxes. Accessories shall be compatible with outlet boxes used and meet requirements of individual wiring.
- B. Damp Location Outlet and Damp or Wet Location Switch Boxes: Deep type, hot dipped galvanized cast-metal weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends, and stainless steel cover plate

with spring-hinged waterproof caps suitable for application. Include faceplate gasket and corrosion-resistant, tamper / vandal proof fasteners.

- C. Wet Location Outlet Boxes: Hot dipped galvanized cast-iron weatherproof outlet wiring boxes, of type, shape, and size required. Include depth of box, threaded conduit ends.
- D. Junction and Pull Boxes: Galvanized sheet steel junction and pull boxes, with screw-on covers, of type, shape, and size, to suit respective location and installation.
 - 1. Type for Various Locations:
 - a. Minimum Size: 4-inch square, 2-1/8-inches deep.
 - b. 150 Cubic Inches in Volume or Larger: Code gauge steel with sides formed and welded, screw covers unless shown or required to have hinged doors. All boxes mounted above ceiling shall have screw covers. Boxes in all other areas with covers larger than 12-inches shall have hinged with screw covers. Knockouts factory stamped or formed in field with a cutting tool to provide a clean symmetrically cut hole.
 - c. Exterior or Wet Areas: 304 stainless steel NEMA 4X construction with gaskets and corrosion-resistant fasteners.
- E. Conduit Bodies: Provide galvanized cast-metal conduit bodies, of type, shape, and size, to suit location and installation. Construct with threaded conduit ends, removable cover, and corrosion-resistant screws.
- F. Bushings, Knockout Closures, and Locknuts: Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts, and insulated conduit bushings of type and size to suit use and installation.
- G. Outlet boxes in fire rated walls: Provide 2-hour rated gasket within box and below cover, equal to Rectorseal Metacaulk box guard and cover guard.

PART 3 - EXECUTION

3.1 INSTALLATION OF BOXES AND FITTINGS

- A. Install electrical boxes and fittings as shown and as required, in compliance with NEC requirements, in accordance with the manufacturer's written instructions, in accordance with industry practices.
- B. Provide recessed device boxes for wall mounted interactive media boards, video displays, televisions, electronic signage and similar installations.
- C. Provide minimum 4-inch square (2-gang), 3-inch deep interior outlet boxes for technology, data, voice, video, and multi-media outlet boxes at locations other than wall mounted interactive boards, video or visual displays. Provide single gang only, 3-inch deep outlet boxes mounted long axis vertically for security, access control, and video surveillance, coordinate with security equipment installation. Provide minimum 4-inch square (2-gang) 2-1/8-inch deep boxes for all other applications. Where indicated differently on plans or where conflicts arise, notify the Architect / Engineer prior to installation. Box extenders or plaster rings shall not be used to increase size. Provide increased box size as required.
- D. Junction and pull boxes, condulets, gutters, located above grid ceilings shall be mounted within 18-inches of ceiling grid. Junction and pull boxes above grid ceilings shall be mounted in the same room served. Junction boxes and pull boxes required for areas with inaccessible ceilings shall be located above the nearest accessible ceiling area. All junction box or pull box openings shall be side or bottom accessible. Removal of light

fixtures, mechanical equipment or other devices shall not be required to access boxes. Outlet boxes above ceiling for low voltage terminations shall face towards the floor.

- E. Use outlet and switch boxes for junctions on concealed conduit systems except in utility areas where exposed junction or pull boxes can be used.
- F. Determine from the drawings and by measurement the location of each outlet. Locate electrical boxes to accommodate millwork, fixtures, marker boards, and other room equipment at no additional cost to the Owner. The outlet locations shall be modified from those shown to accommodate changes in door swing or to clear interferences that arise from construction as well as modifying them to center in rooms. The modifications shall be made with no cost as part of coordination. Check the conditions throughout the job and notify the Architect of discrepancies. Verify modifications before proceeding with installation. Set wall boxes in advance of wall construction, blocked in place and secured. Set all wall boxes flush with the finish and install extension rings as required extending boxes to the finished surfaces of special furring or wall finishes. Provide wall box support legs attached to stud to prevent movement of box in wall.
- G. Unless noted or directed otherwise at installation, place outlet boxes as indicated on architectural elevations and as required by local codes.
- H. Outlets above counters, mount long axis horizontally. Refer to architectural elevations and coordinate to clear backsplash and millwork.
- I. Provide pull boxes, junction boxes, wiring troughs, and cabinets where necessary for installation of electrical systems. Surface mounted boxes below 9 feet and accessible to the public shall not have stamped knockouts.
- J. Provide weatherproof boxes for interior and exterior locations exposed to weather or moisture.
- K. Provide knockout closures to cap unused knockout holes in boxes.
- L. Locate boxes and conduit bodies to ensure access to electrical wiring. Provide minimum 12-inch clearance in front of box or conduit body access.
- M. Secure boxes to the substrate where they are mounted, or embed boxes in concrete or masonry.
- N. Boxes for any conduit system shall not be secured to the ceiling system, HVAC ductwork or piping system.
- O. Provide junction and pull boxes for feeders and branch circuits where shown and where required by NEC, regardless of whether or not boxes are shown.
- P. Coordinate locations of boxes in fire rated partitions and slabs to not affect the fire rating of the partition or slab. Notify the Architect in writing where modification or construction is required to maintain the partition or slab fire rating.
- Q. Exterior boxes installed within 50-feet of cooling towers or water treatment areas shall be of 304 stainless steel, weatherproof NEMA 4X construction.
- R. Identification: Paint the exterior and cover plates of building interior junction boxes and pull boxes located above accessible ceilings or non-finished areas to correspond to the following colors:
 - 1. Orange: - 480/277 VAC systems.

2. Light Blue: - 240 VAC three phase delta systems.
 3. Red – All Emergency circuits, regardless of voltage, and fire alarm system.
 4. Light Green - 120/208 VAC 3 phase and 120/240 VAC single-phase systems
 5. Yellow – Building Management and Control System – BMCS.
 6. White - Security and Surveillance equipment circuits.
- S. All box covers shall be labeled with Panel ID and circuit numbers of all circuits available in box using permanent black marker. Boxes containing main feeders are to list where fed from and load (example “MSB to Panel HA”). Information listed is to be legible, markovers are not acceptable. Multi-sectional panel numbers are not to be listed on covers (example “LA2” referring to Panel LA sec. 2 is to be listed as “LA”). Label covers for special applications explaining contents (example “Emerg. Gen. Annunciator controls”, “IDF ground”). Do not attach box covers that have both sides painted or labeled differently. In public areas where boxes are painted same color as room per architect, label inside covers. Boxes that are not used shall be labeled as not used and include panel ID. Example “Not Used Panel LA”. Unused raceways not in sight of panel shall be terminated in a box and labeled not used and include panel identification.
- T. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- U. Use flush mounting outlet box in finished areas unless specifically indicated as being used with exposed conduit.
- V. Locate flush-mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- W. Do not install flush mounting box back-to-back in walls; provide minimum 6 inches with stud separation. Provide minimum 24 inches with separation in acoustic rated walls.
- X. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness. Provide UL listed materials to support boxes in walls to prevent movement. Ensure box cannot be pushed inside wall.
- Y. Use stamped steel bridges to fasten flush mounting outlet box between studs.
- Z. Install flush mounting box without damaging vapor barriers, wall insulation or reducing its effectiveness.
- AA. Use adjustable steel channel fasteners for hung ceiling outlet box.
- BB. Do not fasten boxes to ceiling support wires.
- CC. Support systems are to hang vertically straight down. All-thread supports, when used, are not to be installed at an angle or bent.
- DD. Use gang box where more than one device is mounted together. Do not use sectional box.
- EE. Use gang box with plaster ring for single device outlets.
- FF. Support outlets flush with suspended ceilings to the building structure.
- GG. Mount boxes to the building structure with supporting facilities independent of the conduits or raceways.

- HH. Where multiple feeders are in one pull box, conductors shall be wrapped with 3M No. 7700 Arc and fireproof tape.
- II. Provide plaster rings of suitable depth on all outlet boxes. Face of plaster ring shall be within 1/8 inch from finished surface.
- JJ. Equip boxes supporting fixtures designed to accept fixture studs with 3/8-inch stud (galvanized malleable iron) inserted through back of box and secured by locknut. Boxes not equipped with outlets shall have level metal covers with rust-resisting screws.
- KK. Do not mount junction boxes above inaccessible ceilings or in inaccessible spaces. Do not mount junction boxes above ceilings accessible only by removing light fixture, mechanical equipment or other devices. At inaccessible spaces use junction box furnished with light fixture or light fixture wiring compartment UL listed for through wiring.
- LL. No more than 12 conduits containing branch circuits may be installed in any junction or pull box.
- MM. All junction boxes shall be protected from building finish painters' over spray and from fire proofing overspray. Remove protective coverings when painting and fire proofing are complete.
- NN. Bond equipment grounding conductor to all junction and pull boxes.
- OO. Do not mount boxes or conduit bodies on walls directly above electrical panels or switchgear located next to walls.
- PP. Do not mount boxes or conduit bodies within 18 inches of outside edges of roof access openings.
- QQ. Box extenders or plaster rings shall not be used to increase the Code mandated cable capacity of a box. Provide proper size box.

3.2 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused box openings.

END OF SECTION

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SECTION 26 05 40

ELECTRICAL GUTTERS AND WIREWAYS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide electrical gutter work as shown, as specified and as required.
- B. Application: The types of electrical gutters required for the project include the following:
 - 1. Electrical wiring gutters.
 - 2. Voice / Data / Video / Communication and signal distribution wireway.

1.2 QUALITY ASSURANCE

- A. UL Label: Gutters and wireways shall be UL labeled.

PART 2 - PRODUCTS

2.1 ELECTRICAL GUTTERS AND WIREWAYS

- A. General: Provide hinged electrical gutters and wireways in the types and sizes indicated or required, minimum 16 gauge thickness, with rounded edges and smooth surfaces; constructed in compliance with applicable standards; with features required.
- B. Size: Provide size indicated. Where size is not indicated, construct in accordance with the NEC and other standards. Gutters shall be of manufacturer's standard lengths, without field cutting or field extensions.
- C. Accessories: Provide gutter and wireway accessories where indicated, constructed of same metal and finish as gutters or wireways.
- D. Supports: Provide gutter and wireway supports indicated, conforming to NEC, and as recommended by the manufacturer, and as specified in Section 26 05 33 Conduit Systems.
- E. Materials and Finishes: NEMA 1 gutters and wireways shall have gray powder coat finish over galvanized steel. Gutters and wireways installed outside shall be NEMA 3RX minimum. Gutters or wireways installed within 100-feet of cooling towers, at kitchen or food preparation areas, and natatorium, spa or therapy pool areas shall be of 304 stainless steel NEMA 4X construction.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide gutters and wireways only where specified or required. Use of gutters and wireways shall be kept to a minimum.
- B. Finishing: Remove burrs and sharp edges of gutters and wireways wherever they could be injurious to conductor insulation or jacket.
- C. Installation: Install gutters and wireways where shown or required, in accordance with the manufacturer's written instructions, NEC, NECA "Standard of Installation," and with recognized industry practices to ensure that the gutters and wireways comply with the

specified requirements. Comply with requirements of NEMA and the NEC pertaining to installation of electrical gutters.

- D. Grounding: Electrically ground gutters and wireways to ensure continuous electrical conductivity. Provide equipment grounding conductor.
- E. Conductors:
 - 1. Complete gutter and wireway installation before starting the installation of conductors.
 - 2. Provide sufficient space to permit access for installing, splicing, and maintaining the conductors.
- F. A maximum of 12 conduits containing branch circuits shall be allowed to be installed in any gutter or wireway.

END OF SECTION

SECTION 26 05 50

FIRESTOPS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide firestop as required, and as specified. Refer to Architectural drawings for all fire and smoke rated partitions, walls, floors, etc.
- B. Types: Firestop required for the project includes smokestop.

1.2 QUALITY ASSURANCE

- A. UL Label: Firestops shall be UL labeled.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Nelson.
- B. 3M (Minnesota Mining Manufacturing).
- C. Hilti.
- D. Specified Technologies, Inc.
- E. Metacaulk .

2.2 MATERIAL AND COMPONENTS

- A. General: Except as otherwise indicated, provide firestop manufacturer's standard materials and components as indicated by published product information, designed and constructed as recommended by the manufacturer, and as required for installation.

2.3 FIRESTOP

- A. Conduits: Provide a soft, permanently flexible sealant for 1-1/2 to 2 hour rated fireproofing for steel conduits (up to 4" diameter).
- B. Low Voltage Cables, Fiber Optic Cable and Innerduct: Provide Specified Technologies, Inc. EZ-Path single, double, or triple pathways as required.

PART 3 - EXECUTION

3.1 INSTALLATION OF FIRESTOPS

- A. General: Install firestops in accordance with the manufacturer's installation instructions and industry practices to ensure that the firestops comply with requirements. Comply with UL and NFPA standards for the installation of firestops.

END OF SECTION

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SECTION 26 24 16

PANELBOARDS AND ENCLOSURES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Panelboards and enclosures, including cabinet, as shown, scheduled, indicated, and specified.

1.2 QUALITY ASSURANCE

- A. UL Standards: Panelboards and enclosures shall confirm to all applicable UL standards and shall be UL labeled.

1.3 SUBMITTALS

- A. Indicate:
 1. Detailed dimensions.
 2. Enclosure material, finish, and NEMA classification type.
 3. Location of main circuit breaker.
 4. Mounting and trim.
 5. Acceptable incoming conductors' size.
 6. Electrical characteristics including voltage, ampacity, overcurrent device frame size and trip ratings, bus material and rating, withstand ratings, lugs, and time current curves of all overcurrent devices and components.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Schneider Electric - Square D.
- B. ABB-General Electric Co.
- C. Siemens.
- D. Eaton.

2.2 MATERIALS AND COMPONENTS

- A. General: Panelboards shall be dead-front type equipped with fusible switches or circuit breakers as shown and as required.
- B. The overcurrent protective device short circuit, coordination and arch flash studies performed by the overcurrent protective device manufacturer shall be used by the respective switchgear vendor(s) to select appropriate equipment, switchgear, and overcurrent protective device characteristics such as but not limited to: equipment bracing, AIC rating, circuit breaker frame size and trip settings, and fuse type/class. The appropriate equipment suitable and required by the studies for code compliance shall be included with the submittal data for review and provided at no additional cost to the Owner. The appropriate equipment recommended by the studies for enhanced selective coordination or enhanced arc flash energy reduction beyond code compliance shall be included with the submittal data for review and consideration purposes by the engineer.

- C. Busing Assembly: Panelboard phase, neutral, and equipment ground busing shall be copper. Bus structure and mains shall have ratings as shown and scheduled. Furnish a bare uninsulated ground bus inside each panelboard enclosure. Two section panelboards shall be connected with copper cable, with an ampacity conforming to the upstream overcurrent device. Neutral bus termination quantity for branch circuit panelboards shall match or exceed the maximum number of single pole circuit breakers the panelboard will accept.
- D. Main circuit breakers and feeder / branch circuit breakers:
1. Less than 125 Amps: Thermal magnetic with factory fixed trip.
 2. 125-600 Amps: Thermal magnetic with adjustable instantaneous trip of 5X – 10X with short time tracking.
 3. 601 Amps and larger: Solid state true RMS sensing with adjustable: current set by rating plug or adjustable dial, I²t settings, ground fault (where required), instantaneous trip, and short time trip; 80-percent continuous current rating.
 4. Provide permanent lock-off device for all fire alarm system branch circuit breakers, for all smoke control fans and equipment, and where indicated or required for circuit breaker to be used as a remote safety disconnect switch.
 5. General requirements:
 - a. Make prepared space provisions for additional breakers or fused switches so that no additional bus or connectors will be required to add circuit breakers or fused switches in the available device mounting space.
 - b. Two and three pole breakers shall have internal common trips.
 - c. All circuit breakers used as the main or branch mounted back-fed main shall be bolt-on. All circuit breakers used in 600 Amp and smaller panelboards shall be bolt-on breakers. Circuit breakers for distribution panelboards rated 601 amps and larger shall have plug-on or bolt-on circuit breakers.
 - d. Branch circuit panelboard shall have interrupting capacity as shown or as required, but in no case less 10k AIC for 120/208/240-Volt systems, and 18k AIC for 277/480-Volt systems.
 - e. 15 and 20 Amp circuit breakers for lighting circuits shall be UL listed switch duty (SWD).
 - f. Personnel ground fault interrupter (GFI) circuit breakers, where shown, shall be maximum 5 mA ground fault trip and shall include a TEST button.
 - g. Equipment ground fault interrupter (EGFI/EGPD) circuit breakers, where shown or required shall be 30mA ground fault trip and shall include TEST button.
 - h. Circuit breakers with 1,200 Amp and larger frame shall have Energy Reducing Maintenance Switching with local status indicator (ERMS).
- E. Fusible Switches for distribution panelboards: Fusible switches shall be quick-make, quick-break type. Each switch shall be enclosed in a separate steel enclosure. The enclosure shall employ a hinged cover for access to the fuses. Interlock cover with the operating handle to prevent opening the cover when the switch is in the ON position. This interlock shall be constructed so that it can be overridden for testing fuses without interrupting service. The switches shall have padlocking provisions in the OFF position. Switches shall include positive pressure rejection type fuse clips for use with UL Class J fuses and be UL labeled for 200,000 AIC.
- F. Spaces: Where space for future breakers or switches is shown, panelboard enclosure shall include removable blank panels or knockouts to allow installation of future breakers or switches, prepared spaces, and panelboard busing shall be complete, including required connectors.

- G. Integrated Equipment Rating: Do not apply series ratings. Each panelboard, as a complete unit, shall have a short-circuit rating equal or greater than the available short circuit current. Rating shall have been established by tests on similar panelboards with the circuit breakers or fusible switches installed.
- H. GFCI circuit breakers not available in the required panel AIC rating shall be series rated with the upstream over current protection device to provide the panelboard with required AIC rating. Coordinate series rating requirements with manufacturer. Mark the panel per NEC 110. The marking shall be visible and state the following: "CAUTION-ENGINEERED SERIES COMBINATION SYSTEM RATED XXX AMPERS. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED".
- I. Panelboard Enclosures:
 - 1. Provide sheet steel enclosures, minimum 16-gauge nominal thickness, with multiple knockouts, unless shown otherwise. Provide all NEMA 1 panelboard fronts with spring-loaded door pulls, and flush lock and key, panelboard enclosures keyed alike to match the Owner's standard key system; coordinate with Owner.
 - 2. All NEMA 1 enclosure panelboards shall be hinged "door-in-door" type with interior hinged door with hand operated latch or latches, as required providing access only to circuit breaker or fusible switch operating handles, not to exposed energized parts. Outer hinged door shall be securely mounted to the panelboard box with factory bolts, screws, clips, or other fasteners, requiring a tool for entry. Hand operated latches are not acceptable. Push inner and outer doors shall open left to right. Manufacturer hardware (OEM), screws, and bolts shall be used to secure dead fronts and covers. Do not use third party hardware. Do not use power tools to secure panel hardware. Provide gray powder coat finish over a rust inhibitor.
 - 3. Equip with interior circuit directory frame, card, and clear plastic covering for panelboards.
 - 4. Panelboards located in kitchen preparation or natatorium areas shall have Type 316 stainless steel front, door, and trim with a NEMA 1 rating for the entire enclosure.
 - 5. Panelboards at exterior locations shall be NEMA 4X Type 316 stainless steel.
 - 6. Panelboards at hose down areas, cooling towers, in greenhouses, and other corrosive locations shall be NEMA 4X 316 stainless steel.
 - 7. Enclosure shall be for recessed or surface mounting as shown or as required.
 - 8. Enclosures shall be fabricated by the same manufacturer as panelboards to be enclosed. Multi-section panelboards shall have same physical dimensions.

PART 3 - EXECUTION

3.1 INSTALLATION OF PANELBOARDS AND ENCLOSURES

- A. General: Install panelboards and enclosures, as shown, including electrical connections, in accordance with the manufacturer's written instructions, the requirements of NEC, NECA Standard of Installation, and industry practices. Circuit breakers shall be factory installed except for required field modifications due to actual site conditions.
- B. Coordination: Coordinate installation of panelboards and enclosures with conductor and raceways installation work.
- C. Anchoring: Anchor enclosures to walls and structural surfaces ensuring that they are permanently and mechanically secured.

- D. Directory Card: Provide a typed circuit directory card(s) upon completion of work. Directory card shall be of super heavy-weight index card stock, 110 lb, white. Directory shall include type of load (i.e.: receptacles, lighting, exhaust fan, etc.) and location (i.e.: Room 102, Office, etc.) Room number shall be identified as the actual graphics room number assigned to the space and not the room number identified on the Plans. Circuits with shunt trip shall be identified with the control circuit operating the shunt trip (i.e.: Kitchen Hood No. 2). Shunt trip breakers with common trip circuit shall be grouped in the panelboard (i.e.: circuits 1, 3, 5 and 7).
- E. Fuses: Install fuses, of the ratings and class shown.
- F. Circuit Arrangement: Branch circuits shall be arranged to provide the best possible phase balance, unless shown otherwise.
- G. Panelboards not intended to be used as service entrance (SE) rated or for establishing a separately derived neutral system shall have the factory installed neutral to ground bonding screws and straps removed and disposed of.
- H. Recessed or flush mounted panelboards: Terminate spare conduits in junction box 18-inches above accessible ceiling close to panelboard location. Label junction box cover as "not used" and include panel identification.
1. Provide (3) 1-inch and (3) $\frac{3}{4}$ -inch spare conduits above accessible ceiling to j-box from each panelboard section.
 2. Where recessed panelboard is located above another building floor, also provide (3) 1-inch and (3) $\frac{3}{4}$ -inch conduits to j-box in ceiling space on floor below.
- I. Conductors shall be bent neatly opposite the fuse switch or circuit breaker to which they are to be attached. Vertically installed conductors shall be neatly tie-wrapped. Conductors shall be connected in a neat and professional manner. Conductors brought in from the top or bottom of the cabinet shall be bent neatly opposite the fuse or circuit breaker to which they are to be attached. Each conductor shall be run along the full height of the panel and returned to the circuit breaker or fuse location to allow relocation of the conductor to any position along the bus. Panelboard shall be cleaned of all construction debris prior to substantial completion review. Neutral and grounding conductors shall be installed similar to the phase conductors.
- J. Circuit breakers and conductors installed for SPD devices shall be located on the same side as the SPD to allow the shortest and straightest run of conductors in respect to the location of the SPD device. Route all conductors to the SPD device with straight as possible run, using longest sweep bends and the shortest conductor length possible. Twist all SPD conductors and secure with tie straps wherever possible.
- K. Install copper ground bus for copper ground conductors. Ground conductors size #1 and larger are to be landed to panelboard enclosure with mechanical lugs and not to ground bus.
- L. Install panels so that breaker number 1 is the top left breaker.
- M. In panels that contain multi-layered neutral bus, install neutrals beginning with the back neutral bus row and work forward. Do not make up neutrals on front neutral bus row unless all other rows are full.
- N. Label breaker mounting space with stick-on number labels.
- O. Mount the fully aligned panelboard such that the maximum height of the top circuit breaker above the finished floor shall not exceed 78-inches. Mount panelboards as high

as practical and such that the bottom of the cabinets will not be less than 6 inches above the finished floor.

3.2 TESTING

- A. Before energizing, energization, check for continuity of circuits and short circuits.
- B. Provide thermal infrared scan of panelboards under full load as directed and witnessed by Owner. Correct any deficiencies causing abnormal heating and repeat the scan. Provide digital video documentation with deficiencies corrected for comparison to future test. Make corrections as needed as soon as possible as directed by the Owner. Repeat the scan at the 11-month prior to closeout, and make corrections prior to close-out.

END OF SECTION

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SECTION 26 27 73

LINE VOLTAGE WIRING DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide wiring device work as shown, scheduled, indicated, and specified. Low voltage and/or digital control switches required for lighting controls and lighting control systems shall be as specified and required for the low voltage and / or digital control lighting system. Refer to drawings or other specification sections for low voltage / digital lighting control systems. Cover plates for lighting control systems shall be as specified in this section unless specifically required otherwise by the low voltage / digital control device bulkhead or form factor.

1.2 QUALITY ASSURANCE

- A. UL Label: Wiring devices shall be UL labeled.
- B. NEMA Standard WD1 and WD6.
- C. Fed. Spec. WC596, W-S-896.

1.3 SUBMITTALS

- A. Mark up a complete copy of the specification section for the product to indicate a) acknowledgement of the specification requirement (Comply), or b) acknowledgement that the particular specification requirement does not apply to this specific project (Not Applicable) or, c) acknowledgement that the specification requirement cannot be made or that a variance is being submitted for review to the Architect/Engineer/Owner (Does Not Comply, Explanation:.) Do not submit an outline form of compliance, submit a complete copy of the specification section with the product data.
- B. Submit a sample of each style and color of 120-Volt duplex receptacle and each 120/277-Volt switch with related cover plate. Attach plate to wiring device and label back side of plate with job description with permanent black marker.
- C. Submit manufacturer's product data sheet for each style of device and plate on the project.
- D. Submit drawings of plans, elevation and sections of receptacles and outlets in casework, cabinetwork and built-in place furniture. Coordinate dimensions with millwork shop drawings and related architectural drawing series.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Toggle switches, straight blade and twist lock devices, interior cover plates:
 - 1. Leviton.
 - 2. Hubbell.
 - 3. Pass and Seymour .
 - 4. Eaton.

- B. Dimming
 - 1. Leviton.
 - 2. Lutron.

2.2 WIRING DEVICE COLOR

- A. Device color shall be gray except 20A, 125V receptacles and toggle wall switches which are directly supplied from an emergency source shall be red, and heavy duty 30 Amp and larger simplex devices which shall be black in color where the building standard color is not available. Provide equivalent hospital grade devices where red is not available in grade specified. Verify with Owner / Architect prior to submitting for approval. Color change kits as required for dimming switches. Low voltage lighting control devices specified elsewhere shall match the line voltage wiring device color specified in this section.

2.3 RECEPTACLES

- A. Industrial grade tamper resistant smooth face duplex receptacles, 2 pole, 3 wire grounding, with ground connection and poles internally connected to mounting yoke, with metal mounting straps, locking plug-tail or back and side wired with screw type terminals, NEMA indicated, (X=color designation).
 - 1. 20A, 125V duplex NEMA #5-20R: Leviton #5362-SGX.
 - 2. 20A, 125V isolated ground duplex NEMA #5-20R: Leviton #5362-IGX.
 - 3. 20A, 125V ground fault circuit interruption (GFCI) NEMA #5-20R weather and tamper resistant: Leviton #G5362-WTX.
 - 4. 20A, 125V weather resistant (WR), tamper resistant: Leviton #TWR20-GY.
 - 5. 20A, 125V plug load control, split circuit marked for "controlled", tamper resistant: Leviton #TDR20-S1G.
 - 6. 15A, with 20A feed-through, NEMA #5-15R, 125V duplex, arc fault (AFCI), tamper resistant: Leviton #AFTR1-HGX.
- B. Heavy-Duty Simplex: Single heavy-duty type receptacles, with green hexagonal equipment ground screw, with metal mounting straps, back or side wiring, black molded phenolic compound.
 - 1. 15-60A, 125-250V, straight blade, NEMA configuration as indicated or as required by Owner.
 - 2. 15-50A, 125-480V, twist lock, NEMA configuration as indicated or as required by Owner.
- C. Hospital grade receptacles, 2 pole, 3 wire grounding, with ground connection and poles internally connected to mounting yoke, with metal mount straps, locking plug-tail or back and side wired with screw type terminals, molded phenolic compound, NEMA configuration indicated.
 - 1. 20A, 125V grounded duplex NEMA #5-20R: Leviton #8300-X.
 - 2. 20A, 125V isolated ground duplex NEMA #5-20R: Leviton #8300-LIG (orange).
 - 3. 20A, 125V ground fault circuit interruption (GFCI) with indicator light: Leviton NEMA 5-20R-8898-HGX.
 - 4. 20A/125V Tamper Resistant Duplex NEMA 5-20R: Leviton 8300-SGX.
- D. USB 2-port charger / tamper-resistant with 125-Volt receptacles:
 - 1. USB type A/C, 1 type A and 1 type C port, 5.1A 5.0VDC charging. 20A, 125V, NEMA 5-20R: Leviton #T5833-HGX.
 - 2. USB A, 2 type A ports, 5.1A 5.0VDC charging. 20A, 125V, NEMA 5-20R: Leviton #T5832-HGX.

- E. USB 4-port charger:
 1. USB type A+C, 2 type A ports and 2 type C ports. 5.0A 5.0VDC charging. Hubbell #USB4ACX.
 2. USB type A, 4 type A ports. 5.0A 5.0VDC charging. Hubbell #USB4X.

2.4 WALL SWITCHES

- A. Toggle: Industrial grade flush toggle switches, with mounting yoke insulated from mechanism, equipped with plaster ears, switch handle, back and side-wired screw terminals.
 1. Single-pole, 120/277V, 20A switch: Leviton #1221-2X.
 2. Double pole 120/277V, 20A switch: Leviton #1222-2X.
 3. Three-way, 120/277V, 20A switch: Leviton #1223-2X.
 4. Four-way, 120/277V, 20A switch: Leviton #1224-2G.
 5. Pilot light single-pole, 120/277V, 20A switch: Leviton #1221-PL.
 6. Momentary, 120/277V, 20A, single-pole double throw, center off: Hubbell only #HBL 1557G.
- B. Toggle key operated switch (verify manufacture and key type with Owner prior to construction).
 1. Single-pole, 120/277V, 20A key operated switch: Hubbell HBL #1221GY.
 2. Two-pole, 120/277, 20A key operated, Hubbell HBL #1222GY.
 3. Three-way, 120/277V, 20A key operated switch: Hubbell HBL #1223GY.
 4. Four-way, 120/277V, 20A key operated switch: Hubbell HBL #1224GY.
 5. Momentary, single pole double throw, center off, 20A key switch: Hubbell #HBL 1557LG.
 6. Key: Hubbell #HBL 1209. Key switches shall be keyed alike to match the Owner's standard key system. Coordinate with Owner.
- C. Rotary key operated switch (verify manufacturer and keying with Owner prior to construction).
 1. Single-pole, 120/277V, 20A key operated switch: Leviton #1221-KL.
 2. Two-pole, 120/277, 20A key operated, Leviton #1222-2KL.
 3. Three-way, 120/277V, 20A key operated switch: Leviton #1223-3KL.
 4. Four-way, 120/277V, 20A key operated switch: Leviton #1224-4KL.
 5. Key switches shall be all keyed alike to match the Owner's standard key system. Leviton #WS-35 or as otherwise directed by Owner.

2.5 WALL DIMMERS

- A. Wall Box Dimmers: Self-contained, wall box mounted, linear slide square law dimmers with ON/OFF switch. Dimmers shall operate continuously at rated load in an ambient temperature up to 40°C and an input of 100 to 277V. Heat sink fins may be removed only as approved by Owner / Engineer for narrow ganging after applying de-rating.
 1. Single-pole, 120/277V, 1000/2308 Watt incandescent / magnetic low voltage: Leviton #AWSMT-MBW.
 2. Single-pole, 120/277V, 1500/3463 Watt incandescent / magnetic low voltage, 2-gang heat sink: Leviton #AWSMT-MCW.
 3. Single-pole, 120/277V, 1920/4432-Watt LED / fluorescent 0-10V dc, 75 mA current sink: Leviton #AWSMT-7DW.
 4. Three, four- or five-way remote switch: Leviton #AWSRT-00W.
 5. Color change kit as required.

2.6 GFCI – GROUND FAULT CIRCUIT INTERRUPTER, BLANK FACE

- A. 20A, 125V, GFCI, switch rated, blank face feed through, Hubbell #GFBF20GYL, gray finish, stainless steel cover plate black laser engraved with device protected, (example: DRINKING FOUNTAIN GFCI).

2.7 INTERIOR WALL COVER PLATES AND FASTENERS

- A. Type 302 non-magnetic stainless-steel with satin finish (also required for wall box device cover plates for low voltage and digital lighting controls specified elsewhere).
- B. Cover plate laser plate engraving for device identification (other than low voltage lighting controls).
 - 1. Provide laser cover plate engraving with black filling for all wiring devices indicating panelboard name, circuit, and voltage.
 - 2. Wiring devices connected to emergency/stand-by generator or inverter shall include the word "EMERGENCY".
 - 3. Text orientation shall be upright, readable from left to right when cover plate is installed.
 - 4. Remotely located lighting switches shall also indicate the room or area and zone controlled by each switch. Coordinate specific wording with Owner/Architect.
 - 5. Blank face GFCI cover plates shall also intuitively indicate the load or equipment served, device, or area protected downstream ("EDF" for drinking fountains, "RM RECEPPTS", "HOOD RECEPPTS", "VENDING", "REFRIG", etc.) For other loads, Owner/Architect shall determine name plate wording.

2.8 EXTERIOR COVER PLATES

- A. Thomas & Betts CK Series, cast aluminum standard depth, locking mount, while-in-use, wet location, universal configuration.
 - 1. Vertical mount receptacle: #CKSUV.
 - 2. Horizontal mount receptacle: #CKMU.
 - 3. Two-gang: #2CKU.
 - 4. 30-60 Amp Devices: #CKLSUV.

2.9 CORD REELS AND DROP CORDS

- A. Cord Reels:
 - 1. Lighted cord reels: Industrial grade, LED hand Lamp only, 125V, 45-foot 16/3 SJEO cord, white finish, LED hand lamp. Hubbell #HBLI45163LED with #HBL340PB pivot base.
 - 2. 20 Amp (2) duplex receptacle cord reels: Industrial grade, 125V, (2) 20A duplex receptacles, GFCI protection, 45-foot 12/3 SJO cord, white finish, yellow outlet box. Hubbell #HBLI45123GF220 with #HBL340PB pivot base.
 - 3. 30 Amp receptacle cord reels: Industrial grade, 125/250V, 30A, 45-foot 10/4 SJO cord, white finish, yellow outlet box. Hubbell #HBLI45104 with #HBL340PB pivot base. 30 Amp NEMA receptacle termination as required by Owner.
 - 4. 50 Amp receptacle cord reels: Industrial grade, NEMA 4 wet location, 600V, 55A, 50-foot 6/4 SOOW cord, yellow finish, self-retracting, with NEMA 50-Amp maximum receptacle termination as required by Owner. KH-Industries RTMH4L-WW-K6K.
 - 5. Recessed enclosure for 20 and 30-Amp cord reels recessed above T-grid drop ceilings: Hubbell #HBLIPRBOX recessed cord reel enclosure, white finish, plenum rated.

- B. Drop cord receptacles:
 - 1. 20A, 125V, 25-feet 600 VAC, 3-conductor 12 AWG SOOW cable, twist lock plug, two 125V, 20A duplex WR GFCI outlets, safety yellow rubber outlet box, mesh strain relief cord grips. KH Industries #PP4DD-520-B12F-520.
 - 2. 20A, 125/250V, 25-feet 600 VAC, 4-conductor 12AWG SOOW cable, twist lock plug, four 125/250V NEMA L1420P outlets, safety yellow rubber outlet box, mesh strain relief cord grips. KH Industries #PP7DD-520-B12F-L1420.
 - 3. 30-60 Amp, voltage, NEMA plug/receptacle as required by Owner, SOOW cable, number of conductors and length as required, mesh strain relief cord grips.
- 2.10 FIRST RESPONDER EMERGENCY REMOTE POWER OFF (FREPO) STATION
- A. Knox Company Remote Power Rapid Access 4500 Series Shutdown Station
 - 1. Recessed mount for public spaces and new construction, surface mount for when mounted to equipment or existing construction.
 - 2. Single lock keyed for local Fire Department/AHJ, verify configuration and keying with Knox Company.
 - 3. Red Finish.
 - 4. Tamper alert for integration with building security system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cover plates for receptacles and toggle switches shall be of the same manufacturer throughout unless otherwise noted.
 - 1. Key switches and keys shall be as specified and also as approved by Owner.
 - 2. Submit samples for each specified toggle switch and duplex receptacle color to Architect.
- B. Install wiring devices where shown and as required, in accordance with manufacturer's written instructions, requirements of NEC, and in accordance with industry practices. Do not install devices until wall construction and wiring is completed.
- C. Install receptacles and switches only in electrical boxes that are clean, free from building materials, debris, and similar matter.
- D. Install wiring devices plumb and aligned in the plane of the wall, floor, ceiling or equipment rack.
- E. Install switches in boxes on the strike side of doors as hung. Install so the up position will close the circuit or will be the highest level of illumination. Where more than one switch is in the same location, install switches in a multi-gang box with a single cover plate.
- F. Provide a cover plate for every wiring device and blank cover plates for unused rough-in-only boxes that matches the building standard. Fasten all plates outdoors with type 302 Allen Head "tamper-proof" screws.
- G. Mounting heights of all wiring devices shall comply with local accessibility standards and local codes, except where wiring devices are indicated for special purpose and access is only required by maintenance or service personnel.
- H. Refer to Architectural drawing and elevations, etc. for exact location of wiring devices. Coordinate location of all wiring devices with other trades, specialty items, and millwork and resolve all conflicts prior to rough-in. Field coordinate exact mounting location with all trades to avoid and resolve conflicts during construction.

- I. Locate receptacles for electric drinking fountains/coolers and bottle fill stations below equipment so that the receptacle is accessible and concealed as much as practical from public view by the equipment open cowling so that the receptacle remain readily accessible. For dual level basin equipment, locate receptacle under the upper basin.
- J. Provide convenience outlet receptacle within 25-feet of all new electrically operated mechanical equipment.
- K. Where exterior receptacles are intended for continuous use, mount in horizontal position with while in use cover plate. (Exterior electric drinking fountains, ice makers, ice storage bins, landscape lighting low voltage transformers, seasonal decorative lighting, etc.)
- L. Install wall box dimmers to achieve full rating specified after de-rating for ganging as recommended by manufacturer.
- M. Do not share neutral conductor on load side of dimming switches.
- N. Install receptacles with grounding pole down, except in any of the following conditions where the grounding pole shall be installed in the up position: healthcare occupancies, if required by local AHJ, if required by Owner's construction standards or if directed by Owner or Architect. If installed horizontally, install with neutral pole on top.
- O. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.
- P. Provide pigtail to each receptacle and each switch. Neutral and phase conductors shall be installed using side or rear entry lugs only. Do not wrap conductors around screw terminals. Tighten all screws and lugs as recommended by manufacturer.
- Q. All receptacles and switches shall have a minimum of two wraps of Scotch 33 or equivalent tape around terminal screws.
- R. Provide toggle switch within sight of all trap primers, circulation pumps, 120-Volt motors and motorized equipment to serve as the equipment disconnect switch.
- S. Mount cord reels and cord reel recessed enclosures to structure with galvanized steel struts and as recommended by manufacturer. Field verify exact location of cord reels with Owner/Architect. Mounting location shall avoid conflicts with piping, light fixtures and ductwork, etc. when cord reel is extended and retracted. Set ball stop as directed by Owner / Architect. Provide hand lamp only type cord reels in commercial / educational automotive garages with classified (hazardous) locations. Provide local toggle switch at standard switch height for hand lamp only cord reels.
- T. Mount drop cord suspension hook or j-box to structure to support the cord's weight and additional normal use pulling tension and as recommended by manufacturer. Use cable grips, either with cord grip hanging hook at open ceilings or with chrome plated escutcheon cover plate mounted to recessed j-box at finished ceilings. Field verify exact location, drop height, and NEMA outlet configuration of drop cords with Owner/Architect. Provide weatherproof receptacle cap or covers if located in wet location. Mounting location shall avoid conflicts with piping, light fixtures and ductwork, etc.

3.2 GROUND FAULT PROTECTION FOR PERSONNEL

- A. When GFCI personnel protection receptacles are not commercially available or cannot be installed at a readily accessible location or indicated otherwise on the drawings, GFCI personnel protection shall be provided by a remote blank face GFCI wiring device or by

an up-stream GFCI receptacle that also provides downstream GFCI protection and located in a readily accessible location. When branch circuit breaker device with integral GFCI protection is required or specified, it shall be within the manufacture's recommended distance limitations of the connected receptacle(s) or load(s) for proper GFCI personnel protection at the farthest outlet.

- B. GFCI personal protection locations include but are not limited to the following:
1. For other than dwelling units: All single phase 125-250-Volt (150-Volts to ground or less) receptacles 50-Amperes or less, and all three phase 125-250-Volt (150-Volts to ground or less) receptacles 100-Amperes or less in the locations indicated below.
 2. Dwelling units: All single phase 125-250-Volt receptacles installed in the following locations indicated below.
 3. Provide personnel GFCI protection as indicated above in the following locations and all additional locations as required by the NEC.
 - a. Outdoors (with exceptions for not readily accessible receptacles with dedicated branch circuits for snow melting, deicing, pipeline/vessel heat receptacles. Provide these loads with 30mA EGFI circuit breaker protection).
 - b. Bathrooms/toilets/restrooms
 - c. Janitors/custodial closets and mop sinks.
 - d. Laundry areas.
 - e. Parking structures, service garages, garages and accessory buildings.
 - f. Basements, crawl spaces (including 120-Volt lighting) .
 - g. Within 6-feet of all water sources including sinks, mop-sinks, lavatories, bathtubs, shower stalls, faucets, eye wash stations, emergency shower stations.
 - h. Indoor damp and wet locations.
 - i. Locker rooms.
 - j. Indoor swimming pools and natatoriums areas and adjacent corridor/hall convenience receptacle outlets located within 25-feet of all access doors.
 - k. Non-dwelling unit therapeutic tubs/pools/whirlpool areas and adjacent corridor/hall convenience receptacle outlets located within 25-feet of all access doors.
 - l. Receptacles serving dwelling unit kitchen counter tops.
 - m. Vending machines.
 - n. Elevators, dumb waiters, escalators, moving sidewalks: receptacles in pits, hoist ways, well ways or those mounted on the cars of elevators and dumb waiters.
 - o. Electric vehicle charging equipment.
 - p. All receptacles serving kitchen or food preparation counter tops.
 - q. Automotive vacuum machines.
 - r. Drinking water fountains/coolers and bottle fill stations.
 - s. Corded high-pressure spray washing machines.
 - t. Tire inflation machines.
 - u. Dish washers.
 - v. Receptacles at end of cord reels or drop cords.
 - w. Boat houses, boat hoist, and all pier/dock receptacles and lighting (excludes shore power that requires GFPE).
 - x. Central plant, mechanical rooms and electrical rooms
 - y. Wood, metal, or other material fabrication or vocational training shops.
 - z. Receptacles that serve educational science and science prep room counter tops.
- C. Where a GFCI protected receptacle outlet is required or indicated behind vending machine, refrigerators or other equipment, provide remote GFCI blank face in same room

as protected receptacle and at a readily accessible location with standard receptacle outlet behind equipment. Refrigerators shall be GFCI protected only where located within 6-feet of power cord distance from the edge of a sink to the surface of the refrigerator.

- D. Unless indicated otherwise, locate blank face GFCI device near light switches at same height as light switches or ganged with the light switch. Provide GFCI protection for all receptacle outlets located below 42-inches in all infant through 2-year old day care and similar areas designated for occupancy by infant through 2-year old day care occupants so the GFCI device can easily be intentionally tripped or tested and reset.
- E. Provide branch circuit breaker 30mA (EDP) or 100mA (EPE) equipment protection for utilization equipment as required by the NEC and where indicated on the drawings.

3.3 FIRST RESPONDER REMOTE EMERGENCY POWER OFF (FREPO) STATION

- A. Provide Knox Company first responder remote emergency power off (FREPO) stations as indicated and/or where required by local AHJ. Mounting locations shall be as directed by the local AHJ and exact locations coordinated with the Architect. FREPOs shall be circuited only to shunt trip or shut-down control circuiting. FREPOs shall be recessed mounted in public locations and in all new construction when attached to building construction. Provide surface mount FREPOs when mounted to equipment or existing construction.
- B. Integrate the FREPOs to shut-down the building non-emergency and non-legally required power sources which include the main electrical utility service disconnect circuit breaker(s), other than non-life safety or non-legally required distribution scale UPS equipment, and non-life safety or non-legally required local power generation equipment.
- C. Provide FREPOs for fire pump, life safety, and legally required electrical generation equipment only when required by the AHJ. When required by the AHJ, fire pump, life safety, and legally required power generation and/or stored energy power supply equipment shall each have separate dedicated FREPOs that shut down only their associated power generation/stored energy equipment. FREPOs for emergency, and legally required systems shall have minimal 25-foot physical separation from the building main utility service FREPOs and clearly labeled with the equipment that they will shut down. FREPOs for fire pumps shall have minimal 25-foot physical separation from the any other FREPOs and from the building main utility service disconnect and clearly labeled with the equipment that it will shut down.
- D. Integrate the FREPOs tamper switch with the building security or building management control system (BMCS) as directed by Owner.

3.4 TESTING

- A. Before energizing, check for continuity of circuits, short circuits, and grounding connections.
- B. After energizing, check wiring devices to demonstrate proper operation and receptacles for correct polarization, voltage and phase orientation if intended 3-phase equipment is phase orientation dependent for proper motor rotation or operation.
- C. Test each individual GFCI receptacle and all downstream receptacles protected by an upstream GFCI device with simulated ground fault tester, make corrections as necessary.
- D. Operate each wall switch with circuit energized and verify proper operation.

END OF SECTION