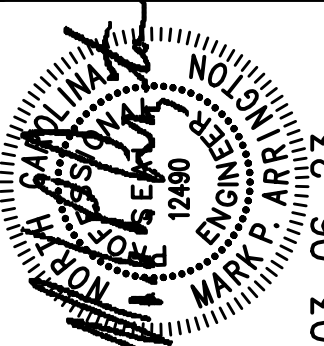


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JOB NUMBER	22-168	REVISION DATES
DESIGNED BY	CH	
CHECKED BY	WPA	
DATE	03.06.23	

**CLEVELAND COUNTY**  
**LEGRAND CENTER LIGHTING**

**ELECTRICAL**  
**SPECIFICATIONS**

SHEET  
**E400**

**ELECTRICAL GENERAL REQUIREMENTS**

- 1.1 SCOPE:**
- Applicable requirements of the General Conditions of the Contract, Amendments, Supplementary General Conditions, and Special Conditions govern work under this Division.
  - Work covered by this Division consists of providing all labor, equipment, supplies, and materials, and performing all operations, including trenching, backfilling, cutting, patching, and chasing necessary for the installation of complete electrical systems in strict accordance with these specifications and the applicable drawings.
  - Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work, the same as if herein specified or shown.
  - This Contractor is referred to the General and Special Conditions of the contract which shall form a part and be included in this section of the specification and shall be binding on this Contractor.
  - Some items of equipment are specified in the singular; however, the Contractor shall provide and install the number of items or equipment as indicated on the drawings, and as required for complete systems.

**1.2 DEFINITION:**

- The word "Contractor" as used in this section of the specification refers to the Electrical Contractor unless specifically noted otherwise. The word "Provide" means furnish, fabricate, complete, install, erect, including labor and incidental materials necessary to complete in place and ready for operation or use the item referred to or described herein and/or referred to on the Contract Drawings.

**1.3 CONTRACTOR'S QUALIFICATIONS:**

- It is assumed that the Contractor has had sufficient general knowledge and experience to anticipate the needs of a construction of this nature. The Contractor shall furnish all items required to complete the construction in accordance with reasonable interpretation of the intent of the Drawings and Specifications. Any minor items required by code, law or regulations shall be provided even if not specified or specifically shown, where it is part of a major system.

**1.4 CONTRACT DOCUMENTS:**

- The contract drawings are diagrammatic and are not intended to indicate every detail of construction, or every item of material or equipment required, or exact locations. Indicated locations of outlets, equipment, and connections are approximate and shall be verified by reference to related documents.
- The Contractor shall procure complete drawings and specifications on all coincident construction and fit the Electrical work in with it. He shall cooperate with other trades to achieve well-coordinated progress and result; and avoid conflicts with other trades. He shall make minor moves and changes necessary to accommodate other equipment and/or preserve symmetry without claim for extra payment. Should there be any doubt as to the spacing intent, or location of equipment, the Contractor shall have the point clarified by the Architect/Engineer before proceeding with the installation.

**1.5 RECORD DRAWINGS:**

- During construction of this project, the Contractor shall maintain one complete set of electrical contract drawings, on which shall be recorded all significant changes. This set of drawings shall be used for no other purpose. Upon completion of the work, the Contractor shall submit these drawings to the Architect/Engineer for approval and presentation to the Owner.
- Upon completion of the project, the Contractor shall prepare an Operation and Maintenance Manual, which shall include catalog data, equipment information, wiring diagrams, and warranty information for the electrical installation. Submit in three copies to the Architect/Engineer for approval and presentation to the Owner.

**1.6 REGULATIONS AND COMPLIANCE:**

- The requirements of the North Carolina State Building Code which includes the National Electrical Code, and of all other State and Local codes, ordinances, regulations, and interpretations by authorities having jurisdiction are binding upon this Contractor, and nothing contained in, or inferred by, these specifications or the applicable drawings may be construed as waiving those requirements. The latest edition of the National Electrical Code, referred to herein and on the drawings as "N.E.C.", forms a part of these specifications; and under no circumstances may the installation fail to meet the minimum requirements therein.
- This Contractor shall secure and pay for all permits, fees, inspections, and licenses required. Upon completion of the project and prior to his request for final payment he shall present to the Architect/Engineer a certificate of inspection and approval from the inspection authorities.
- The Contractor shall include in his work, without extra cost to the Owner, any labor, materials, service, apparatus, drawings, to comply with all applicable laws, ordinances, rules, and regulations, whether shown on drawings and/or specified.
- All materials furnished, and all work installed shall comply with the National Fire Codes of the National Fire Protection Association, and with the requirements of all governmental departments having jurisdiction.
- All materials and equipment shall bear the approval label, and shall be listed by the Underwriters' Laboratories, Inc., or any other third-party listing organization acceptable to the North Carolina Building Code Council. Refer to the list of acceptable testing agencies on the NC OSFM website under 'Code Enforcement Resources'.
- It is the responsibility of the contractor to notify the local electrical inspector to schedule the required inspections.

**1.7 ELECTRICAL TESTING:**

- Conduct full scale tests with all lights, equipment and appliances in operation and prove the electrical system satisfactory for operation and free from defects. Pay attention to the balancing of the single-phase loads on the three-phase system. Promptly remedy all defects.
- All tests specified shall be completely documented indicating time of day, date, temperature, and all pertinent test information.
- All required documentation of readings indicated above shall be submitted to Engineer prior to, and as one of the prerequisites for, final acceptance of the project.
- All elements of the electrical system provided, furnished, installed, or otherwise altered under this contract shall be subjected to testing required under this contract. Where test results indicate failure, the contractor shall repair, adjust, or replace as required and repeat the testing at no extra cost.

**1.8 GUARANTEE:**

- The Contractor shall guarantee that the work done has been done in accordance with the Contract Documents, free of imperfect materials and defective workmanship. For a period of one year after acceptance by the Owner, the Contractor shall repair or replace, at no additional expense to the Owner, any imperfect materials or defective workmanship.

**2.1 GENERAL:**

- Except where reuse of existing items is specifically indicated or permitted, all materials and equipment shall be new and shall conform to the standards of the National Electrical Manufacturer's Association and Underwriter's Laboratories, Inc. In every instance where such a standard has been established for the item involved.
- Catalog numbers and trade names in these specifications and drawings are intended only to set forth and convey to bidders the general style, type, character, and quality of product desired. Similar products of other manufacturers; of equal quality, size, capacity, character, and appearance may be substituted on the written approval of the Architect/Engineer. Requests for approval of substitutions shall be made after the award of the contract in accordance with the bidding requirements of these specifications.
- It is the intent of the drawings and specifications that the installation be complete, of finished appearance, and ready for operation. Manufacturers' catalog numbers as used herein and on the drawings are indicative of the type of product to be installed, and do not necessarily identify all parts and accessories required for the proper assembly, installation, and utilization of the product. All required parts and accessories shall be provided.
- Materials shall be inspected by the Contractor upon their arrival at the site to be sure they are correct. Material and equipment stored on the site shall be protected against physical damage, dirt and damage caused by precipitation, wind, condensation, excessive humidity, and extremes of temperature. Materials shall be stored in their original cartons when substantial, clean, and dry storage facilities provided under this Contract. Alternate storage provisions may be submitted to the Architect/Engineer for approval prior to the arrival of the material. Under no circumstances shall equipment be stored in the weather under a cover of polyethylene or tarpaulin. The Architect/Engineer will be the sole judge as to the acceptability of storage facilities, and when directed by the Architect/Engineer, improperly stored or damaged material shall be removed from the site and replaced with new material.

**2.2 SUBMITTALS:**

- Submittal data shall be thoroughly reviewed and approved by the Contractor prior to being forwarded to the Architect/Engineer. Submittal data received from the Contractor will be considered to have been reviewed and approved by the Contractor as suitable for the application and for installation in the space allotted.
- The submittal of shop drawings shall be with the Contractor stamp affixed. This stamp indicates that the Contractor, by approving and submitting shop drawings, represents that he has determined and verified all field measurements and quantities, field construction criteria, material, catalog material, and similar data that he has reviewed and coordinated information in the shop drawings with the requirements of the work and the Contract Documents. It also, indicates that any deviation from the Contract Documents has been shown on the submittal and clearly defines the deviations from the specifications.
- Approval rendered on shop drawings shall not be considered as a guarantee of quantities, measurements, or building conditions. Where drawings are approved, said approval does not mean that drawings have been checked in detail. Said approval does not in any way relieve the Contractor from his responsibilities or necessity of furnishing material or performing work as required by the contract drawings and specifications.
- Failure of the Contractor to submit shop drawings in ample time for checking shall not entitle him to an extension of Contract time, and no claim for extension by reason of default will be allowed.
- Contractor shall keep on the job at all times copies of all approved shop drawings.

**2.3 EQUIPMENT DEVIATIONS:**

- Where the Contractor proposes to use an item of equipment other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundations, piping, wiring, or any other part of the mechanical, electrical, or architectural layout, all such redesign, and all new drawings and details required therefor, shall be prepared by the Contractor at his own expense and submitted for approval by the Architect/Engineer.
- Where such approved deviation requires a different quantity and arrangement of wiring, conduit, and equipment from that specified or indicated on the drawings, the Contractor shall furnish and install any such structural supports, electrical wiring and conduit, and any other additional equipment required by the system, at no additional cost to the Owner.

**3.1 GENERAL:**

- The Contractor shall coordinate the work and equipment of this Division with the work and equipment specified elsewhere to assure a complete and satisfactory installation. Work such as excavation, backfill, concrete, flashing, wiring, etc., which is required by the work of this section shall be performed in accordance with the requirements of the applicable section of the specifications.
- It is the intention of these specifications and drawings to call for finished work, tested and ready for operation. Whenever the work "provide" is used, it shall mean "furnish and install complete and ready for use".

**3.2 DUTIES OF CONTRACTOR:**

- Contractor shall furnish and install all materials called for in these Specifications and accompanying drawings and must furnish the apparatus complete in every respect. Anything called for in the specifications and not shown on the drawings or shown on the drawings and not called for in the specifications must be furnished by the Contractor.
- Contractor is responsible for familiarizing himself with the details of the construction of the building. Work under these specifications installed improperly or which requires changing due to improper reading or interpretation of building plans shall be corrected and changed as directed by the Architect/Engineer without additional cost to the Owner.
- The Contractor shall follow drawings in laying out work and check drawings or other trades to verify spaces in which work will be installed. Maintain maximum headroom and space conditions at all points. Where headroom or space conditions appear inadequate, Architect/Engineer shall be notified before proceeding with installation.
- While every effort has been made to accommodate the equipment necessary for the work of this contract, it is the responsibility of the Contractor to ensure that equipment supplied as a part of this contract will fit in the spaces provided for by the drawings. Any concern by the contractor regarding the adequacy of a space for the equipment supplied, shall be brought to the attention of the Architect/Engineer in a written form prior to the approval of the related equipment submittals and prior to any rough-in associated with this equipment.
- The plans are diagrammatic and are not intended to show each fitting or a complete detail of all the work to be done; but are for illustrating the type of system, etc., and special conditions considered necessary for the experience mechanic to take off his materials and lay out his work. This Contractor shall be responsible for taking such measurements as may be necessary at the job and adopting his work to local conditions.
- Conditions sometimes occur which require certain changes in drawings and specifications. If such changes in drawing and specifications are necessary, the same are to be made by the Contractor without expense to the Owner, providing such changes do not require furnishing more materials, or performing more labor than the true intent of the drawings and specifications demands. It is understood that while the drawings are to be followed as closely as circumstances will permit, the Contractor is held responsible for the installation of the system according to the true intent and meaning of the drawings. Anything not entirely clear in the drawings and specification will be fully explained if application is made to the Architect/Engineer. Should, however, conditions arise where in the judgment of the Contractor certain changes will be advisable, the Contractor will communicate with the Architect/Engineer and secure his approval of these changes before going ahead with the work.
- The right to make any responsible change in location of apparatus, equipment, routing of conduit up to the time of roughing in, is reserved by the Architect without involving any additional expense to the Owner.
- It shall be the duty of prospective Contractors to visit the job site and familiarize themselves with job conditions. No extras will be allowed because of additional work necessitated by, or changes in plans required because of evident job conditions, that are not indicated on the drawings.
- Contractor shall leave the premises in a clean and orderly manner upon completion of the work and shall remove from the premises all debris that has accumulated during the progress of the work.

**3.3 COORDINATION:**

- This Contractor shall coordinate the work of all subs and shall furnish any information necessary to permit the work of all trades to be installed satisfactorily and with the least possible interference or delay.
- Where the work will be installed near, or may interfere with the work of other trades, the Contractor shall assist in working out space conditions to make a satisfactory adjustment. If directed by the Engineer, the Contractor shall prepare composite working drawings and sections of a suitable scale not less than 3/8" = 1'-0", clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordination, or to cause any interference with work of any subs, he shall make the necessary changes in his work to correct the condition without extra charge.
- The Contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for coordinating adjacent work.

**3.4 CAUTION:**

- Required excavation for installation of all electrical work shall be provided by the Electrical Contractor. Care shall be taken not to disturb or damage work of other trades.
- Trenching and shoring shall comply with requirements of North Carolina State Department of Labor's regulations entitled "Safeguards during Construction", and "Trenching and Shoring".
- In backfilling pipe trenches, approved fill shall first be compacted firmly and evenly on both sides of pipe in 6" layers to a depth of 12" over the top of the pipe. Remainder of trench shall be backfilled to established grade in 6" layers. The Contractor shall compact between each layer with a high-frequency vibrator tamper such as Wacker Neuson Soil Compactor or equals by Multiquip or Weber. Fill shall be compacted to density specified in Earthwork Section for the area through which trench is cut. Where compaction requirements are not established for an area, the Contractor shall compact fill to 95% maximum density at optimum moisture content.
- Excess earth shall be deposited on the site as directed by the Architect/Engineer.
- Where ditches occur outside of building, the surface shall be finished to match existing surfaces. Any existing work, or work of other trades, which is damaged or disturbed shall be repaired or replaced and left in good order.

**3.5 SLEEVES, CUTTING, AND PATCHING:**

- Contractor shall place his own sleeves and advise other trades of required chases and openings, so they can be properly built in. Sleeves provided under this division shall be formed out of no less than schedule 40 galvanized rigid steel conduits. Where any raceway supports installed under this Contract pierce the roof, suitable pitch pockets shall be provided and coordinated with the roofing contractor as necessary to be acceptable to the Architect/Engineer. Provide suitable fittings where any raceways or equipment cross expansion joints.
- Permitted cutting or patching necessary shall be done by Contractor. Structural members shall not be cut except by written permission of Architect/Engineer.

**3.6 PROTECTION AND CLEAN-UP:**

- Protect all material and work from damage during construction. Equipment installed in the building prior to its being closed in and dried out shall be protected from the elements in the same manner as previously specified for stored materials. Protect finished surfaces from splattering of mortar, paint, dirt, plaster, etc. Do not install device plates, face plates, copings, flush cabinet trims, or fixtures on walls or ceilings until after painting or cleaning of the surface has been completed and arrange for such items that are required to be field painted to be painted before being mounted. Repair, clean and touch-up or replace all damaged material. At the completion of the project, remove all dust from finished surfaces, including lighting fixtures, lenses and lamps.
- The Contractor shall keep premises free of debris resulting from his work.

**3.7 PAINTING AND FINISHING:**

- Suitable finishes shall be provided on all items of electrical equipment and materials which are exposed. This shall consist of either an acceptable finish as manufactured and supplied to the job or application of suitable finishes after installation.
- When installed in finished areas, exposed equipment and materials shall be supplied with prime coat and shall be professionally painted or enameled as directed to match or blend with adjacent surfaces.
- In unfinished areas such as equipment rooms, exposed equipment shall be furnished with suitable factory applied finishes (e.g. standard gray enamel finish for panelboards, etc.).
- Equipment furnished in finishes such as stainless steel and brushed aluminum shall not be painted.
- All finishing shall be as directed by, and shall be satisfactory to, the Architect/Engineer.
- Paint material shall be selected from the products listed below and, insofar as practical, products of only one manufacturer shall be used. Contractor shall submit to the Architect/Engineer the listed manufacturer he proposes to use in the work. Should the Contractor desire to use products of a manufacturer not listed below, or products made by a listed manufacturer but not scheduled herein, Contractor shall submit complete technical information on the proposed products to the Architect/Engineer for approval. Only products approved by the Architect/Engineer shall be used.

**3.8 OBSERVATION:**

- The project will be observed periodically as construction progresses. The Contractor will be responsible for notifying the Architect/Engineer at least 72 hours in advance when any work to be covered up is ready for inspection. No work shall be covered up until after observation has been completed.

**BASIC MATERIALS AND METHODS**

**1.1 WIRING METHODS:**

- Unless otherwise indicated or specified, the Wiring Method for this project shall consist of copper conductors with 600-volt insulation installed in metal raceways.
- The word "Raceway" and the word "Conduit" (or abbreviation "C") used herein or on the drawings indicate Rigid Metal Conduit, Intermediate Metal Conduit, Electrical Metallic Tubing, Rigid Nonmetallic Conduit, Flexible Metal Conduit, or Liquidtight Flexible Metal Conduit.
- Reference to "Rigid Conduit" or "RMC" indicates heavy-wall Rigid Metal Conduit only.
- Reference to "IMC" indicates Intermediate Metal Conduit.
- Reference to "PVC" indicates Rigid Nonmetallic Conduit.
- Reference to "EMT" or "Tubing" indicates Electrical Metallic Tubing.
- Reference to "Flex" or "Flexible Conduit" indicates Flexible Metal Conduit, or, where required, Liquidtight Flexible Metal Conduit.

**1.2 FASTENING METHODS:**

- Acceptable fastening methods include wood screws and nails on wood construction, toggle bolts on hollow masonry, expansion bolts and lead anchors on brick and concrete, and machine screws on metal surfaces.
- Explosive fasteners may be used in steel and concrete in accordance with the manufacturer's recommendations.
- Wires, perforated metal strap, and wooden plugs are not acceptable as fastening material.
- Materials used shall be good quality, made of zinc or cadmium coated steel or other non-corroding material.
- Materials, whether exposed or concealed, shall be firmly and adequately held in place. Fastening and support shall afford safety factor of three or higher and shall be in full compliance with the seismic protection requirements of the N.C. State Building Code.
- Fixtures, raceways, and equipment shall be supported from the structure. Nothing may be supported on suspended ceiling unless noted so on the Drawings or specifically permitted by the Architect/Engineer.
- Equipment and raceways attached to outside walls, or interior walls subject to permanent moisture, shall be shimmed out with non-corroding material to provide 1/4" air space between wall and equipment or raceway.

**1.3 EQUIPMENT IDENTIFICATION:**

- Suitable nameplates shall be provided for the identification of electrical equipment including panelboards, safety switches and circuit breakers.
- Nameplates shall be of engraved white core plastic laminate, not less than 1/16" thick. Nameplate identification shall include equipment name, source of power supply and voltage.
- Nameplate engraving shall be of professional quality, with block style letters, minimum 1/4" high.
- Nameplates shall be attached with sheet metal screws. They shall be sized to allow for installation of screws without obscuring text.
- All empty conduit runs and conduit with conductors for future use shall be identified for use and shall indicate where they terminate. Identification shall be by tags with string or wire attached to conduit or outlet.

**1.4 SLEEVES AND PENETRATIONS:**

- The Electrical Contractor shall provide sleeves and openings for his penetrations through exterior walls, interior walls and partitions, floors, and roofs. Provisions for all such penetrations shall be as approved by the Architect/Engineer.
- For any raceway passing through an exterior wall, above or below grade, provide appropriate sleeve and water proofing. Center the conduit in the sleeve and fill the space between conduit and sleeve with appropriate compound such as lead and oakum, and then apply caulking compound - Thiocaulk or approved equal - flush with the wall surfaces.
- For raceways penetrating floor slabs, smoke partitions, and fire-rated walls, provide steel pipe sleeves and seal with high-temperature non-shrink grout or other material as approved by the Architect/Engineer. Materials and installation methods shall be UL listed as a Through-Penetration Firestop System suitable for use with the UL Fire Resistance Design encountered. Refer to the UL fire protection details shown on the drawings. Refer to the UL fire penetration details shown on the drawings.

**1.5 SUBMITTALS:**

- Submit for approval manufacturer's data sheets for all basic materials.

**RACEWAYS AND FITTINGS**

**1.1 SCOPE:**

- Provide complete raceway systems as indicated on the drawings, as herein specified, and as required by applicable codes.
- All wiring shall be installed in raceways unless specifically noted otherwise.

**1.2 SUBMITTALS:**

- Submit for approval manufacturer's data sheets for all raceway system components.

**2.1 MANUFACTURERS:**

- Metal raceway and components shall be as manufactured by Allied, Triangle, Wheatland, Thomas & Betts, or other approved manufacturers.
- Non-metallic raceway system components shall be as manufactured by Carlon, Queen City Plastics, Ipex or other approved manufacturers.

**2.2 MATERIALS AND APPLICATIONS:**

- Rigid Metal Conduit shall be zinc coated Schedule 40 steel or alloy 6063-T42 aluminum with threaded couplings and fittings. Termination at sheet metal enclosures shall consist of double nut locknuts and insulating bushings. Rigid Steel conduit shall be used for all exposed and concealed work except where other raceways are indicated or permitted. Aluminum conduits complete with aluminum fittings may be used in lieu of steel conduit except in wet locations, underground, or in poured concrete. Steel and aluminum shall not be mixed in the same run of conduit. Where using aluminum conduit, Contractor shall use couplings, fittings, boxes and supports with appropriate dielectric means to prevent corrosion with dissimilar metals.

- Intermediate Metal Conduit (IMC) with threaded couplings and fittings may be used for exposed and concealed work in lieu of rigid metal conduit except underground outside the building foundation, or where supporting lighting fixtures, or in hazardous locations, or when exposed to severe impact or injury. Termination at sheet metal enclosures shall consist of double locknuts and insulating bushings.
- Electrical Metallic Tubing (EMT) may be used for concealed work in lieu of Rigid Metal Conduit except underground or in poured concrete. EMT may be used for exposed work in lieu of Rigid Metal Conduit except outdoors, or above a roof, or where supporting lighting fixtures, or when exposed to severe impact or injury, or in hazardous locations, or less than 10 feet above a floor or platform in other than in electrical, mechanical, or communications closets or equipment rooms.

- Rigid PVC Conduit shall be Schedule 40, UL listed for use with 90°C Conduit run underground or run in or under a poured concrete slab shall be rigid PVC. Vertical elbows and vertical extensions from underground or concrete embedded PVC conduits smaller than 3" trade size may also be of PVC provided that they remain concealed or otherwise protected but shall be of Rigid Steel Conduit (or IMC where permitted) where they stub up into exposed locations or trade size is 3" or larger. An insulating bushing or end bell shall be provided at each termination. Conduit run underground and not under a poured concrete slab shall have installed continuously above it a warning tape. Tape shall be 12 inches wide, centered on conduit and located 12 inches below finished grade.

- Flexible Metal Conduit shall be of zinc coated steel of minimum length and shall be used in lieu of Rigid Metal Conduit for connections to moving or vibrating apparatus, recessed lighting fixtures, dry-type transformers, and motors. Flexible Metal Conduit may be used where rigid connections are impractical due to obstructions or space limitations. Flexible Metal Conduit used in wet, damp, or corrosive location shall be PVC jacketed liquid-tight complete with liquid-tight connectors.

- Fittings for steel conduit and tubing shall be of zinc coated steel or malleable iron. Insulating bushings of plastic provided for Rigid and Intermediate Metal Conduits shall be rated for 150°C. Bonding bushings shall be steel or malleable iron with non-removable plastic throats rated 150°C. EMT fittings shall be of the compression type and concrete tight or rain tight as applicable. Setscrew, indenter, pressure cast and die cast fittings are not acceptable. Connectors for EMT, Flexible Metal Conduit and Liquid-tight Flexible Metal Conduit shall be the insulated throat type. Connectors for Flexible Metal Conduits shall be of the "Tite-Bite" design.

- Conduit expansion fittings shall be of zinc coated steel or malleable iron and steel conduit, complete with flexible bonding straps. Expansion fittings shall allow longitudinal conduit movement of 4 inches.
- Minimum raceway size shall be 1/2", except Flexible Metal Conduit connections to individual lighting fixtures may be 3/8". Other raceway sizes, unless indicated on the drawings, shall be determined by the Contractor in accordance with NEC requirements for type THW insulated conductors, or the actual insulation used if it is thicker than type THW.

**3.1 INSTALLATION:**

- Rigid and Intermediate Metal Conduits shall be made up with full threads, to which a conductive pipe compound (T & B Korr-Shield or equal) has been applied and buttered in coupling. Terminations at sheet metal enclosures in indoor dry locations shall be made with double locknuts and an insulating bushing. Terminations at sheet metal enclosures in outdoor, damp, and wet locations shall be made with threaded conduit hubs of zinc coated malleable iron.

- Except where run under a concrete slab on grade, underground conduits shall be installed a minimum of 30" below grade. Trenching and backfilling shall comply with Section 16010 Electrical General Requirements.

- All underground conduits shall have metallized warning tape installed above the conduit that identifies the specific system buried below. The warning tape shall consist of a minimum 3.5 mil solid foil core encased in a protective plastic jacket (total thickness 5.5 mils). Tape shall be 6 inches wide with black lettering imprinted on a color-coded background that conforms to APWA color code specifications. Tape shall be installed 18 inches above the conduit and in no case less than 6 inches below grade.

- Installation of PVC conduit shall be in accordance with the manufacturer's recommendations using solvent welded couplings and fittings. Field bends shall be made with approved heating equipment. Open flames are not permitted. An insulating bushing or end-bell shall be provided at each termination.

- Conduits shall be rigidly supported not more than 8 feet on center and shall be concealed within walls, ceilings, and floors, except as indicated or specifically approved by the Architect/Engineer; kept at least 6" from flues and steam or hot water pipes; and protected against the entry of dirt, plaster, or trash. Raceways shall be supported independently of suspended ceiling members and suspension wires.

- PVC conduits that turn up inside walls shall transition to EMT no greater than 60 inches above slab or at the first box encountered, whichever comes first.
- Suspended EMT shall be provided with additional hangers at elbows and bends, and where necessary to avoid strain at couplings and connectors.

- Exposed conduits, where permitted, shall be run parallel or perpendicular to walls, structural members and ceilings; with right-angle turns consisting of symmetrical bends or cast metal fittings with threaded hubs. Offsets may be used where necessary if they are of minimum length.

- Conduits crossing expansion and contraction joints shall cross perpendicular to the joint and shall be provided with expansion fittings. Conduits shall not be embedded in the concrete slabs at the expansion and contraction joints.

- Immediately after installation, conduit openings shall be covered to prevent entrance of foreign matters. Covers shall remain in place throughout the rough-in stage.

- When installing conduit on interior surface of exterior walls, mount 1/4 inch from wall with clamp backs or strut.

**CONDUCTORS**

**1.1 SCOPE:**

- Furnish and install a complete system of wire and cable.

**1.2 SUBMITTALS:**

- Submit for approval manufacturer's data sheets for all conductor types. All wire shall be listed by an "approved" third party testing agency.

**2.1 MATERIALS:**

- Insulated conductors shall be as manufactured by Encore, Southwire, General Cable or approved equal.
- Unless otherwise indicated, all wire and cable conductors shall be copper.
- Conductors shall be not smaller than #12 AWG except that #10 AWG minimum is required for the entire length of 120-volt branch circuits whose distance to the center of the load exceeds 75 feet. #14 AWG may be used for signal and remote-control circuits. #16 AWG may be used for taps to individual recessed lighting fixtures on circuits protected by over-current devices rated at 20 amperes or less and contained within flexible metal conduits that do not exceed 6 feet in length. Conductors that are smaller than #14 AWG may be used only where specifically indicated on the drawings or specified herein.
- Conductors #10 AWG and smaller shall be solid, dual rated type THWN/THHN.
- Conductors #8 AWG and larger shall be Class B stranded, dual rated type THWN/THHN.
- Each conductor shall bear easily readable markings along entire length, indicating size and insulation type.
- Insulation on conductors #10 AWG and smaller shall be suitably colored in manufacture.
- Conductors in any location subject to abnormal temperature shall be furnished with an insulation type suitable for temperature encountered.
- Where no indication is made of wire size, the conductor shall be of N.E.C. size to match its overcurrent protective device, but in no case smaller than #12 AWG.
- Joints in solid conductors shall be spliced using ideal "wire-nuts", 3M Company "Scotchlock" or T&B connectors in junction boxes, outlet boxes and lighting fixtures.
- "Sta-kon" or other permanent type crimp connectors shall not be used for branch circuit connections.

**3.1 SPLICES, TAPS, AND CONNECTIONS:**

- Splices in conductors #10 AWG and smaller shall be made with twist-on spring steel devices UL listed as Pressure Cable Connectors, with integral insulating covers rated 75°C at 600 volts, except that those used for connections to light fixtures and other heat-producing equipment shall comply with temperature ratings marked on the equipment but not less than 90°C.
- Splices in copper conductors #8 AWG and larger shall be made with mechanical devices UL listed as Pressure Cable Connectors and insulated with thermoplastic tape UL listed for use as sole insulation. Tape may be omitted from connectors supplied with securely fastened insulating covers which completely enclose the connector and the conductors. Insulating covers shall be rated 75°C at 600 volts.
- Connect solid wires to equipment, switches, and devices equipped with binding screw terminals by looping the wire under the screw head in such a manner that the loop is tightened as the screw is tightened. Straight-in wiring under screw terminals is not acceptable.
- Stranded wires shall not be inserted into back-wiring holes on devices, nor shall they be directly connected to screw head terminals. They shall be fitted with insulated crimp-on type spade terminals for connection under the screw head.
- Joints in stranded conductors shall be spliced by approved mechanical connectors and gum rubber tape or friction tape. Solderless mechanical connectors for splices and taps, provided with UL-approved insulating covers, may be used instead of mechanical connectors plus tape.
- Conductors, in all cases, shall be continuous from outlet to outlet and no splicing shall be made except within outlet or junction boxes, troughs and gutters.
- All single-phase circuits shall be provided with individual neutral. Utilizing multi-pole breakers for single-phase circuits sharing a neutral is not allowed. No more than three current carrying conductors allowed per conduit, except three single-phase branch circuit conductors, each with individual neutrals, shall be allowed in a conduit.

**3.2 COLOR CODING:**

- All wiring shall be color-coded.
- On 120/208V, 3 phase, 4 wire power systems, conductor insulation shall be color coded Black (Phase A), Red (Phase B), Blue (Phase C), and White (Neutral).
- On 277/480V, 3 phase, 4 wire power systems, conductor insulation shall be color coded Brown (Phase A), Orange (Phase B), Yellow (Phase C) and Gray (Neutral).
- Insulation for grounding conductors on all systems shall be Green.

- Conductors #4 AWG and larger may be identified with two or more bands of appropriate color plastic tape applied near each splice and termination. Painting of wire will not be acceptable.
- Phase sequence shall be "A", "B" and "C" from left to right, top to bottom or front to back when facing equipment.

- Control and signal wiring shall not use the above-named colors except green for grounding. Any other colors or striping may be used