

SECTION 260500 –COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 GENERAL CONDITIONS:

- A. The General Conditions, Supplementary General Conditions, General Requirements, and Special Conditions shall be and are hereby made a part of this Section of the specifications.
- B. In case of conflicts between the electrical drawings and Division 26 of these specifications, the more stringent requirements shall govern. In all cases, notify the Engineer for direction.
- C. The requirements of COMMON WORK RESULTS FOR ELECTRICAL establish minimum requirements, apply to, and are hereby made a part of all sections of Division 26, 27, and 28 of this specification.
- D. The Contractor shall be responsible for excavation of all earth, soil, and rock conditions at the site. Review the elevations and soil boring logs and include all associated costs.

1.2 DESCRIPTION:

- A. The electrical work shall include all labor, materials, tools, transportation, equipment, services and facilities, required for the complete, proper and substantial installation of all electrical work shown on the plans, and/or outlined in these specifications. The installation shall include all materials, appliances, and apparatus not specifically mentioned herein or noted on the drawings but which are necessary to make a complete working installation of all electrical systems.
- B. All of the electrical related work required for this project (unless specified otherwise) is a part of the Electrical Contract price but is not necessarily specified under this division of the specifications or shown on the electrical drawings. Therefore, all divisions of the specifications and all drawings shall be consulted.
- C. The plan drawings are schematic only and are not intended to show the exact routing of raceway systems unless dimensions are noted on the drawings. Final routing will be governed by field conditions (structural members, mechanical equipment, ductwork, underground piping, duct banks, etc.) and shall be determined by the Contractor and approved by the Architect. Any changes in routing shall not change the design of the raceway system.
- D. The plan drawings showing device and equipment locations are schematic only and are not intended to show exact locations unless dimensions are noted on the drawings. The Contractor shall review all contract drawings that may affect the location of devices and equipment to avoid possible interference and permit full coordination of all work. The right to make any reasonable change in location within 6'-0", is reserved by the Architect up until the time of rough-in at no extra cost.
- E. Furnish and install electrical wiring, systems, equipment and accessories in accordance with the specifications and drawings. Capacities and ratings of transformers, cable,

switchgear, panelboards, motor control, and other items, arrangement for specified items in general are shown on drawings.

- F. Ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways accordingly sized.

1.3 MINIMUM REQUIREMENTS:

- A. Codes Rules and Regulations: Execute all work under ADA, the latest rules and regulations of the National Electrical Code (NEC), the National Fire Protection Association, and with all laws, regulations and ordinances of the County, State, City, and the Utility Company.
- B. Codes shall govern in case of any direct conflict between codes, plans and specifications; except when plans and specifications require higher standards than those required by code. Variance from the plan and specifications made to comply with code must be approved by the Architect. If approved they shall be made with no increased cost to the Owner.

1.4 STANDARDS:

- A. All material and equipment shall be listed, labeled or certified by UL LLC, where such standards have been established. Equipment and material which are not covered by UL Standards will be accepted provided equipment and material is listed, labeled, certified or otherwise determined to meet safety requirements of a nationally recognized testing laboratory. Equipment of a class which no nationally recognized testing laboratory accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as NEMA, or ANSI. Evidence of compliance shall include certified test reports and definitive shop drawings.
- B. Definitions:
 - 1. Certified: Equipment is "certified" if:
 - a. Equipment has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards, or to be safe for use in a specified manner.
 - b. Production is periodically inspected by a nationally recognized testing laboratory.
 - c. It bears a label, tag, or other record of certification.
 - 2. Nationally recognized testing laboratory: A testing laboratory which is approved, in accordance with OSHA regulations, by the Secretary of Labor.

1.5 QUALIFICATIONS (PRODUCTS AND SERVICES):

- A. Manufacturers Qualifications: The manufacturer shall regularly and presently produce, as one of the manufacturer's principal products, the equipment and material specified for this project, and shall have manufactured the item for at least three years.

B. Product Qualification:

1. Manufacturer's product shall have been in satisfactory operation, on three installations of similar size and type as this project, for approximately three years.
2. The Engineer reserves the right to require the Contractor to submit a list of installations where the products have been in operation before approval.

1.6 MANUFACTURED PRODUCTS:

- A. Materials and equipment furnished shall be new, of best quality and design, free from defects, of current production by manufacturers regularly engaged in the manufacture of such items, for which replacement parts should be available. All items used on this project shall be free of asbestos, PCB, and mercury material.
- B. When more than one unit of the same class of equipment is required, such units shall be the product of a single manufacturer.
- C. Equipment Assemblies and Components:
1. Components of an assembled unit need not be products of the same manufacturer unless indicated otherwise.
 2. Manufacturers of equipment assemblies, which include components made by others, shall be completely responsible for the final assembled unit.
 3. Components shall be compatible with each other and with the total assembly for the intended service.
 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory and Field wiring shall be identified on the equipment being furnished and on all wiring diagrams.
- E. When Factory Testing is Specified:
1. The Engineer shall have the option of witnessing factory tests. The Contractor shall notify the Engineer a minimum of 15 working days prior to the manufacturer making the factory tests.
 2. Four copies of certified test reports containing all test data shall be furnished to the Engineer prior to final inspection and not more than 90 days after completion of the tests.
 3. When equipment fails to meet factory test and reinspection is required, the Contractor shall be liable for all additional expenses, including expenses of the Engineer.

1.7 EQUIPMENT PROTECTION:

- A. Equipment and material shall be protected during shipment and storage against physical damage, dirt, moisture, cold and rain.
- B. During installation, equipment, controls, controllers, circuit protective devices, and other like items, shall be protected against entry of foreign matter and be vacuum cleaned both inside and outside before testing, operating and painting.

- C. Damaged equipment shall be, as determined by the Engineer, placed in satisfactory operating condition or be returned to the source of supply for repair or replacement.
- D. Painted surfaces shall be protected with factory installed removable heavy Kraft paper, sheet vinyl or equal.
- E. Damaged paint on equipment and materials shall be restored to the original quality of paint and workmanship as used by the manufacturer so repaired area is not obvious.

1.8 GENERAL WORK REQUIREMENTS:

- A. Arrange, phase and perform work to assure electrical service both temporary and permanent for buildings at all times.
- B. Coordinate location of equipment and conduit with other trades to minimize interferences.
- C. Examination of Site:
 - 1. Visit the site, inspect the existing conditions and check the drawings and specifications so as to be fully informed of the requirements for completion of the work.
 - 2. Lack of such information shall not justify an extra to the contract price.
- D. Permits:
 - 1. Obtain and pay for all licenses and permits, fees, inspection and certificates required for the execution of this work.
 - 2. Pay fees and charges for connection to outside services and use of property.
 - 3. Deliver permits and certificates to the Architect to be transmitted to the Owner.
- E. Responsibility:
 - 1. This Contractor will be held responsible for any and all damage to any part of the building or to the work of other contractors, as may be caused through this contractor's operation.
 - 2. Any mutilation of building finishes or equipment initiated by electrical construction shall be properly corrected by the respective finishing contractor and paid for by the Electrical Contractor.
 - 3. The operation of the temporary power and the permanent electrical system shall be the responsibility of this Contractor until acceptance of the building by the Owner.
- F. Work to be done by General Contractor:
 - 1. Build in all openings, sleeves, chases, etc., for conduit and equipment as established, furnished and set by this Contractor. The General Contractor shall seal or grout all openings after this Contractor has installed the conduits.
 - 2. Build in bolts, brackets, hangers etc., for work established, furnished and set by this Contractor.
 - 3. All concrete work required for equipment furnished and set by this Contractor including clean up pads under electrical gear, fixture bases, transformer bases, etc.

4. Painting: All painting of electrical equipment installed in finished areas shall be done by the General Contractor. Painting will not be required on receptacles, switches, circuit breakers etc. All fixtures and exterior poles specified to be factory-primed shall be painted by General Contractor. Paint all wiremold, exposed conduit and equipment, etc., to match final wall colors.
5. Provide fireproofing above fixtures located in fire rated ceilings per U.L. requirements.
6. Pay all utility costs for operation of electrical system during construction until acceptance of building by the Owner.

G. Work done by the Mechanical Contractor:

1. The Mechanical Contractor shall furnish wiring diagrams and temperature control drawings of all equipment furnished to the Electrical Contractor. (Catalog information is unacceptable, provide point to point drawings.)
2. The Mechanical Contractor shall furnish and install all control equipment requiring connections to air, water, steam, etc., such as pneumatic electric relays, remote bulb temperature controls, solenoid valves, aquastats and pressure controls.
3. The Mechanical Contractor shall reimburse the Electrical Contractor for any changes in system design i.e.; control or equipment which affects the Electrical Contractor. Also refer to equipment connections, controls and instrumentation in 260500.

H. Workmanship and Coordination:

1. Make installation substantially as shown on the plans.
2. Make alterations in location of apparatus or conduit as may be required to conform to building construction without extra charge.
3. Mechanical equipment service clearances and electrical apparatus service clearances as specified in their respective manufacturer's product data shall be maintained free from conduit.
4. Cooperate with other trades in their installation of work.
5. Complete the installation in a workmanlike manner, completely connected and ready to give proper and continuous service.
6. Use only experienced licensed electricians.

I. Cutting and Patching:

1. Notify the General Contractor in ample time, of the location of all chases, sleeves, and other openings required in connection with the work of this contract.
2. Cutting and patching made necessary because of failure to comply with the above shall be done by the General Contractor at the expense of the Electrical Contractor.
3. When it is necessary for the Electrical Contractor to cut building materials, it shall be done in a neat and workmanlike manner meeting with the approval of the Architect.
4. Holes through concrete shall be carefully drilled with a "Concrete Termite" drill. A Star Drill or Air Hammer will not be permitted. Structural members shall not be cut without approval from the Architect.
5. Any penetrations thru the roof shall be made with "Stoneman" 900 Series flashing connections as manufactured by Elmdor/Stoneman, City of Industry, California, or as approved by the Architect.

6. Any penetrations made in exterior or basement foundation walls shall be sealed with Thunderline "Link-Seal" connections, as manufactured by Thunderline Corporation, Wayne, Michigan.

J. Manufacturer's Instructions:

1. Apply, install, connect, erect, use, clean, and condition articles, materials and equipment as directed by the manufacturer.

1.9 EQUIPMENT INSTALLATION AND REQUIREMENTS:

A. Equipment location shall be as close as practical to locations shown on the drawings.

B. Working spaces shall not be less than specified in the National Electrical Code for all voltages specified.

C. Inaccessible Equipment:

1. Where the Engineer determines that the Contractor has installed equipment without proper clearances or not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled as directed at no additional cost to the Owner.

- a. Install access panels as approved by the Architect to provide access to all equipment, J-boxes and outlets located in non-accessible spaces. Panels shall be flush locking type with a fire rating equal to the ceiling system.

2. "Conveniently accessible" is defined as being capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as motors, pumps, belt guards, transformers, piping, and ductwork. Outlet and box covers shall be removable by using regular length (8") screw drivers.

D. Distribution Equipment:

1. All items of Electrical Distribution Equipment (switchboards - panelboards - disconnects) shall be of one manufacturer, unless specifically noted on the drawings, in the specifications, or approved by the Engineer. Intermixing of distribution equipment by different manufacturers will not be permitted.
2. Equipment layouts on the drawings are based on one manufacturer. Verify all actual equipment sizes with equipment manufacturer prior to bidding.
3. If layout changes are required due to differing electrical manufacturer's equipment size, they must be submitted to and approved by the Engineer. National Electric Code working clearances must be maintained at all times. Extra remuneration will not be allowed for layout changes that differ from those shown.
4. Provide and install all steel supports as required for mounting of electrical equipment.
5. Anchor all free standing electrical equipment including switchboards, switchgear, substations, motor control centers, paralleling gear, transfer switches, transformers, etc. to the floor with plated, 1/2" diameter minimum, anchor bolts or as recommended by the manufacturer.

1.10 EQUIPMENT CONNECTIONS, CONTROLS AND INSTRUMENTATION:

- A. General: The following applies to all electrical power and control connections for all equipment requiring electrical installation work provided by others.
- B. Electrical Contractor shall install and connect the following items for equipment requiring electrical power that is either furnished or specified by other Contractors and/or the Owner. Where these required items are not furnished with the equipment being connected, it shall be the Electrical Contractors responsibility to provide the necessary items including conduit, boxes and wiring.
1. Starters
 2. Variable Frequency Drives
 3. Disconnecting Devices
 4. Thermal Overload Devices
 5. Overcurrent Devices
 6. Short Circuit Protective Devices
 7. Power Factor Correction Devices
 8. Voltage Transformation Equipment
 9. Control Devices (Local and Remote)
 10. Audible and Visual Control Status Annunciation Devices
 11. Equipment Mounting Structures
 12. Additional Miscellaneous Devices
- C. In general, all major equipment will be specified to be factory prewired with only service and interconnecting wiring required at the site by the electrical contractor; however, the Electrical Contractor shall check all divisions of the specification to verify if the equipment is specified factory prewired and if not, then it shall be the responsibility of the Electrical Contractor to provide the complete wiring of the equipment in accordance with wiring diagrams provided by other contractors and/or Owner to the Electrical Contractor. All interconnecting of equipment shall be by the Electrical Contractor.
- All line and low voltage wiring and connections required to control the equipment are a part of this section. All wiring shall be in conduit. All conduit, wiring, and terminations shall be provided by the Electrical Contractor. All line and low voltage wiring in conduit. TCC provides low voltage conduit. All line voltage wiring and connections required to control the equipment are a part of this section and shall be provided by the Electrical Contractor. Mechanical controls are to be provided by a Temperature Controls Contractor (TCC). Low voltage control wiring and associated conduit for the control system shall be provided and installed by the TCC. Terminations will be made by the TCC. All line and low voltage wiring shall be in conduit.
- D. The Electrical Contractor shall provide 120 volt control power supply; #12 Ga. CU. THHN/THWN in 1/2" C. minimum at all points required by controls, instrumentation and sprinkler risers. Circuit as shown on the plans or to the nearest 120 volt panel if no circuiting is indicated. Use spare 20 Amp. breakers. Each control panel shall be on a separate circuit unless otherwise indicated. If the controlled equipment is fed from the emergency system, then the control power supply must feed from the emergency system.
- E. The Contractor shall become familiar with the equipment to be furnished by the other Contractors and/or the Owner in connection with this work and include provisions for such

connections and work in the Contractor's price. Extra remuneration will not be allowed for such work.

- F. Connections to all equipment have been designed from units as specified on the drawings or in the specifications. In the event equipment or control differs on approved shop drawings it shall be the responsibility of the Supplying Contractor to coordinate electrical connections to the units and reimburse Electrical Contractor for any changes in system design. These changes shall not involve additional cost to the Owner.
- G. Review all plans and specifications to verify all equipment connections that are required by mechanical and/or other contractors. Although the electrical drawings will show equipment connection requirements, it is the Electrical Contractor's responsibility to connect all equipment furnished by other Contractor's at no extra cost to the Owner, even if this equipment connection is not shown on the electrical drawings. Coordinate all required connections not shown on the electrical drawings with the Engineer.

1.11 NAMEPLATES:

- A. General: The following items shall be equipped with nameplates:
 - 1. Disconnect switches (fused or nonfused), transformers and switchboards (including branch circuit breakers/switches), panelboards, separately mounted circuit breakers, starters, contactors, relays, junction boxes and pull boxes.
- B. Inscription: Nameplates shall adequately describe the function or use of the particular equipment involved. Nameplates for panelboards and switchboards shall include the panel designation, voltage, and phase, A.I.C. rating of the supply (see schedules, one-line diagram, and color coding). For example, "Panel A" 120/208 V, 3-Phase, 4-Wire, 10,000 A.I.C. or "50,000 AIC with 22 KA Breakers, Series with class 'J' Fuses":
 - 1. Phase A - Black
 - 2. Phase B - Red
 - 3. Phase C - Blue
 - 4. Neutral - White
 - 5. Ground - Green
- C. The name used for a machine nameplate shall be the same as the one used on the machine's motor starter, disconnect and P.B. station nameplates. Nameplates for fused switches and panels shall also indicate fuse type and size.
 - 1. In addition to the instructions listed above:
 - 2. Lettering shall be engraved through front layer to form 1/4" characters. Nameplates shall be securely fastened to the equipment to be identified, with No. 4 Phillips, round head, cadmium plated, steel self tapping screws or nickel plated brass bolts. Motor nameplate may be nonferrous metal not less than 0.03 inches thick, die stamped. In lieu of separate plastic nameplates, engraving directly on device plates is acceptable. Letters engraved thus, shall be filled with contrasting enamel. All nameplates and their installation are part of this work. Free hand lettering or dymo label marker will not be acceptable.

1.12 MATERIALS OF APPROVED EQUAL:

- A. Where items of equipment and/or materials are specifically identified herein by a manufacturer's name, model or catalog number, and only such specific items may be used in the base bid, except as hereinafter provided.
- B. Unless requests for changes in base bid specifications are received, approved and noted by written addendum prior to the opening of bids, the successful contractor will be held to furnish specified items.
- C. After contract is awarded, changes in specifications shall be made only as defined under "Substitution of Equipment".

1.13 SUBSTITUTION OF EQUIPMENT:

- A. After execution of the contract, substitution of equipment of makes other than those specifically named in the contract documents, may be approved by the Engineer, only if the equipment named in the specifications cannot be delivered to the job in time to complete the work in proper sequence and due to conditions beyond control of the Contractor. Provide documentary proof in writing from the manufacturer that the specified equipment will not be available in time. If the Contractor is responsible for the delay, the substitution will not be approved.
- B. Requests for substitutions must be accompanied by documentary proof of equality or difference in price and delivery, if any, in form of certified quotations from suppliers of both specified and proposed equipment.

1.14 SUBMITTALS: IN ACCORDANCE WITH SECTION SAMPLES AND SHOP DRAWINGS, FURNISH THE FOLLOWING:

- A. The Engineer's approval shall be obtained for all equipment and material before delivery to the job site. Delivery, storage or installation of equipment or material which has not had prior approval will not be permitted at the job site.
- B. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings and other data necessary for the Engineer to ascertain that the proposed equipment and materials comply with specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify equipment being submitted.
- C. Submittals shall be complete and submitted together for each section. Individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assemble as a whole. Partial submittals will not be considered for approval.
 - 1. Mark the submittals, "SUBMITTED UNDER SECTION_____". Mark out all statements on sheets that do not apply otherwise. The Engineer may select options and equipment not originally specified. All options that are not marked out will be assumed that the Contractor will furnish the same.
 - 2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
 - 3. Submit each section separately.

4. Mark catalog cuts to indicate equipment, capacities, finishes, sizes, etc. Each individual item shall have its own sheet provided for approval. (Example: Separate sheets for each panelboard.)
- D. The submittals shall include the following:
1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports as required.
 2. Elementary and interconnection wiring diagrams for communication and signal systems, control system and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
 3. Parts list which shall include those replacement parts recommended by the equipment manufacturer, quantity of parts, current price and availability of each part.
 4. Quantities of materials will not be verified by the Architect or Engineer. Approval stamp on shop drawings does not constitute approval of quantities listed on shop drawings.
 5. Shop drawings:
 - a. All shop drawings shall be checked and signed by this contractor and general contractor prior to submittal to the Architect/Engineer.
 - b. Shop drawings submitted without Contractor's signatures or approval and verification will not be approved.
 - c. Shop drawings shall be submitted on wire, cables, devices, lighting fixtures (including distribution curves), motor starters, panelboards, disconnects, conduit, raceway systems, etc.
 6. Each sheet shall be either 8 1/2" x 11"; 8 1/2" x 13"; or 11" x 17" bond with a 5" x 3" clear area for engineer's stamp. (This area shall not be used by this contractor or the general contractor's stamp.) Larger drawings shall be able to be blue printed.
- E. Engineer's acceptance of Compliance Submittals will not relieve the Contractor from his responsibility for any deviations from the requirements of the contract documents, unless Contractor has in writing called Engineer's attention to such deviation at the time of submission and the Engineer has given written approval to the specific deviation; nor shall any acceptance by Engineer relieve Contractor from responsibility for errors or omissions in Compliance Submittals.
- F. Quantity of Submittals: See the general specification sections.

1.15 ELECTRICAL WORK COMPLETION:

- A. Before requesting final inspection the following work must be completed.
- B. Operating Instructions:
 1. The Contractor shall submit along with the shop drawings of the equipment, three (3) copies of operating instructions for all items. Instructions shall be prepared by the manufacturer of the equipment.

2. After the operating instructions have been approved by the Engineer, the Contractor shall include the three (3) copies in maintenance instructions brochures.
3. The Contractor shall also obtain all manufacturers' instructions, manuals, and one complete set of drawings and turn these over to the Architect at the completion of the project.
4. The Contractor shall keep in a safe place; all keys and special wrenches furnished with equipment under this contract and shall give same to the Architect at the completion of the project.
5. The Contractor shall prepare a complete brochure, in triplicate, covering all systems and equipment furnished and installed under his contract. Brochures shall be submitted to the Architect-Engineer for approval and delivery to the Owner. The cost of this brochure shall be included in the contract cost. Brochures shall contain the following:
 - a. Certified equipment drawings and/or catalog data clearly marked for equipment furnished as required for approval submission under detailed section of the specifications.
 - b. Complete operating and maintenance instructions for each item of equipment.
 - c. Complete part list for each equipment item.
 - d. Any special emergency operating instructions or a list of service organizations (including addresses and telephone numbers) capable of rendering emergency service to the various parts of the system.
6. Brochures shall be bound in hard backed three ring binders with an index, sub dividers and reinforced sheets.
 - a. Project name and address.
 - b. Section of work covered by brochure, i.e., "Electrical Work".
 - c. Name and address of Architect.
 - d. Name and address of Engineer.
 - e. Name and address of Contractor.
 - f. Telephone number of Contractor, including night or emergency number.
7. In addition to these written instructions, each respective Contractor shall fully and carefully instruct the Owner, or Owner's selected representatives, as to the proper operation, care and maintenance of each system and its equipment.

1.16 TESTING AND ADJUSTMENT:

- A. Check, test, and adjust the mechanisms of all electrical equipment and adjustable parts of lighting fixtures as required for optimum performance.
- B. Perform tests for insulation resistance in accordance with the requirements of the National Electrical Code and insure that all circuits are free from short circuits.
- C. Keep a calibrated voltmeter and ammeter available at all times and provides service for test readings when and as required, up until the project is accepted by the Owner.

D. Electrical Testing and Verification: Refer to the following specification sections (as applicable) for required tests and verifications:

1. 260519 – Low Voltage Electrical Power Conductors and Cables
2. 260526 – Grounding and Bonding for Electrical Systems
3. 262416 – Panelboards
4. 262726 – Wiring Devices

1.17 AS-BUILT DRAWINGS:

A. Show on black or blue line prints in red ink all changes from original plans made during the installation. Return two (2) sets of red marked drawings, specifications and addenda, as set forth in the General Conditions, to the Architect upon completion of the project.

1.18 FINAL INSPECTION:

- A. Final inspection will be made upon written request from the General contractor after the project is completed; in accordance with the Supplementary General Conditions.
- B. This Contractor and his principal subcontractors shall be represented at the inspection by a person of authority responsible to demonstrate to the engineer that his work conforms to the intent of the plans and specifications.
- C. Extra inspections made necessary by the Electrical Contractor's failure to comply with the conditions as set forth above shall be charged to the Contractor for the Inspector's time both on the job and spent in travel between the office and the project site.

1.19 GUARANTEE:

- A. Guarantee all work, material and equipment for a period of two years after date of substantial completion.
- B. During the two year guarantee period the Electrical Contractor shall be responsible for any defects which develop in the electrical systems. Upon notification of a defect by the General Contractor the Electrical Contractor shall make immediate effort to correct it and shall notify the Architect when this work is completed. This guarantee does not include ordinary lamp failure.
- C. Repairs and/or replacements shall be made with no cost to Owner.

1.20 SINGULAR NUMBER:

A. Where any device or part of equipment is referred to in these specifications in the singular number (such as "the switch"), such reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.21 LOW-VOLTAGE SYSTEMS:

A. Power wiring for low-voltage systems shall be furnished and installed by the contractor as shown on the drawings and as required by the equipment manufacturer.

Poudre School District
Rocky Mountain HS EM Electrical Upgrades 2021

- B. Low voltage outlets shall be installed as shown on the drawings and shall be as specified for voice outlets, hereinbefore, or as otherwise shown or required by the application or by the equipment manufacturer.
- C. Conduit for low-voltage systems shall be limited to the following and shall be furnished and installed by the Electrical Contractor.
 - 1. Conduit in walls, from outlets to accessible ceilings, terminated with open end bushing above ceiling.
 - 2. Conduits between floors, terminated with open end bushings.
 - 3. Conduits across fire and/or smoke walls, terminated with open end bushings, and sealed with approved fire rated material.
 - 4. Other conduits as shown on drawings.
- D. Conduits shall be sized as required by the number and type of conductors applied and/or as noted on plans (minimum 1") and shall be not smaller than sizes recommended by the equipment manufacturer.
- E. When ceiling voids are used as air return plenums, only U.L. Listed plenum cable shall be used or cables shall be completely routed in conduit.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 260500

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. Section includes:
 - 1. Building wires and cables rated 600 VAC and less.
 - 2. Connectors, splices, and terminations rated 600 VAC and less.
 - 3. Wire lubricating compound.
 - 4. Control wiring.
 - 5. Communication and signal wiring.
 - 6. Fireproofing tape.

1.3 SUBMITTALS

- A. Product Data (Where indicated in Section "Common Work Results for Electrical", provide the following information): For each type of product indicated.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended use.
- B. Comply with NFPA 70.
- C. Comply with NEMA WC 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES (POWER AND LIGHTING):

- A. Conductors and Cables: NEMA WC 70, except as hereinafter specified.
 - 1. All conductors shown on plans are sized for copper.
 - 2. UL label required.
- B. Single Conductor:
 - 1. Soft annealed copper.
 - 2. Stranded for sizes No. 10 and larger. Solid or stranded for sizes No. 12 and smaller, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise.

3. Minimum size No. 12, except where larger sizes are shown. (Size No. 14 minimum for controls).

C. Stranding:

1. Conductors between stationary and moving devices, such as hinged doors or panels, shall have Class H or Class K stranding. All other conductors shall have Class B or Class C stranding.

D. Insulation:

1. THHN-THWN, XHHW - Sizes No. 12 and larger.

2.2 SPLICES AND JOINTS:

- A. In accordance with UL 486 A, B, D and NEC.

- B. Split-bolt type connectors are not allowed.

C. Branch circuits (No. 10 and smaller):

1. Connectors: Solderless, screw-on, reusable pressure cable type, 600 volt, 105 degree C. with integral insulation, approved for copper and aluminum conductors.
2. The integral insulator shall have a skirt to completely cover the stripped wires.
3. The number, size, and combination of conductors, as listed on the manufacturer's packaging shall be strictly complied with.

D. Branch Circuits (No. 8 and No. 6):

1. Connectors: Pre-insulated, mechanical, reusable cable type, 600 volt, 90 degree C. with integral insulation, approved for copper and aluminum conductors, cold temperature rated to -45 degree C. Connectors shall be equal to those manufactured by Polaris Connectors.
2. Provide connectors rated for the location where installed.
3. The number, size, and combination of conductors, as listed on the manufacturer's packaging shall be strictly complied with.

E. Feeder Circuits:

1. All feeder conductors shall be the same size and type and be continuous from the overcurrent device to the panel or equipment the feeder terminates at.
2. Connectors shall be indent type, UL listed for use with the size and type of wire installed of high conductivity and corrosion-resistant material. Do not install more than one conductor per connector unless the connector is UL listed for use with the number of conductors installed.
3. Power distribution blocks shall be provided for splices or where quantity or size of conductors exceeds the terminal rating of the device to be connected. Power distribution blocks shall be equal to Square D by Schneider Electric Class 9080 Type LB or Mersen Electrical Power MPDB series. Provide with covers. Power distribution blocks shall be securely mounted in a code sized enclosure.

4. Field installed compression connectors for cable sizes 250 kcmil and larger shall have not less than two clamping elements or compression indents per wire.
5. Insulate splices and joints with materials approved for the particular use, location, voltage, and temperature. Insulation rating shall be not less than that of the conductor that is being joined.
6. Plastic electrical insulating tape: Flame retardant, cold and weather resistant.

2.3 CONTROL WIRING:

- A. Unless otherwise specified in other sections of these specifications, size control wiring as specified for power and lighting wiring, except the minimum size shall be not less than No. 14, 90 degrees C. insulation. Where stranded conductors are used, provide with spade type insulated copper terminals.
- B. Size wire large enough so that the voltage drop under inrush conditions does not adversely affect operation of the controls.

2.4 COMMUNICATION AND SIGNAL WIRING:

- A. Shall conform to the recommendations of the manufacturers of the communication and signal systems; however, not less than what is shown.
- B. Wiring shown is for typical systems. Provide wiring as recommended by the manufacturer for the systems being furnished.
- C. Multi-conductor cables shall have the conductors color coded.

2.5 WIRE LUBRICATING COMPOUND:

- A. The cable pulling lubricant shall be compatible with all cable jackets. The lubricant shall be UL (or CSA) listed. The lubricant shall contain no waxes, greases, silicones, or polyalkylene glycol oils or waxes.
- B. A 200-gram sample of the lubricant, when placed in an one-foot, split metal conduit and fully dried for 24 hours at 105 degrees C, shall not spread a flame more than three-inches beyond a point of ignition at a continued heat flux of 40 kW/m². Total time of test shall be one-half hour.
- C. Approved Lubricant is:
 1. Polywater J from American Polywater Corporation

PART 3 - EXECUTION

3.1 INSTALLATION, GENERALLY:

- A. Install in accordance with the NEC, and as specified.
- B. Install all wiring in raceway systems.

- C. Where No. 10 or No. 12 stranded conductors terminate at receptacles, toggle switches, or other devices with a screw-type connection, provide a solid conductor pigtail or spade-type connector listed for use with the appropriate class of stranded wire.
- D. Install a ground wire sized per NEC 250.122 in each conduit containing phase conductors.
- E. Color Code:
 - 1. All conductors shall be identified by circuit number and color coding at all termination points and splices. All conductors shall be identified in all pull and junction boxes by the following method of color coding. Means of identification shall be permanently posted at each branch circuit panel with a nameplate identifying color coding system used in that panelboard.

Phase	208/120V	480/277V
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	Gray
Ground	Green	Green
Iso. Grd	Green w/Yellow	Green w/Yellow

- 2. Use solid color compound or solid color coating for No. 6 and smaller branch circuit conductors and neutral sizes.
- 3. Phase conductors No. 4 and larger color code using one of the following:
 - a. Solid color compound or solid color coating.
 - b. Colored as specified using 3/4-inch wide tape. Apply tape in half overlapping turns for a minimum of three-inches for terminal points, and in junction boxes, pull boxes, troughs, manholes, and handholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable stating size and insulation type.
 - c. Yellow stripe on isolated ground may be 1/4-inch wide yellow tape on top of green.
- 4. Where neutrals are located in the same raceway, junction box or enclosure, neutrals shall be marked or labeled to indicate which circuit conductor (phase conductor) they are associated with. Neutrals (with stripes matching the associated phase conductor color) meeting the requirements of NEC Section 200.6 are acceptable for this purpose.
- 5. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
- 6. Provide plastic engraved color code legend on each panelboard and switchboard per NEC Section 210.5 (C).
- 7. All improperly color coded conductors will be completely replaced at no additional cost to Owner.

- F. All cable and wiring shall be continuous between electrical equipment. Splices shall not be added except as required for taps in branch circuits or as approved by the engineer.
- G. Splice cables and wires only in outlet boxes, junction boxes, pull boxes, manholes, or handholes. Do not splice cables in panelboards, switchboards, disconnects, etc.
- H. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
- I. For panelboards, cabinets, wireways, switches, and equipment assemblies, neatly form, and tie all cables.
- J. Seal cable and wire entering a building from underground between the wire and conduit, where the cable exits the conduit, with a non-hardening approved compound.
- K. Wire Pulling:
 - 1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling of cables.
 - 2. Use ropes made of nonmetallic material for pulling feeders.
 - 3. Attach pulling lines for feeders by means of either woven basket grips or pulling eyes attached directly to the conductors, as approved by the Engineer.
 - 4. Pull multiple cables into a single conduit with a single continuous pull.
 - 5. Use wire lubricant per this specification when recommended by the cable manufacturer or as required to prevent damage to cables during installation.
- L. Individual neutrals shall be provided for each circuit. Multi-wire branch circuits (i.e. Two or more phase sharing a neutral conductor) shall not be allowed, unless specifically noted or shown on the plans. Where multi-wire branch circuits are shown or noted on the plans, provide a disconnecting means that will simultaneously disconnect all phase conductors at the panel where the branch circuit originates.

3.2 SPLICE INSTALLATION:

- A. Splices and terminations shall be mechanically and electrically secure.
- B. Where the Engineer determines that unsatisfactory splices or terminations have been installed, remove the devices and install approved devices at no additional cost to the Owner.

3.3 CONTROL, COMMUNICATION, AND SIGNAL WIRING INSTALLATION:

- A. Unless otherwise specified in other sections of these specifications, install wiring as described below. Wiring shall be connected to perform the functions shown and specified in other sections of this specification.
- B. Except where otherwise required, install a separate power supply circuit for each system, or control equipment, or control power. Circuit to nearest 120 volt panel or nearest emergency panel if equipment controlled is connected to emergency system. Use spare 20 Amp breakers in panels where none are designated. Verify all requirements with actual equipment supplied in field.

- C. Install a breaker lock-on clip on the handle of the branch circuit breaker for the power supply circuit for each system to prevent accidental de-energizing of the systems. Lock-on clips for circuit breakers serving fire alarm systems shall be painted red.
- D. System voltages shall not exceed 120 volts and shall be lower voltages where shown on the drawings or required by the NEC.
- E. Wire and cable identification:
 - 1. Install a permanent wire marker on each wire at each termination, outlet box, junction box, panel, and device. Markers shall be typed or handwritten and shall be clearly legible.
 - 2. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
 - 3. Wire markers shall retain their markings after cleaning.
 - 4. In each manhole and handhole, install permanent, waterproof tags to identify the cable type/system and the building or area served.

3.4 FEEDER IDENTIFICATION:

- A. In each, interior pullbox and junction box, identify each phase, neutral and/or ground conductor by conductor color coding or tape based on system voltage.
- B. In manholes and handholes, install permanent, waterproof tags to identify the cable type. Identify each phase, neutral, and/or ground conductor by conductor color coding or tape based on system voltage.

3.5 FIELD TESTING:

- A. Feeders and branch circuits shall have their insulation tested after installation and before connection to utilization devices such as fixtures, motors, or appliances.
- B. Test shall be performed by megger and conductors shall test free from short-circuits and grounds.
- C. Test conductors' phase-to-phase and phase-to-ground.
- D. Megger motors after installation but before start-up and test free from grounds.
- E. The Contractor shall furnish the instruments, materials, and labor for these tests.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. This section includes grounding and bonding systems and equipment.

1.3 SUBMITTALS:

- A. Product Data (Where indicated in Section "Common Work Results for Electrical", provide the following information): For each type of product indicated.

1.4 QUALITY ASSURANCE:

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS:

- A. Insulated General Purpose: UL and NFPA 70 approved types, copper, with THW, XHHW or dual rated THHN-THWN insulation color identified green.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
- C. Size conductors not less than what is shown on the drawings and not less than required by the NFPA 70.

2.2 GROUND BUS:

- A. Pre-drilled rectangular bars of annealed copper, 1/4 by 4 inches in cross-section with 9/32 inch holes spaced 1-1/8 inches apart. Stand-off insulators shall comply with UL 891 for use in switchboards, 600V and shall be Lexan or PVC, impulse tested at 5000V.

2.3 GROUND RODS:

- A. Copper-clad steel, sectional type, 3/4-inch diameter by 20 feet long.

2.4 CONNECTORS:

- A. Listed and labeled by a NRTL acceptable to the authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connections:
 - 1. Exothermic welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
 - 2. For structural steel, steel grounding stud for compression connector.
- D. Compression Connectors: Hydraulic crimped, irreversible compression type kits. Connectors shall be factory filled with oxide inhibitor. All crimps shall be made with a hydraulic tool that embosses the index number on the outside of the connector.
- E. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long barrel, two-bolt connection to ground bus bar.
- F. All splices and grounding electrode connections shall be made with exothermic welds or with hydraulic compression fittings.

2.5 INTERSYSTEM GROUND BAR:

- A. Complies with UL 467.
- B. Base and cover shall be impact resistant and UV rated.
- C. Shall be rated for copper and aluminum conductors.
- D. Shall have provisions for one main grounding electrode conductor and a minimum of four bonding conductors.

PART 3 - EXECUTION

3.1 APPLICATIONS:

- A. Conductors: Install solid or stranded conductors for #12 AWG and smaller and stranded conductors for #10 AWG and larger unless otherwise indicated.
- B. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
- C. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors or hydraulic compression connectors except as otherwise indicated.
3. Connections to Structural Steel: Welded connectors.
4. Aboveground Connections to Ground Rods: Bolted connectors.

3.2 INSTALLATION, GENERALLY:

- A. Ground in accordance with the NFPA 70 as shown, and as hereinafter specified. All equipment ground conductors shall be terminated on a ground bus or ground lug attached to equipment can.
- B. System Grounding:
 1. Secondary service neutrals shall be grounded at the supply side of the secondary disconnecting means and at the related transformers.
 2. Separately derived systems (transformers downstream from the service entrance) ground the secondary neutral.
- C. Equipment Grounding:
 1. Metallic structures, enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be grounded for personnel safety and to provide a low impedance path for possible ground fault currents.

3.3 SECONDARY EQUIPMENT AND CIRCUITS:

- A. Conduit Systems:
 1. Ground all metallic conduit systems.
 2. Non-metallic conduit systems shall contain a grounding conductor.
 3. Conduit provided for mechanical protection containing only a grounding conductor, bond to that conductor at the entrance and exit from the conduit via grounding bushings.
- B. Feeders and Branch Circuits: Install green grounding conductors with feeders and branch circuits in all feeders and branch circuits and in any raceway containing a phase conductor.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
 1. Bond the grounding wires to each pullbox, junction box, outlet box, cabinets, and other enclosures through which the ground wires pass (except for special grounding systems for intensive care units and other critical units shown.).
 2. Make ground wire connections to ground bus in motor control centers, panelboards, etc.
- D. Receptacles and toggle switches are not approved for grounding through their mounting screws. Ground with a ground wire from green ground terminal on the device to the outlet box ground screw.

- E. Ground lighting fixtures to the green grounding conductor of the wiring system when the green ground is provided; otherwise, ground the fixtures through the conduit systems. Fixture connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- F. Fixed electrical appliances and equipment shall have a ground lug installed for termination of the green ground conductor.

3.4 CONDUCTIVE PIPING:

- A. Bond all conductive piping systems in the building to the electrical system ground. Bonding connections shall be made as close as practical to the water pipe ground or service equipment ground bus.

3.5 SPLICES:

- A. All splices and grounding electrode connections shall be made with exothermic welds or with hydraulic compression fittings.

3.6 INSTALLATION:

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where subject to strain, impact, or damage.
- B. Grounding electrode conductors shall be continuous.

END OF SECTION 260526

SECTION 260533 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Description:
 - 1. This section includes the furnishing, installation, and connection of raceways, fittings, and boxes to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
 - 2. The term conduit, as used in this specification, shall mean any or all of the raceway types specified.
- B. Section Includes:
 - 1. Metal conduits, tubing, and fittings.
 - 2. Non-metallic conduits and fittings.
 - 3. Metal wireways and auxiliary gutters.
 - 4. Non-metallic wireways and auxiliary gutters.
 - 5. Surface raceways.
 - 6. Boxes and enclosures.

1.3 DEFINITIONS:

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.
- D. RGS: Rigid galvanized steel.

1.4 ACTION SUBMITTALS:

- A. Product Data (Where indicated in Section “Common Work Results for Electrical”, provide the following information): For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings (Where indicated in Section “Common Work Results for Electrical”, provide the following information): For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 CONDUIT:

- A. Raceway Size: In accordance with the NFPA 70 but not less than 3/4-inch unless otherwise shown. Where permitted by the NFPA 70, 1/2-inch flexible conduit may be used for connections to recessed lighting fixtures.
- B. Raceway Supports:
 - 1. Parts and hardware: Zinc-coat or provide equivalent corrosion protection.
 - 2. Pipe Straps: Fed. Spec. FF-S-760, Type I, Style A or B.
 - 3. Individual Raceway Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
 - 4. Multiple Raceway (trapeze) hangers: Not less than 1-1/2 by 1-1/2 inch, 12 gauge steel, cold formed, lipped channels or not less than 2-1/8 by 2-1/8 inch, 18 gauge B-Line "4Dimension Channel"; with not less than 3/8-inch diameter steel hanger rods.
 - 5. Solid Masonry and Concrete Anchors: Fed. Spec. FF-S-325; Group III self-drilling expansion shields, or machine bolt expansion anchors Group II, Type 2 or 4, or Group VIII.
- C. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.

2.2 RACEWAYS:

- A. Install raceway types as shown on drawings and as listed below.
- B. Metal Conduit:
 - 1. Rigid steel: UL 6 and ANSI C80.1.
 - 2. Rigid aluminum: UL 6A and ANSI C80.5.
 - 3. Rigid intermediate steel conduit (IMC): UL 1242 and ANSI C80.6.
 - 4. Electrical metallic tubing (EMT): U.L. 797 and ANSI C80.3. Maximum size 5-inch. Permitted only with cable rated 600 volts or less.
 - 5. Flexible steel conduit (commercial Greenfield): UL 1, zinc-coated steel.
 - 6. Liquid-tight flexible metal conduit: UL 360 flexible galvanized steel tubing covered with extruded liquid-tight jacket of polyvinyl chloride (PVC). Provide conduit with a continuous copper bonding conductor spiral between the convolutions.
 - 7. PVC Coated Rigid Steel: NEMA RN 1. Conduit and fittings shall be as manufactured by Robroy Industries; Plasti-Bond, Perma-Cote, and KorKap or Thomas & Betts; Ocal. Any deviation will require approval of the specifying Engineer or Owner.
 - a. Shall be UL listed.
 - b. All male threads on conduit, elbows and nipples shall be protected by application of a urethane coating.
 - c. All female threads on fittings or conduit couplings shall be protected by application of a urethane coating.

C. Conduit Fittings for Metal Conduit:

1. Comply with NEMA FB 1 and UL 514B.
2. Rigid steel and IMC conduit fittings:
 - a. Standard threaded couplings, locknuts, bushings, and elbows: Fed. Spec. W-F-408, except only material of steel or malleable iron is acceptable. Integral retractable type IMC couplings are acceptable also.
 - b. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure
 - c. Bushings: Metallic insulating type, consisting of an insulating insert molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted. Bushings for conduit smaller than 1-1/4-inch shall have flared bottom with ribbed sides.
 - d. Erickson (union-type) and set screw type couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
 - e. Sealing fittings: Threaded cast iron type. Use continuous drain type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank coverplates having the same finishes as that of other electrical plates in the room.
 - f. In trade sizes 2-1/2 inches to 4-inches for rigid steel raceway or intermediate metal raceway, contractor may use Allied 'Kwik-Couple' fittings in lieu of individual steel couplings. 'Kwik-Couple' fittings shall not be used in hazardous locations. Where 'Kwik-Couple' fittings are used exterior for vertical risers, install fitting with taper end up.
3. Rigid aluminum conduit fittings:
 - a. Standard threaded couplings, locknuts, bushings, and elbows: Malleable iron, steel or aluminum alloy materials. Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4 percent copper are prohibited.
 - b. Locknuts and bushings: As specified for rigid steel and IMC raceways.
 - c. Set screw fittings: Not permitted for use with aluminum raceway.
4. Electrical metallic tubing fittings:
 - a. Fed. Spec. W-F-408, except only material of steel for compression type. Steel or die-cast is acceptable for set screw type. Die-cast compression is not acceptable.
 - b. Couplings and connectors: Concrete tight and rain tight, with connectors having flared throats. Use gland and ring compression type or set screw type couplings and connectors. Set screw type couplings for conduit 2 inches and larger shall be four set screws each. Use set screws of case-hardened steel with hex head and cup point to firmly seat in wall of conduit for positive grounding.
 - c. Indenter type connectors or couplings are prohibited.

- d. In trade sizes 1-1/4 inches to 4 inches, contractor may use Allied “Kwik-Fit EMT” or “Kwik-Fit Compression EMT” fittings in lieu of individual steel couplings.
 - 5. Flexible steel conduit (greenfield) fittings:
 - a. Fed. Spec. W-F-406 and UL 5, except only steel or malleable iron material is acceptable.
 - b. Clamp type, with insulated throat.
 - 6. Liquid-tight flexible metal conduit fittings:
 - a. Fed. Spec. W-F-406, except only steel or malleable iron material is acceptable.
 - b. Type incorporating a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
 - 7. Expansion and deflection couplings:
 - a. UL 467 and UL 514.
 - b. Accommodate, 1.9 cm (0.75”) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
 - c. Include internal flexible metal braid sized to guarantee conduit ground continuity and fault currents in accordance with UL 467, NFPA 70 Section 250.98, and the NFPA 70 code tables for ground conductors.
 - d. Shall be watertight, seismically qualified, corrosion-resistant, threaded for and compatible with rigid or intermediate metal conduit.
 - e. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat resistant molded rubber material with stainless steel jacket clamps.
 - f. Expansion fittings shall accommodate a minimum of 4-inches of movement.
 - D. Nonmetallic Conduit:
 - 1. PVC Conduit: NEMA TC 2 and UL 651 Schedule 40, conduit size is 3/4-inch minimum.
 - E. Conduit Fittings for Non-Metallic Conduits:
 - 1. PVC Conduit: Comply with NEMA TC 3; match to conduit type and material.
- 2.3 OUTLET BOXES:
- A. UL-50, UL514A and NEMA OS 1.
 - B. Cast metal where required by NFPA 70 or shown, and equipped with rustproof boxes; NEMA FB 1.
 - C. Sheet metal boxes: 4-inch square, galvanized steel, except where otherwise shown.

- D. Boxes installed in concrete or masonry and boxes larger than two gang shall be masonry type.
- E. Box extensions used to accommodate building finishes shall be of the same material as the recessed box.
- F. Boxes for use with IMC or RGS raceways shall be cast 'F' type or stainless steel unless noted otherwise on the drawings.
- G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

2.4 WIREWAYS AND AUXILIARY GUTTERS:

- A. Sized according to NFPA 70.
- B. Equip with hinged covers, except where removable covers are shown. Wireways shall only be permitted as indicated on the drawings or approved by the Engineer.
- C. Fittings and accessories: Include covers, couplings, offsets, elbows expansion joints, adapters, hold down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.
- D. Metal Wireways:
 - 1. Sheet metal complying with UL 870 and NEMA 250.
 - 2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70 and shall be marked for intended location and application.

2.5 PULL AND JUNCTION BOXES:

- A. Small boxes shall comply with NEMA OS 1.
- B. Larger boxes shall comply with UL 50 and NEMA 250.
- C. Pull and junction boxes shall be code gauge steel boxes with hinged, bolted or screwed covers. Boxes shall be flush or surface mounted as shown or required.
- D. Junction and pull box shall be installed where shown on drawings and additional boxes shall be installed if required for pulling of wire provided location and installation is approved by the Architect. All boxes shall be code construction with screw type cover and shall be installed in accessible locations.
- E. Pull and junction boxes for use with IMC or RGS raceways shall be cast 'FS' type or stainless steel unless noted otherwise on the drawings. Comply with NEMA FB 1 and UL 1773 with gasketed cover.

PART 3 - EXECUTION

3.1 RACEWAY:

- A. Minimum 3/4-inch above grade, 3/4-inch below grade, and 1-inch on site, unless otherwise noted.
- B. A ground wire, sized per NFPA 70 Section 250.122 shall be installed in all conduits containing phase conductor(s).
- C. RGS or IMC must be used at all times when exposed to weather or physical abuse and in all NFPA 70 classified hazardous locations. EMT may not be used in direct contact with earth, or in concrete slabs on grade.
- D. All nonmetallic (PVC and fiberglass) conduits shall be provided with separate ground conductor sized per NFPA 70.

3.2 PENETRATIONS:

A. Cutting or Holes:

- 1. Locate holes in advance where they are proposed in the structural sections such as ribs or beams. Obtain the approval of the Structural Engineer prior to drilling through structural sections.
- 2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammer, impact electric, hand or manual hammer type drills are not allowed, except where permitted by the Structural Engineer as required by limited working space.

B. Fire Stop:

- 1. Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases, and maintains specified fire rating. Completely fill and seal clearances between raceways and openings with the fire stop material. See Section "Common Work Results for Low Voltage Systems Cabling" for firestopping requirements for low voltage cabling sleeves.

C. Fire Barrier Penetration Seals:

- 1. Manufacturer: Subject to compliance with requirements, provide fire barrier penetration seals of one of the following:
 - a. Electro Products Div./3M
 - b. Nelson; Unit of General Signal.
- 2. Provide seals for any opening through fire-rated walls, floors, ceilings, or assemblies used as passage for components such as conduits or cables.
- 3. Cracks, voids or holes up to 4-inch diameter: Use putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable

jackets, and capable of expanding 10 times when exposed to flame or heat and UL-listed.

4. Execution: Fill entire opening with sealing compound. Adhere to manufacturer's installation instructions. All fire barrier seals shall meet the rating of the wall.

D. Waterproofing:

1. Install sleeves and sleeve seals at exterior floor, exterior wall, and roof conduit penetrations and completely seal clearances around the conduit and sleeve and make watertight as specified in Section, SEALING AND CAULKING.

3.3 CONDUIT SYSTEMS INSTALLATION, GENERAL:

A. Installation: In accordance with UL, NFPA 70, as shown, and as hereinafter specified.

1. Where non-metallic (PVC or fiberglass) conduits are used, a ground wire sized per NFPA 70 Section 250.122 shall be provided if not already specified.

B. All branches of the emergency system shall be installed entirely independent of other raceway systems. Common supports and hangers may be used.

C. Raceway Burial Depths: (Underground work)

1. 18" minimum, 30" maximum cover to grade or bottom of floor slab.
2. 24" minimum under streets, highways, roads, alleys, driveways and parking lots.
3. 2" minimum below concrete slab inside a building.
4. Prior to any underground work, contractor shall verify and locate all existing underground utilities. All existing utilities may not be shown on the drawings. Verify in field with owner and with utility locating services. The contractor shall exercise extreme caution when trenching or boring, hand digging at all crossings and where in close proximity of existing utilities. Repair existing parking lots, streets, roads, alleys, driveways, etc. to its original condition in a timely manner prior to substantial completion. Contractor shall be responsible for any damage to underground utilities.
5. Underground conduits shall be installed in a sand bed and in an organized manner.

D. Install raceways as follows:

1. Comply with NECA 1, comply with NECA 101 for metal conduit and NECA 102 for aluminum conduit except where requirements on drawings or this article are stricter.
2. In complete runs before pulling in cables or wires.
3. Flattened, dented, or deformed raceways are not permitted. Remove and replace the damaged raceways with new undamaged material.
4. Assure raceway installation does not encroach into the ceiling height head room, walkways, or doorways.
5. Cut square with a hacksaw, ream, remove burrs, and draw up tight.
6. Mechanically and electrically continuous.
7. Independently support raceway. Do not use other supports i.e., (suspended ceilings, suspended ceiling supporting members, lighting fixtures, mechanical

pipng, or mechanical ducts.). Group raceways with common supports where possible. Conduit shall be supported within 12-inches of connectors.

8. Close ends of empty raceway with plugs or caps at the rough-in stage to prevent entry of debris, until wires are pulled in.
9. Raceway installations under fume and vent hoods are prohibited.
10. Secure raceways to cabinets, junction boxes, pull boxes and outlet boxes with bonding type locknuts. For RGS and IMC raceway installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make raceway connections to junction box covers.
11. Flashing of penetrations of the roof membrane is specified in Section, FLASHING AND SHEET METAL.
12. Raceways shall not be used as a support.
13. Use thread compounds that are UL approved conductive type to insure low resistance ground continuity through the raceways.
14. Tightening set screws with pliers is prohibited.
15. Keep raceways a minimum of 6 inches away from parallel runs of flues and steam or hot-water pipes.

E. Raceway Bends:

1. Make bends with standard raceway bending machines.
2. Raceway hickey may be used for slight offsets, and for straightening stubbed out raceways.
3. Bending of raceways with a pipe tee or vise is prohibited.

F. Raceways Installed Under Metal - Corrugated Sheet Roof Decking

1. Where rigid metal conduit or intermediate metal conduit is not used, raceways shall be installed and supported so the nearest outside surface of the raceway is not less than 1.5 inches from the nearest surface of the roof decking.

G. PVC coated RGS:

1. Use only fittings listed for use with this type of conduit.
2. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduit and fittings. Use sealant recommended by conduit manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. Right angle beam clamps and U bolts shall be specially formed and sized to snugly fit the outside diameter of the coated conduit.
4. All clamping, cutting, threading, bending, and assembly instructions listed in the manufacturer's installation guide should be vigorously followed. Installer certification, before installation, is required.

3.4 CONCEALED WORK INSTALLATION:

A. General:

1. Raceway and Outlet Boxes Installation: All raceway systems work and outlet boxes shall be installed concealed in walls, floor and roof construction or concealed within furred spaces or above ceilings. In equipment or mechanical

rooms exposed work shall include feeders and connections to equipment unless noted otherwise.

B. In Concrete:

1. Raceway: RGS, IMC, PVC or EMT; except do not install EMT in concrete slabs that are in contact with soil, gravel or vapor barriers.
2. Align and run raceways in direct lines.
3. Install raceways through concrete beams only when the following occurs:
 - a. Where shown on the structural drawings.
 - b. As approved by the Structural Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of raceways in concrete that is less than three inches thick is prohibited. All raceways installed in concrete shall be approved by the Structural Engineer.
 - a. Raceway outside diameter larger than one-third of the slab thickness is prohibited.
 - b. Space between raceways in slabs: Approximately six conduit diameters apart, except one conduit diameter at conduit crossings.
 - c. Install raceways approximately in the center of the slab so that there will be a minimum of 3/4-inch of concrete around the raceways.
5. Make couplings and connections watertight.

C. Above Furred or Suspended Ceilings and in Walls:

1. Raceways for conductors 600 volts and below:
 - a. RGS, IMC, rigid aluminum, or EMT. Types mixed indiscriminately in the same system are prohibited.
 - b. Do not use aluminum in wet locations or in contact with concrete.
2. Align and run raceways parallel or perpendicular to the building lines.
3. Connect recessed or lay-in lighting fixtures and all other devices installed in a lay-in ceiling to raceway runs with flexible metal conduit extending from a junction box to the fixture. Provide a ground wire in all flexible conduits.
4. Tightening set screws with pliers is prohibited.

3.5 EXPOSED WORK INSTALLATION:

A. Raceways for Conductors 600 volts and below:

1. RGS, IMC, rigid aluminum, or EMT. Types mixed indiscriminately in the system are prohibited.
2. Do not use aluminum in wet locations or in contact with concrete.
3. All raceways exposed to physical abuse and in all industrial pump, treatment plant locations shall be RGS, or IMC.

- B. Align and run raceways parallel or perpendicular to the building lines.
- C. Install horizontal runs close to the ceiling or beams and secure with raceway straps.
- D. Surface metallic raceways:
 - 1. Surface metallic raceway shall only be used where shown on the drawings, and in remodels and modifications to existing where wall and ceiling voids do not permit concealed installation but shall not be used at any other location unless called for on the drawings.
 - 2. All surface raceway and outlets must be painted to match the surface it is attached to.
 - 3. Install a ground wire sized per NFPA 70 Section 250.122 for the largest circuit in the raceway if not already specified.
- E. Painting:
 - 1. Paint exposed raceways as specified in Section, PAINTING.
 - 2. Paint raceways containing cables rated over 600 volts safety orange as specified in Section, PAINTING. In addition, paint legends, using 2-inch high black numerals and letters, showing the cable voltage rating. Provide legends where raceways pass through walls and floors and at maximum 20-foot intervals in between.

3.6 WET OR DAMP LOCATIONS:

- A. Unless otherwise shown, use raceways of RGS or IMC above grade.
- B. Provide sealing fittings, to prevent passage of water vapor, where raceways pass from warm to cold locations, i.e., (refrigerated spaces, constant temperature rooms, air conditioned spaces) or similar spaces.
- C. Rooftops:
 - 1. Where raceways or cables are exposed to direct sunlight on or above rooftops, raceways or cables shall be installed a minimum of 7/8" above the roof to the bottom of the raceway or cable.
 - 2. The ampacity of conductors or cables shall be de-rated in accordance with N.E.C. Section 310.15(B)(3)(c).
 - 3. Raceways or cables shall be supported up off the surface of the roof with a polymeric rooftop support equal to Caddy Pyramid series. Supports shall be non-penetrating and shall be designed to prevent damage to the roofing materials. Wood supports are not allowed.

3.7 MOTORS AND VIBRATING EQUIPMENT:

- A. Use flexible metal conduit (Type FMC) for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission. Provide liquid-tight flexible metal conduit Type (LFMC) for installation in exterior locations, kitchens, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, treatment plants, pump stations, and locations

subject to seepage or dripping of oil, grease or water. Provide a green ground wire with all flexible metal conduit.

3.8 EXPANSION JOINTS:

- A. Expansion fittings shall be used wherever the change in length of PVC conduit due to temperature variation exceeds 0.25-inches per NEC Section 352.44.
- B. All conduits routed outdoors or in non-conditioned spaces (i.e., attics, non-insulated plenums, etc.) shall have expansion fittings per the following:
 - 1. Steel: One expansion fitting in runs longer than 40 feet. Provide additional expansion fittings every 200 feet.
 - 2. Aluminum: One expansion fitting in runs longer than 20 feet. Provide additional expansion fittings every 100 feet.
 - 3. PVC: One expansion fitting in runs longer than 20 feet. Provide additional expansion fittings every 50 feet.
- C. Equip raceways 3-inches and larger, that are rigidly secured to the building structure on opposite sides of a building expansion joint, with expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- D. Equip raceways smaller than 3-inches, that are rigidly secured to the building structure on opposite sides of a building expansion joint, with junction boxes located 12-inches either side of the expansion joint. Connect junction boxes with 24-inches of flexible conduit that is slack (to allow for movement). Flexible conduit shall have an insulated copper bonding jumper installed. In lieu of this flexible conduit, expansion and deflection couplings as specified above for 3-inches and larger conduits are acceptable.

3.9 RACEWAY SUPPORTS, INSTALLATION:

- A. All raceways shall have supports at maximum spacing of 10-feet and within 3-feet of a fitting, elbow, change of direction, box outlet or enclosure. Safe working load shall not exceed 1/4 of proof test load of fastening devices. This shall apply to both vertical and horizontal conduit runs.
- B. Use pipe straps or individual raceway hangers for supporting individual conduits.
- C. Support multiple raceway runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the raceways, wires, hanger itself, and 200 pounds. Attach each raceway with U-bolts or other approved fasteners.
- D. Support raceways independently of junction boxes; pull boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
 - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.

2. Existing Construction:
 - a. Steel expansion anchors not less than 1/4-inch bolt size and not less than 1-1/8 inch embedment.
 - b. Power set fasteners not less than 1/4-inch diameter with depth of penetration not less than 3-inches.
 - c. Use vibration and shock resistant anchors and fasteners for attaching to concrete ceilings.
 - F. Hollow Masonry: Toggle bolts are permitted. Bolts supported only by plaster are not acceptable.
 - G. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
 - H. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
 - I. Chair, wire, or perforated strap shall not be used to support or fasten conduit.
 - J. Spring steel type supports "caddy clips" that are listed for the intended use are acceptable in appropriate locations.
 - K. Vertical Supports: Vertical raceway runs shall have riser clamps and supports in accordance with NFPA 70 and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.
- 3.10 BOX INSTALLATION:
- A. Boxes for Concealed Raceways:
 1. Mount flush. Boxes protruding from the finished wall surface or with more than 1/8-inch gap between the wall or outlet mounted in the box will be changed out with all wall reconstruction expense paid by the Electrical Contractor.
 2. Provide raised covers for boxes to suit the wall or ceiling, construction and finish.
 - B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling in operations.
 - C. Remove only knockouts as required and plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
 - D. Outlet boxes in the same wall mounted back-to-back are prohibited.
 - E. Minimum size of outlet boxes for ground fault interrupter (GFI) receptacles is 4-inches square by 2-1/8 inches deep, with device covers for the wall material and thickness involved.
 - F. Where lighting fixtures and appliance outlets are to be mounted in concrete or in plaster finish on concrete, outlet boxes shall be installed in forms at exact dimensions from bench marks, columns, walls or floors.

- G. Where lighting fixtures and appliances outlets are to be mounted on masonry walls and/or plastered furring or other finish, outlet boxes shall be roughed in to general location before installation of wall and furring and shall be reset to exact dimensions before walls and furring are constructed.
- H. All outlet boxes shall be set true to horizontal and vertical lines parallel to walls, floors and ceilings and true to finish lines. All boxes shall be secured to ceilings or walls so all installations are solidly mounted.
- I. Boxes mounted to wall studs shall be secured to a horizontal box mounting bracket equal to B-Line Series #BB2 or Caddy Series #SGB. B-Line Series #BB4, Caddy Series #H23 or equal one piece support brackets may be used for mounting light switch boxes only. However, metal stud clips with far side box supports are not acceptable.
- J. Boxes for exterior exposed work (where approved by the engineer) shall be Appleton or Pyle National Type FS or FSC for shallow devices and Type FD or FDC for deep devices. Boxes for ceiling mounted light fixtures shall have approved no-bolt fixture studs. Boxes used as junction boxes shall have beveled edge flat steel blank cover.
- K. Where outlet boxes are mounted exposed in unfinished areas, (where approved by the engineer) surface mounted boxes shall be 4-inches square, have rounded corners and 1/2-inch raised steel cover plates.
- L. Location of outlets on small drawings is approximate and exact dimensions for locations of outlets shall be as taken from large scale plans and details on drawings or as directed by the Architect/Engineer.
 - 1. Outlets shall be located generally from column centers and finished wall lines or to center of wall or joints between wall panels. Ceiling outlets shall be installed at elevation of suspended ceiling connected to outlets in ceiling or slab above. Where necessary to fit and center with panel or ceilings and wall spaces, the contractor must, at no expense the Owner, shift the lighting outlets or other outlets as required by the Architect.
- M. Boxes for switches and receptacles installed in columns shall be located off center to allow for future partitions.
- N. Boxes for switches at or near door shall be installed on the side opposite the hinge. Verify door swing direction prior to rough-in.
- O. To prevent sound from traveling through walls, electrical devices from different rooms shall not be mounted in the same stud place. Through-wall boxes shall not be used. In fire rated walls or partitions, outlet boxes on opposite sides of walls or partitions shall be separated by a horizontal distance of 24-inches. Outlet boxes larger than 4-inch square shall not be installed in fire rated walls or partitions. Verify location of fire rated walls or partitions with Architectural drawings prior to rough-in.
- P. Mark all junction boxes and pull boxes and/or the conduit where it enters the box with panel designation and circuit number in permanent, black marker. Mark on the outside where located in unfinished spaces and mark on the inside in finished spaces.

Q. Verify exact location of floor boxes and poke-throughs with Architect prior to rough-in.

3.11 TELEPHONE, CABLE TV, COMMUNICATIONS, SECURITY AND OTHER SYSTEMS
CONDUIT:

- A. These specifications include the furnishing of all labor and materials necessary for the complete installation of a system of conduits, outlets, and boards for use by the system suppliers.
- B. This installation must be done according to the requirements of the system suppliers and the general specifications covering "Light and Power" herewith.
- C. Provide and install pull boxes at all locations as required by the system suppliers. Mark all pull boxes and/or the conduit where it enters the box with type of system in permanent, black marker. Mark on the outside where located in unfinished spaces and mark on the inside in finished spaces.
- D. Provide and install conduit sleeves thru floors and walls as required by the system suppliers.
- E. The systems shall be provided with main service conduit sized as indicated on drawings. Each phone, data or TV location requires 1-inch empty conduit with pull rope unless noted otherwise. Conduits shall be routed to nearest associated telephone or data terminal board or above lay-in ceiling. If ceiling is an air return plenum, cables shall be routed completely in conduit or must be rated for use in air return plenum. Verify conditions of job prior to rough-in.
- F. Outlets:
 - 1. All wall outlets shall be installed with standard square box, plates furnished by system suppliers, or as directed. All outlets to be located as directed. Outlet boxes not used shall be provided with blank covers.
- G. All conduit ends shall be equipped with non-metallic insulated bushings.
- H. All 2, 3 and 4-inch conduits within buildings shall include pull boxes after every two 90 degree bends. Size per NFPA 70 Article 370.
- I. Terminate conduit runs to/from the associated telephone or data backboard in a closet or designated space at the top or bottom of the backboard. Conduits shall enter closets next to the wall and be flush with the backboard.
- J. All empty conduits located in equipment closets or on backboards shall be sealed with a standard non-hardening duct seal compound to prevent the entrance of moisture and gases and to meet fire resistance requirements.
- K. Conduit runs shall contain no more than four quarter turns (90 degree bends) between pull boxes/backboards.
- L. Furnish and install nylon pull rope in all empty conduits. (Sleeves through floor/wall are exceptions).

Poudre School District
Rocky Mountain HS EM Electrical Upgrades 2021

END OF SECTION 260533

SECTION 262200 - LOW-VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. This Section includes the following types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:
 - 1. General purpose distribution transformers.
 - 2. K-Factor rated transformers.
 - 3. Buck-boost transformers.

1.3 SUBMITTALS:

- A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer to be provided.
- B. Operation and Maintenance Data: Include operation and maintenance data for all transformers in the operation and maintenance manuals.
- C. Test Records: Submit the following test records to the Engineer for review and include in the operational and maintenance manuals:
 - 1. Recorded output voltages and tap settings per paragraph ADJUSTING in Part 3 of this Section.

1.4 QUALITY ASSURANCE:

- A. Source Limitations: Obtain each transformer type through one source from a single manufacturer.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended use.
- C. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.5 COORDINATION:

- A. Coordinate size and location of concrete bases with actual transformer provided.
- B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ACME Electric Corporation; Power Distribution Products Division.
 - 2. Eaton Electrical Inc.; Cutler-Hammer Products.
 - 3. General Electric Company.
 - 4. Siemens Infrastructure and Cities (Siemens IC)
 - 5. Square D by Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS:

- A. Description: Factory assembled and tested designed 60-Hz service.
- B. Core and coil assemblies:
 - 1. Shall be rigidly braced to withstand the stresses caused by short circuit currents and rough handling during shipment.
 - 2. Cores shall be grain-oriented, non-aging silicon steel with high magnetic permeability.
 - 3. Coils shall have continuous windings without splices except for taps.
 - 4. Primary, secondary, and tap connections shall be brazed or pressure type.
 - 5. Coil windings shall have end fillers or tie downs for maximum strength.
 - 6. Coil material shall be aluminum or copper.
 - 7. Core and coil assemblies shall be bonded to their enclosures by adequate flexible bonding straps.
 - 8. Coils shall be impregnated with nonhygroscopic thermosetting varnish.
 - 9. Cores shall be constructed with low hysteresis and eddy current losses.
 - 10. Cores shall have a flux density well below the saturation point to prevent core overheating caused by harmonic voltage distortion.
 - 11. Cores shall be of common core construction. Use of more than one core, or Scott-T connections, shall not be acceptable.
- C. Ratings shown on the Drawings are for continuous duty without the use of cooling fans.
- D. Sound Level Requirements: In accordance with NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.
- E. Enclosures:
 - 1. Shall be of a type compatible with the environment in which the transformer is installed.
 - 2. Shall be not less than code gauge steel.
 - 3. Ventilation openings shall prevent accidental access to live components.
 - 4. Shall be thoroughly cleaned and painted at the factory with manufacturer's prime coat and standard finish.
- F. Wall-Mount Brackets or Ceiling-Mount Brackets: Manufacturer's standard brackets.

2.3 GENERAL PURPOSE DISTRIBUTION TRANSFORMERS:

- A. In addition to the General Transformer Requirements above, General Purpose Distribution Transformers shall meet the following requirements:
- B. Comply with NEMA ST 20 and list and label as complying with UL 1561.
- C. Taps: All transformers rated 30 kVA and larger shall have two 2.5% full capacity taps above normal rated primary voltage, and four 2.5% full capacity taps below normal rated primary voltage.
- D. Insulation Class: 220 deg C, UL-component-recognized insulation system. Transformer enclosure warm spot shall not exceed 35 degrees C rise above a 30 degrees C ambient condition. Transformer shall have the following maximum temperature rise above 40 degrees C ambient temperature:
 - 1. Transformers 0-10 kVA: 115 degrees C
 - 2. Transformers 15 kVA and larger: 150 degrees C
- E. Energy Efficiency Standard for Transformers Rated 15 kVA and Larger:
 - 1. Meet Efficiency Levels for distribution transformers as specified in DOE 2016 Efficiency.

2.4 NON-LINEAR LOAD (K-FACTOR RATED) TRANSFORMERS:

- A. In addition to the requirements for General Purpose Distribution Transformers above, K-Factor Rated Transformers shall meet the following requirements:
- B. Taps: All transformers rated 15 kVA and larger shall have two 2.5% full capacity taps above normal rated primary voltage, and four 2.5% full capacity taps below normal rated primary voltage.
- C. Transformers shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
 - 1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 - 2. Indicate value of K-factor on transformer nameplate.
 - 3. Manufacturers rating K-Factors by average temperature rise alone shall not be acceptable.
- D. Transformer secondary neutral terminal shall be sized for 200% of the secondary phase current.
- E. Electrostatic Shielding: Each winding shall have an independent, single, full-width electrostatic shield arranged to minimize interwinding capacitance.
 - 1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
 - 2. Include special terminal for grounding the shield.

3. Shield Effectiveness:

- a. Capacitance between Primary and Secondary Windings: Not to exceed 33 picofarads over a frequency range of 20 Hz to 1 MHz.
- b. Common Mode Noise Attenuation: Minimum of minus 120 dBA at 0.5 to 1.5 kHz; minimum of minus 90 dBA at 1.5 to 10 kHz; minimum of minus 65 dBA at 10 to 100 kHz; minimum of 40 dBA at 100 to 1000 kHz.
- c. Transverse (Normal) Mode Noise Attenuation: Minimum of minus 52 dBA at 1.5 to 10 kHz; minimum of minus 300 dBA at 10 to 100 kHz; minimum of 30 dBA at 100 to 1000 kHz.

2.5 BUCK-BOOST TRANSFORMERS:

- A. In addition to the General Transformer Requirements above, Buck-Boost Transformers shall meet the following requirements:
- B. Transformers shall be the self-cooled, two-winding dry type, rated for continuous duty.
- C. Transformers shall have wiring terminals suitable for connection as autotransformer.
- D. Transformers shall comply with NEMA ST 20 and shall be listed and labeled as complying with UL 506 or UL 1561.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
- B. For floor mounted transformers, construct 3.5" high concrete bases and anchor transformers according to manufacturer's written instructions.

- C. All transformers shall be protected on the primary side by Class 'L' or 'J' time delay fuses or a circuit breaker. Manufacturer shall size and coordinate to allow for transformer inrush and protect transformer from damage.
 - 1. 112.5 kVA and Larger Transformers: Where circuit breakers are used for primary protection, provide Adjustable Electronic Trip Molded Case Circuit Breakers.

3.3 IDENTIFICATION:

- A. Label each transformer with an engraved nameplate.

3.4 CONNECTIONS:

- A. Ground equipment according to Section "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Use flexible metal conduit, maximum of 6 feet in length, for conduit connections to the transformer.

3.5 CLEANING:

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

3.6 ADJUSTING:

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recorded output voltages and tap settings as test results.
- B. Connect buck-boost transformers to provide nameplate voltage of equipment being served, plus or minus 5 percent, at secondary terminals.

END OF SECTION 262200

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. Section includes:
 - 1. Lighting and appliance branch-circuit panelboards.
 - 2. Distribution panelboards.

1.3 SUBMITTALS:

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage surge suppressor, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment, include the following information:
 - 1. Dimensional data.
 - 2. Enclosure type, per NEMA 250.
 - 3. Detailed bus configuration, including current and voltage ratings.
 - 4. Short-circuit current rating of panelboard and overcurrent protective devices.
 - a. Where series ratings are permitted and utilized, submit evidence of series ratings for each selected combination of fuses and/or circuit breakers.
 - 5. Evidence of NRTL listing for series rating of installed devices.
 - 6. Detailed features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 7. Layout or elevation of each panelboard showing the relative locations of all specified breakers, lugs, accessories, and features.
 - 8. Wiring diagrams for power, signal, and control wiring.
- C. Operation and Maintenance Data: Include operation and maintenance data for all panelboards and components in the operation and maintenance manuals. Data shall include, but not be limited to:
 - 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 2. Summary of final settings for all adjustable overcurrent protective devices.
 - 3. Print or copy of all final panel schedules in 8.5" x 11" format.

- D. Test Records: Submit the following test records to the Engineer for review and approval, and include in the operation and maintenance manuals:
 - 1. Load Balancing: Submit records of load readings before and after load balancing, per paragraph ADJUSTING in Part 3 of this Section.

1.4 QUALITY ASSURANCE:

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.
- B. Product Selection for Restricted Space: Drawings may indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with any indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1 and NFPA 70.

1.5 COORDINATION:

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates wall or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and requires clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of any concrete bases with actual equipment provided.

1.6 PROJECT CONDITIONS:

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner in writing, not fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of electric service without Owner's written permission.
 - 3. Comply with NFPA 70E.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS:

- A. All panelboard components shall be the product and assembly of the same manufacturer. All similar units of all panelboards shall be of the same manufacturer.

- B. All panelboards shall be completely factory assembled with molded case circuit breakers or switches.
- C. Panelboards shall have main breaker, main switch, or main lugs, voltage, bus sizing, and flush or surface mounting as indicated on the Drawings.
- D. Enclosures: Flush or surface mounted as indicated on the Drawings
 - 1. Rated for environmental conditions at installed location:
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Cabinets:
 - a. Finish shall be galvanized steel.
 - b. Shall not have ventilation openings for panels with bus ratings of 225 amperes or less.
 - c. Back and sides shall be fabricated from one piece of formed steel for lighting and appliance branch-circuit panelboards.
 - d. Shall contain a minimum of four interior mounted studs and necessary hardware for “in” and “out” adjustment of panel interior.
 - e. Gutter sizes for cabinets containing through-feeders shall be increased by the amount required for auxiliary gutters in the NEC.
 - f. For multi-section flush-mounted panelboards, all cabinets shall be the same height.
 - 3. Front Trim:
 - a. Shall include frame and door with concealed hinges.
 - b. Shall be secured to cabinet with screws. Trim clamps are not allowed.
 - c. Shall be galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer’s standard two-coat, baked-on finish consisting of prime coat and thermosetting top coat.
 - d. Shall be same width and height as cabinet for surface-mounted panels. Shall overlap cabinet by at least 0.75 inches for flush-mounted panels.
 - e. Shall not have ventilation openings for panels with bus ratings of 225 amperes or less.
 - f. Shall include a welded angle on the rear to support and align trim to cabinet.
 - g. Shall be separate for each section of multi-section panelboards. For flush installations, trims and doors of all sections shall be the same height.
 - h. All trims for circuit breaker panelboards with bus ratings of 600 amperes or less shall be hinged trim construction with a concealed piano hinge on the right side. Trim shall be able to be hinged open by operating a latch or removing no more than four (4) screws.
 - 4. Doors:
 - a. Shall be galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer’s standard two-coat, baked-on finish consisting of prime coat and thermosetting top coat.

- b. Shall be provided with concealed butt hinges welded to the doors and trim.
- c. In making switching devices accessible, doors shall not uncover any live parts.
- d. Shall have metal directory card holder with transparent protective cover for card, permanently mounted to inside of door.
- e. Shall have the manufacturer's standard flush lock. All panels shall use the same key.

E. Phase, Neutral, and Ground Buses:

- 1. Material shall be plated copper with copper connection straps bolted together and rigidly supported on molded insulators.
- 2. Phase bus bars for panels with single pole branches shall be arranged for sequential phasing of branch circuit devices.
- 3. Phase bus bar connections for breakers with trip settings of 100 amperes and less shall be arranged so that a two-pole breaker may be substituted for two single-pole breakers, and a three-pole breaker may be substituted for three single-pole breakers, without any modifications to the bus bars or connecting straps.
- 4. Protective devices shall be able to be replaced without removing adjacent units or main bus connectors, and without drilling or tapping. Panel phase bus connections to protective devices shall be field removable by means of a screwdriver.
- 5. Neutral bus shall be full sized. Neutral bus shall be rated for 200 percent of phase bus ampacity for panels fed from K-Factor Rated transformers and as indicated on the Drawings.
- 6. Equipment ground bus shall be bonded to cabinet, and shall have adequate terminals and lugs for all branch circuit and feeder equipment grounding conductors.
- 7. In multi-section panelboards, the bussing in each section shall be full size. In all except the final section, provide sub-feed line-side lugs or feed-through load-side lugs for cable connections to the other sections. Sections with tapped bus or cross-over bus shall not be accepted.
- 8. Coordinate lug quantities and sizes with the feeders serving the panel, as scheduled on the Drawings.

F. Future Devices: Where designated on panel schedule or one-line diagram as "space" or "future", include all mounting brackets, bus connections, filler plates, and necessary appurtenances necessary for installation of devices.

G. Panelboard Short-Circuit Current Rating:

- 1. Refer to the Drawings for required A.I.C. ratings for each panelboard.
- 2. Panelboards shall bear a UL label indicating the integrated equipment rating.
- 3. Rating Options:
 - a. Fully rated panelboards and circuit breakers.

2.2 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS:

- A. Shall comply with the GENERAL REQUIREMENTS FOR PANELBOARDS listed above.

- B. 480 Volt Panelboards: Subject to compliance with requirements, provide product from one of the following list of manufacturers and types:
 - 1. Siemens Infrastructure and Cities (Siemens IC): P1
 - 2. Square D by Schneider Electric: NF
- C. Shall comply with NEMA PB 1, lighting and appliance branch-circuit type.
- D. Branch Overcurrent Protective Devices: Shall be bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Shall have flush latch. For doors over 36" in height, provide two latches.

2.3 DISTRIBUTION PANELBOARDS:

- A. Shall comply with the GENERAL REQUIREMENTS FOR PANELBOARDS listed above.
- B. Circuit Breaker Distribution Panelboards: Subject to compliance with requirements, provide product from one of the following list of manufacturers and types:
 - 1. Siemens Infrastructure and Cities (Siemens IC): P4 or P5
 - 2. Square D by Schneider Electric: I-Line
- C. Shall comply with NEMA PB 1, power and feeder distribution type.
- D. Branch Overcurrent Protective Devices:
 - 1. For circuit breaker distribution panelboards, shall be circuit breakers, replaceable without disturbing adjacent units.
- E. Cabinet Finish: May be factory primed and suitable treated with a corrosion-resisting paint finish meeting applicable UL standard for outdoor applications.
- F. Doors:
 - 1. Shall be provided where distribution panelboards are installed in finished rooms.
 - 2. Shall have a vault-type latch with three-point catch arranged to fasten door at top, center, and bottom.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES:

- A. Molded Case Circuit Breaker (MCCB):
 - 1. Molded Case Circuit Breakers shall comply with the requirements specified in Section "Overcurrent Protective Devices".
 - 2. Circuit breakers shall be factory-installed in the panelboards in the same numbered positions indicated on the Drawings.
 - 3. Thermal-Magnetic or Non-Adjustable Electronic Trip Molded Case Circuit Breakers shall be provided for all panelboard circuit breakers less than 400 amperes, unless noted otherwise.

4. Adjustable Electronic Trip Molded Case Circuit Breakers shall be provided for all panelboard circuit breakers 400 amperes and larger, unless noted otherwise.
 5. Where indicated on the drawings breaker shall be provided with a handle blocking clip, allowing the breaker to be blocked in the "ON" position.
- B. Fused Switch:
1. Fused switches shall comply with requirements specified in Section "Enclosed Switches and Circuit Breakers".
 2. Fuses shall comply with requirements specified in Section "Overcurrent Protective Devices".

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- B. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. Where indicated on the Drawings, install panelboards on concrete bases, in addition to attaching them to the vertical finished or structural surface behind the panelboard.
- B. Install wall-mounted panelboards so that the maximum height of the highest circuit breaker or switch above the finished floor does not exceed 78 inches. The bottom of the cabinet shall not be less than 6 inches above the finished floor.
- C. Mount panelboard cabinet plumb and rigid, without distortion of the box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Arrange panelboard sections for easy removal without disturbing other sections. Locate sections so that present and future conduits can be conveniently connected. Coordinate sizes of cabinets with the designated installation space.
- E. Where flush-mounted panelboards are specified, install one 3/4-inch empty conduit into an accessible ceiling space for every three single-pole spare breakers or breaker spaces, for future use.
- F. Multi-section panelboards shall be coupled together by conduit nipples appropriately sized for all feeder wiring installed between the sections.
- G. Where multi-section panelboards are flush-mounted, sections shall be arranged side by side and shall be 1.5 inches apart.
- H. Arrange conductors in gutters into neat groups and bundle and wrap with nylon cable ties.

- I. At the direction of the Architect or Engineer, where panelboards are installed in public areas, paint the exposed surfaces of the trims, doors, and cabinets to match surrounding wall finishes after the panelboards are installed.

3.3 IDENTIFICATION

- A. Identify all field-installed conductors, interconnect wiring, and components.
- B. Panelboard Nameplates: Label each panelboard with a nameplate as indicated on the Drawings and as specified elsewhere
- C. Create a type-written schedule of circuits in each panelboard, after approval of the Engineer, and install in the directory holder in each panelboard.
 1. Circuit descriptions shall include final room numbers, room descriptions, and items or equipment served.
 2. Spare breakers and breaker spaces shall be neatly marked in pencil, to allow for future updates of the schedule.
 3. Schedules shall be typed on paper directory cards or printed on card stock appropriately sized for the directory sleeves provided on the panel door.

3.4 ADJUSTING:

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY:

- A. This section includes the furnishing, installation, and connection of wiring devices.
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Tamper-resistant receptacles.
 - 3. Weather-resistant receptacles.
 - 4. Snap switches and wall-box dimmers.
 - 5. Pendant cord-connector devices.
 - 6. Cord and plug sets.

1.3 DEFINITIONS:

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. SPD: Surge Protective Device.

1.4 ADMINISTRATIVE REQUIREMENTS:

- A. Coordination:
 - 1. Receptacles for Owner Furnished Equipment: Match plug configurations.
 - 2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS:

- A. Product Data (Where indicated in Section “Common Work Results for Electrical”, provide the following information): For each type of product.
- B. Shop Drawings (Where indicated in Section “Common Work Results for Electrical”, provide the following information): List of legends and description of materials and process used for premarking wall plates.

1.6 CLOSEOUT SUBMITTALS:

- A. Operational and Maintenance Data: For wiring devices to include all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING DEVICE REQUIREMENTS:

- A. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.
- B. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NFPA 70.

2.2 RECEPTACLES:

- A. Comply with NEMA WD 1, NEMA WD 6, and UL 498.
- B. LIST OF ACCEPTABLE RECEPTACLE MANUFACTURERS

Manufacturer	Volt	Hubbell / Kellems	Leviton	P&S	Bryant	Cooper Wiring Devices
1. Specification Grade:						
Duplex:	20 A. 125 V.	5352A	5352	5362	BRY5362	5352
Ground Fault:	20 A. 125 V.	GFRST20	G5362-WT	2097	---	---
Tamper Resistant:	20 A. 125 V.	BR20TR	---	TR5362	---	TR5362
Weather Resistant Ground Fault:	20 A. 125 V.	GFWRST20	G5362-WT	2097TRWR	---	---

- C. Weatherproof duplex receptacles shall be weather resistant GFCI grounded duplex receptacles.
 - 1. All receptacles shall be mounted with the same orientation (horizontal or vertical). When a different orientation is required or desired, obtain permission from the Architect/Engineer prior to rough-in.
 - 2. Damp Locations: Provide with a single weatherproof coverplate.
 - 3. Wet Locations: Provide "In-Use" extra-duty metallic weatherproof cover.
 - a. Hubbell #WP26E (vertical) or #WP26EH (horizontal)
 - b. Red Dot #CKMUV (vertical) or #CKMU (horizontal)
 - c. Taymac #MX3200(vertical) or #MX3300 (horizontal)
 - d. Intermatic #WP1010MXD (vertical) or #WP1010HMXD (horizontal)
- D. See plans for Special Outlet Schedule.
- E. Receptacle body shall be formed of high-impact nylon faced thermoplastic or urea and receptacle contacts shall be Bronze. Hard use industrial specification grade receptacles shall have a one piece brass bridge with integral ground contacts.

- F. Receptacles:
 - 1. All receptacles in schools shall be tamper-resistant.
 - 2. Receptables shall be 20A commercial grade. Duplex receptacles shall be extra heavy-duty tamper resistant type with nylon fronts and backs.
- G. When only one receptacle is connected to a 20 amp circuit by itself, that receptacle must be rated 20 Amp.
- H. All receptacles shall be self-grounding with ground lug.
- I. Install receptacles to clear all cabinets, equipment, etc.
- J. Color of receptacles: Receptacles to match existing.
- K. All 120V, 15 or 20A receptacles located, within kitchens, within 6 feet of a sink, exterior locations, elevator machine rooms, elevator pits, garages, per NFPA 70 and as located on the plans shall be ground fault circuit interrupters (GFCI) for personnel protection (Class A) with 5ma trip. Feed through GFCI receptacles or GFCI breakers may be used to protect other receptacles in the same room and on the same circuit if wired per the manufacturer's recommendations. Prior to final inspection, perform ground fault test on each protected receptacle and submit list of all receptacles tested with results to the Engineer. Label receptacles that are GFCI protected by another feed through GFCI receptacle or by GFCI breaker "GFCI protected".
- L. Provide duplex receptacle on separate circuit beside each telephone terminal board location and other communications equipment requiring 120V, power.
- M. All 15 and 20 amp, 125 or 250 volt non-locking receptacles in damp or wet locations should be listed as "weather resistant".

2.3 PENDANT CORD-CONNECTOR DEVICES:

- A. Description:
 - 1. Matching plug and receptacle body connector.
 - 2. Body: Nylon with screw-open, cable-gripping jaws and provisions for attaching external cable grip.
 - 3. External Cable Grip: Woven wire mesh type made of high-strength, galvanized steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

2.4 CORD AND PLUG SETS:

- A. Description:
 - 1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
 - 2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket, with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

3. Plug: Nylon body and integral cable clamping jaws. Match cord and receptacle type for connection.

2.5 TOGGLE SWITCHES:

- A. Wall Switches: Wall switches in general, used to control lighting shall be quiet operating.
- B. Comply with NEMA WD 1, UL 20, and FS W-S-896.
- C. Switches shall be single pole, two-pole, three-way, four-way, keyed, and with pilot light as called for on the drawings. Groups of switches shall be under one gangplate. Where switches are in fire rated walls groups of switches shall be maximum of two (2) gangs under one cover plate.
- D. Switches shall be as follows unless specified otherwise.

Single Pole	20 A. 120 V. / 277 V.
Two Pole	20 A. 120 V. / 277 V.
Three-Way	20 A. 120 V. / 277 V.
Four-Way	20 A. 120 V. / 277 V.
Pilot Light	20 A. 120 V. / 277 V.
Key Switch	20 A. 120 V. / 277 V.

- E. When only one switch is connected to a 20 amp circuit by itself, it must be rated 20A.
- F. All switches shall be self grounding w/ground lugs.

G. LIST OF ACCEPTABLE SWITCH MANUFACTURERS

Manufacturer:	P&S	Hubbell / Kellems	Leviton	Bryant	Cooper Wiring Devices
Specification Grade Switches	PS 20AC Series	HBL 1220 Series	1220 Series	4901	AH 1220 Series

- H. Pilot light switches shall be illuminated toggle switch lighted red in "on" position. Key switches shall be master keyed.
- I. Color of switches: Match existing.
- J. Provide barriers between 277V switches and between 277V and 120V switches installed in a common outlet box.

2.6 WALL PLATES:

- A. Wall plates shall be stainless steel for all flush devices.
- B. Wall plates in industrial areas, gymnasiums, maintenance areas, warehouses and other high abuse areas shall be stainless steel.
- C. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
- D. Provide plates for all telephone, cable TV, communication outlets.

2.7 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements set forth by the drawings and these specifications, provide products by one of the following:
 1. Hubbell Building Automation/Unenco
 2. Leviton Mfg. Company Inc.
 3. Watt Stopper
 4. Synergy Lighting Controls; Acuity Brands
- B. General:
 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 5 to 30 minutes. At time of installation, Contractor to set sensor at maximum sensitivity and a time out of 20 minutes.
 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 3. Relay Unit: Dry contacts rated for 20A ballast load at 120V and 277V ac, for 13A tungsten at 120V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24V dc, 150mA, Class 2 power source as defined by NFPA 70.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.

Poudre School District
Rocky Mountain HS EM Electrical Upgrades 2021

- b. Relay/Power Pack: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
- c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind door.

5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

C. Sensor Types:

- 1. Passive infrared (PIR) Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage. Typical usages include (but are not limited to) small restrooms, storage rooms, and high volume spaces (i.e. work bays, gymnasiums, etc.).
- 2. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage. Typical usages include (but are not limited to) large storage spaces, large or multiple stall restrooms, open offices, corridors, break rooms, and work areas.
- 3. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit. Typical usages include (but are not limited to) classrooms, offices, and meeting rooms.

D. List of approved products:

Manufacturer:	Hubbell/ Unenco	Leviton	Wattstopper	Synergy	Greengate
1. Wall Mounted, Single Relay, Passive Infrared (900SF)	LHIRS	OSS-ID	PW-100	LIRW	ONW-P-1001-MV
2. Wall Mounted, Dual Relay, Passive Infrared	LHIRD	ODS0D-TD	PW-200	LIRW-DS	ONW-P-1001-DMV
3. Ceiling Mounted Ultrasonic (1000SF)	OMNIUS1000	OSC10-UOW	WT-1105	LUSOH	ODC-U-1001
4. Ceiling Mounted Ultrasonic (2000SF)	OMNIUS2000	OSC20-UOW	WT-2205	LUSOH	ODC-U-2000
5. Ceiling Mtd Ultrasonic (Corridor)			WT-2255		
6. Ceiling Mounted Dual-Technology (1000SF)	OMNIDT1000	OSC10-MOW	DT-300	LMTOH	OMC-DT-2000-R
7. Wall/Ceiling Mounted Dual-Technology (2000SF)	LODT		DT-200		
8. Electronic Timer Switch*	TD-200		TS-400		TSW-MV

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Installation shall be in accordance with NFPA 70, and as shown on the drawings.
- B. Comply with NECA 1.
- C. Switches shall be located on the latch side of all doors. If switches must be located on the hinge side of a door, they shall be located so that they are not behind the door when it is open. All questionable locations shall be brought to the Engineers/Architects attention.
- D. Verify all outlet locations on the job prior to rough-in. Locations may be altered up to 6'-0" in any direction without additional cost to the Owner.
- E. When conductors larger than #12 AWG are used on 15A or 20A circuits, splice #12 AWG pigtails for device connections.
- F. Install ground pin up on vertically mounted receptacles and install ground pin to the right on horizontally mounted receptacles.
- G. Dimmers: Do not remove cooling fins from dimmers. Space boxes as required.

3.2 FIELD QUALITY CONTROL:

- A. Convenience Receptacles:
 - 1. Verify ground continuity.
 - 2. Verify correct polarity of hot and neutral conductors.

END OF SECTION 262726

SECTION 262810 - OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. Section includes:
 - 1. Cartridge fuses rated 600 VAC and less for use in control circuits, enclosed switches, panelboards, switchboards, enclosed controllers, and motor control centers.
 - 2. Plug fuses rated 125 VAC and less for use in enclosed switches and fuseholders.
 - 3. Spare fuse cabinets.
 - 4. Molded Case Circuit Breakers (MCCBs)
 - 5. Insulated Case Circuit Breakers (ICCBs)
 - 6. Molded Case Switches

1.3 DEFINITIONS:

- A. ICCB: Insulated Case Circuit Breaker
- B. MCCB: Molded Case Circuit Breaker

1.4 SUBMITTALS:

- A. Product Data: For each type of product indicated. Include construction details, material, dimensions, and descriptions of individual components.
 - 1. Dimensions and manufacturer's technical data on features, performance, and electrical characteristics.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (both interrupting and withstand, as appropriate).
 - 4. Evidence of UL listing for series rating of installed devices.
- B. Operation and Maintenance Data:
 - 1. Manufacturer's written instructions for testing, operating, and adjusting overcurrent protective devices.
 - 2. Summary of final settings for all adjustable overcurrent protective devices.

1.5 QUALITY ASSURANCE:

- A. Source Limitations: Obtain overcurrent protective devices, components, and accessories, within same product category, through one source from a single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for the intended locations and application.
- C. Comply with NFPA 70.
- D. Comply with NEMA FU 1 for cartridge fuses.
- E. Comply with UL 248-11 for plug fuses.
- F. Comply with UL 489 for circuit breakers.

1.6 COORDINATION:

- A. Coordinate overcurrent protective device ratings with utilization equipment nameplate limitations of maximum fuse and/or breaker size and with system short-circuit current levels.

1.7 EXTRA MATERIALS:

- A. Furnish extra materials that match products installed and that are packaged in protective covering for storage and identified with labels describing contents.
 - 1. Fuses: Equal to 10 percent of quantity of installed fuses for each size and type but no fewer than three for each size and type.

PART 2 - PRODUCTS

2.1 FUSES:

- A. Manufacturers: Subject to compliance with requirements, provide product from one of the following list of manufacturers:
 - 1. Cooper Bussmann, Inc.
 - 2. Edison Fuse, Inc.
 - 3. Mersen Electrical Power
 - 4. Littelfuse, Inc.
- B. Cartridge Fuses:
 - 1. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 2. Fuse Classes:
 - a. Class-CC: UL 248-4, time-delay, rejection type
 - b. Class-J: UL 248-8, dual-element, time-delay
 - c. Class-L: UL 248-10, dual-element, time-delay
- C. Plug Fuses:
 - 1. Characteristics: UL 248-11, dual-element, time-delay, Edison base.

2.2 MOLDED-CASE CIRCUIT BREAKERS:

- A. Shall be provided as factory installed components of panelboards or switchboards, or as separately enclosed units, as specified in other Sections or on the Drawings.
- B. Manufacturers: Subject to compliance with requirements, provide product from one of the following list of manufacturers:
 - 1. Siemens Infrastructure and Cities (Siemens IC)
 - 2. Square D by Schneider Electric
- C. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.
- D. Standard Features and Accessories:
 - 1. Standard frame sizes, trip ratings, and number of poles.
 - 2. Line connections shall be bolt-on.
 - 3. Lugs: Mechanical type, suitable for the trip rating, number and size of conductors, and conductor material.
 - 4. Multi-pole units shall be enclosed in a single housing or be factory-assembled to operate as a single unit. They shall have a trip element for each pole, a common trip bar for all poles, and a single operator.
 - 5. Operating handle shall indicate ON, TRIPPED, and OFF positions.
 - 6. Shall be 80% rated, unless 100% rating is shown on the Drawings or is otherwise specified.
 - 7. Application Listing: Appropriate for application:
 - a. Type SWD for switching fluorescent lighting loads.
 - b. Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - c. Type HACR for feeding heating, air conditioning, and refrigeration equipment.
- E. Optional Features and Accessories: Provide where indicated on the Drawings or otherwise specified.
 - 1. Ground-Fault Protection: Relay and trip unit with push-to-test feature.
 - 2. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
 - 3. Handle Padlocking Device: Fixed attachment, for padlocking circuit-breaker handle in off position.
 - 4. Shunt Trip: 120-Volt trip coil energized from separate circuit, set to trip when at least 75% of coil voltage is applied, with coil clearing contact.
 - 5. Auxiliary Contacts: One SPDT switch with “a” and “b” contacts; “a” contacts mimic circuit-breaker contacts; “b” contacts operate in reverse of circuit-breaker contacts.
 - 6. Key Interlock Kit: Externally mounted to prohibit circuit breaker operation; key shall be removable only when circuit breaker is in off position.

7. Alarm Contacts: One SPDT switch with “a” and “b” contacts; “a” contacts mimic circuit breaker contacts; “b” contacts operate in reverse of circuit breaker contacts.
- F. Thermal-Magnetic (or Non-Adjustable Electronic Trip) Circuit Breakers:
1. Shall have inverse time element for low-level overloads.
 2. Shall have instantaneous magnetic trip element for short circuits.
 3. Shall have front-mounted, field-adjustable magnetic trip setting for circuit-breaker frame sizes 250 amperes and larger. Factory setting shall be LO, unless otherwise noted.
- G. Current-Limiting Circuit Breakers: Frame sizes 400 amperes and smaller; shall have let-through ratings less than NEMA FU 1, RK-5.
- H. Ground-Fault Circuit Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (5-mA trip) with self-test circuitry.
- I. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
- 2.3 MOLDED-CASE SWITCHES:
- A. Manufacturers: Subject to compliance with requirements, provide product from one of the following list of manufacturers:
1. Siemens Infrastructure and Cities (Siemens IC)
 2. Square D by Schneider Electric
- B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame interrupting rating.
- C. Features and Accessories:
1. Standard frame sizes and number of poles.
 2. Lugs: Suitable for the trip rating, number and size of conductors, and conductor material.
 3. Provide the following options or accessories where indicated on the Drawings or otherwise specified:
 - a. Shunt Trip: 120-Volt trip coil energized from separate circuit, set to trip at 75 percent of rated voltage, with coil clearing contact.
 - b. Auxiliary Contacts: Two SPDT switches with “a” and “b” contacts; “a” contacts mimic circuit-breaker contacts; “b” contacts operate in reverse of circuit-breaker contacts.
 - c. Key Interlock Kit: Externally mounted to prohibit circuit breaker operation; key shall be removable only when circuit breaker is in off position.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine overcurrent protective devices before installation. Reject units that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install overcurrent protective devices of sizes and with characteristics appropriate for each piece of equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS:

- A. Cartridge Fuses:
 - 1. Feeders: Class-J for up to 600 A Class-RK1 for up to 600 A; Class-L for over 600 A
 - 2. Motor branch circuits: Class-J for up to 600 A Class-RK5 for up to 600 A; Class-L for over 600 A
 - 3. Single-phase motor and other branch circuits where appropriate fuse holders are specified in other Sections: Class-CC
- B. Plug Fuses:
 - 1. Motor and other branch circuits: Edison-base type.

3.3 CIRCUIT BREAKER APPLICATIONS:

- A. Refer to applicable Drawings and Specification Sections for information on types of circuit breakers to be installed in particular applications. Applicable Sections may include, but not be limited to, “Switchboards”, “Panelboards”, and “Enclosed Switches and Circuit Breakers”.

3.4 INSTALLATION:

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

END OF SECTION 262810

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

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

1.2 SUMMARY:

- A. Section includes:
 - 1. Fusible Switches
 - 2. Nonfusible Switches
 - 3. Toggle Type Switches
 - 4. Fustats
 - 5. Enclosed Circuit Breakers
 - 6. Enclosures

1.3 DEFINITIONS:

- A. NC: Normally closed
- B. NO: Normally open

1.4 SUBMITTALS:

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, factory setting, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
- B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work. Include wiring diagrams for power, signal, and control wiring.
- C. Operation and Maintenance Data: Include operation and maintenance data for all enclosed switches and circuit breakers in the operation and maintenance manuals. Data shall include, but not be limited to:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.5 QUALITY ASSURANCE:

- A. Source Limitations: Obtain enclosed switches and circuit breakers, components, and accessories, within same product category, through one source from a single manufacturer.
- B. Product Selection for Restricted Space: Drawings may indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for the intended locations and application.
- D. Comply with NFPA 70.

1.6 COORDINATION:

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and requires clearances for equipment access doors and panels.

1.7 PROJECT CONDITIONS:

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Owner in writing, not fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of electric service without Owner's written permission.
 - 3. Comply with NFPA 70E.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES:

- A. Manufacturers: Subject to compliance with requirements, provide product from one of the following list of manufacturers:
 - 1. Siemens Infrastructure and Cities (Siemens IC)
 - 2. Square D by Schneider Electric
- B. Type GD General Duty switches are not allowed, unless specifically noted otherwise.
- C. Type HD, Heavy Duty, Single Throw, 1200 A and smaller: UL 98 and NEMA KS 1.
 - 1. Shall be horsepower rated for the load served.

2. Shall have clips or bolt pads to accommodate the specified fuses, with rejection features to reject fuses other than those specified.
 - a. Refer to Section “Overcurrent Protective Devices” for specified fuse types.
 3. Shall have an external operating handle indicating ON and OFF positions, with provisions to padlock the switch in the OFF position.
 4. Shall have a mechanical interlock to prevent the opening of the cover unless the handle is in the OFF position. This interlock shall be defeatable with a special tool to permit inspection.
 5. Shall have an equipment ground kit. Equipment ground shall be internally mounted and labeled for copper and aluminum ground conductors.
 6. Accessories: Provide where indicated on the Drawings or required to complete the intended design.
 - a. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - b. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - c. Auxiliary Contact Kit: One NO/NC (Form “C”) auxiliary contact arranged to activate before switch blades open.
 - d. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - e. Service Entrance Rating: Labeled for use as service entrance equipment.
- D. Other specialty switch types, such as Six Pole or Double Throw, shall be provided where indicated on the Drawings or as necessary for the equipment served, and shall meet the requirements for Type HD single throw switches above.
- 2.2 NONFUSIBLE SWITCHES:
- A. Shall meet all requirements for FUSIBLE SWITCHES above, except that they shall not accept fuses.
- 2.3 TOGGLE TYPE SWITCHES:
- A. Shall be installed where indicated on the Drawings or elsewhere in the Specifications.
 - B. Shall be 20 A, 30 A, 40 A, or 60 A, one, two, or three poles, voltage and horsepower rated for the load served.
 - C. Shall be provided with matching steel coverplate, with provisions for padlocking the switch in the OFF position.
 - D. Shall be provided with an appropriately sized mounting box where other than a standard outlet box is necessary for switch installation.

2.4 FUSTATS:

- A. 120 V motor loads up to 0.5 horsepower: Shall be horsepower rated, and include an Edison-base fuse holder and integral toggle switch. Where located in damp or wet locations, provide weatherproof unit equal to Bussman #SSN.
- B. 120 V motor loads, 0.75 horsepower: Shall consist of a horsepower rated Edison-base fuse holder, with a separate horsepower rated toggle switch mounted adjacent to fuse holder.
- C. 120 V motor loads, 1 horsepower, or 277 V motor loads: Shall consist of a horsepower and voltage rated manual motor starter switch and a horsepower and voltage rated fuse holder designed to hold a time-delay Class CC rejection-type fuse.
 - 1. Manual motor starter switch: NEMA ICS 2, general purpose, Class A, with quick-make, quick-break toggle action, marked to indicate ON, OFF, and TRIPPED. Shall include an ambient-compensated type overload relay with inverse-time characteristics and NEMA ICS 2, Class 10 tripping characteristics. Shall have heaters and sensors in each phase, matched to nameplate full-load current of specific motor it protects and appropriately adjusted for duty cycle.

2.5 ENCLOSED CIRCUIT BREAKERS:

- A. Circuit breakers shall comply with Section “Overcurrent Protective Devices”.
 - 1. Shall be Thermal-Magnetic or Non-adjustable Electronic Trip Molded-Case for breakers less than 400 amperes, unless noted otherwise.
 - 2. Shall be adjustable Electronic Trip Molded-Case for breakers 400 amperes and larger, unless noted otherwise.

2.6 ENCLOSURES:

- A. Comply with NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50.
- B. Enclosure Types: Shall be compatible with environmental conditions at installed locations, unless more stringent requirements are specified on the Drawings or elsewhere in the Specifications.
 - 1. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
- C. Finished Spaces: In finished spaces, enclosures shall be flush mounted unless otherwise noted.

PART 3 - EXECUTION

3.1 EXAMINATION:

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the work.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION:

- A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated. Maximum mounting height and required working clearances shall comply with NFPA 70.
- B. Install fuses in fusible devices.
 - 1. Where fuses serve utilization equipment or motors, coordinate final fuse sizes with equipment nameplates and comply with listed minimum and maximum sizes.
 - 2. Plug fuses installed in fustats shall be sized for 125 percent of the nameplate full load amps or running load amps.
- C. Comply with NECA 1.

3.3 IDENTIFICATION:

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
- B. Label each enclosure with engraved nameplate.

3.4 ADJUSTING:

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit breaker trip ranges.

END OF SECTION 262816

