

SECTION 26 00 00 – ELECTRICAL REQUIREMENTS

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SECTION 26 00 00 – ELECTRICAL REQUIREMENTS

A. GENERAL

1. Scope of Work

- a. This Contractor shall provide all materials, equipment and labor necessary to install and set into operation the electrical equipment as shown on the Engineering Drawings and as contained herein.

2. Quality Assurance

- a. See the General and Supplementary General Conditions.
- b. All work shall be in accordance with the North Carolina State Building Code, which includes the 2020 edition of the National Electrical Code.
- c. Wherever the words "Approved", "Approval", and "Approved Equal" appear, it is intended that items other than the model numbers specified shall be subject to the approval of the Engineer.
- d. "Provide" as used herein shall mean that the Contractor responsible shall furnish and install said item or equipment. "Furnish" as used herein shall mean that the Contractor responsible shall acquire and make available said item or equipment and that installation shall be by others. "Install" as used herein shall mean that the Contractor responsible shall make installation of items or equipment furnished by others.
- e. All material and equipment that the Contractor proposes to substitute in lieu of those specified shall be submitted to the Engineer ten (10) days prior to the bid date for evaluation. The submittal shall include a full description of the material or equipment, and all pertinent engineering data required to substantiate the equality of the proposed item to that specified. Article 8 of the General Conditions will be followed for substitutions after award of Contract.

3. Submittals

- a. See General and Supplementary General Conditions and Division 1.
- b. Within ten (10) days after notification of the award of the Contract and written notice to begin work, the Contractor shall submit for approval to the Architect/Engineer a detailed list of equipment and material which he proposes to use. Items requiring submittal data for approval will be noted at this time. Six (6) sets of submittal data shall be provided for approval.
- c. Each submittal shall bear the approval of the Contractor indicating that he has reviewed the data and found it to meet the requirements of the specifications as well as space limitations and other project conditions. The submittals shall be clearly identified showing project name, manufacturer's catalog number and all necessary performance and fabrication data. Detailed submittal data shall be provided when items are to be considered as substitution for specified items. Acceptance for approval shall be in writing from the Engineer.

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- d. The Contractor shall submit to the Engineer a set of accurately marked-up plans indicating all changes encountered during the construction. Final payment will be contingent on receipt of these as-built plans.
 - e. The Contractor shall furnish four (4) bound sets of maintenance and operating instructions, parts lists, electrical circuit wiring diagrams, all submittal data, and sufficient manufacturer's literature to operate and maintain all equipment.
 - f. The Contractor shall submit to the Engineer a duplicate set of final electrical inspection certificates prior to final payment.
4. Product Delivery, Storage and Handling
- a. All material and equipment shall be delivered and unloaded by the Contractor within the project site as noted herein or as directed by the Owner.
 - b. The Contractor shall protect all material and equipment from breakage, theft, or weather damage. No material or equipment shall be stored on the ground.
 - c. The material and equipment shall remain the property of the Contractor until the project has been completed and turned over to the Owner.
5. Work conditions and Coordination.
- a. The Contractor shall review the mechanical plans to establish points of connection and the extent of electrical work to be provided in his Contract.
 - b. This Contractor shall be responsible for all electrical work and make final connections to equipment installed in his Contract. Unless otherwise noted, this Contractor shall wire to disconnect switches, junction boxes, or circuit breakers as provided in his Contract.
 - c. All work shall be coordinated with other trades. Cutting of new work and subsequent patching shall be approved by Architect/Engineer and shall be at the Contractor's expense with no extra cost to the owner.
6. Guarantee
- a. See the General and Supplementary General Conditions.
 - b. Where extended warranties or guarantees are available from the manufacturer, the Contractor shall prepare the necessary Contract Documents to validate these warranties as required by the manufacturer and present them to the Owner.

B. PRODUCT

- 1. Materials and equipment shall be new, unless noted otherwise, of the highest grade and quality and free from defects or other imperfections. Materials and equipment found defective shall be removed and replaced at the Contractor's expense.
- 2. The Contractor shall provide nameplates for identification of all equipment, switches, panels, transformers, etc. See specification section 26 05 53 Electrical Identification.

3. All materials and equipment shall be approved third party agencies or bear re-examination listing where such approval has been established for the type of device in question. Third party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment

C. EXECUTION

1. Inspection

- a. If any part of this Contractor's work is dependent for its proper execution or for its subsequent efficiency or appearance on the character or conditions of contiguous work not executed by him, the Contractor shall examine and measure such contiguous work and report to the Architect or Engineer in writing any imperfection therein, or conditions that render it unsuitable for the reception of this work. Should the Contractor proceed without making such written report, he shall be held to have accepted such work and the existing conditions, and he shall be responsible for any defects in this work consequent thereon and will not be relieved of the obligation of any guarantee because of any such imperfection or condition.
- b. It is the responsibility of the electrical contractor to notify the **State Electrical Inspector with the NC Department of Construction** to schedule required inspections including rough-in, above ceiling and final inspections. Inspections shall be scheduled during normal working hours, Monday through Friday.

2. Installation

- a. All work shall be performed in a manner indicating proficiency in the trade.
- b. All conduit, pipes, ducts, etc., shall be either parallel to building walls or plumb where installed in a vertical position and shall be concealed when located in architecturally finished areas.
- c. Any cutting or patching required for installation of this Contractor's work shall be kept to a minimum. Written approval shall be required by the Architect/Engineer if cutting of primary structure is involved.
- d. All patching shall be done in such a manner as to restore the areas or surfaces so as to match existing finishes.
- e. The Contractor shall lay out and install his work in advance of pouring concrete floors or walls. He shall furnish and install all sleeves or openings through poured masonry floors or walls above grade required for passage of all conduits, pipes or duct installed by him. The Contractor shall furnish and install all inserts and hangers required to support his equipment.
- f. Grounding
 - 1) All grounding shall be in accordance with the requirements of the NEC.
 - 2) Install a separate green grounding conductor with the circuit conductors in each conduit. Use of the conduit only shall not be an acceptable means of equipment grounding.

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- 3) Install ground wire in all flexible connections (flex shall not be acceptable for grounding purposes), and in all Wiremold.
 - 4) All grounding conductors shall be sized per Article 250.122 of the NEC.
 - 5) All ground points shall be accessible for inspection.
 - 6) Boxes with concentric, eccentric, or over-sized knockouts shall be provided with bonding bushings and jumpers. The jumper shall be sized per NEC Table 250.122 and lugged to the box.
3. Performance
 - a. The Contractor shall perform all excavation, backfilling, and patching operations as indicated on the drawings.
 4. Erection
 - a. All support steel, angles, channels, pipes or structural steel stands and anchoring devices that may be required to rigidly support or anchor material and equipment shall be provided by this Contractor.
 5. Field Quality Control
 - a. The Contractor shall conform to the requirements of Division 3 for concrete testing.
 - b. The Contractor shall test his entire installation and shall furnish the labor and materials required for these tests. Tests shall be performed in accordance with the requirements of the particular section of the specifications and in accordance with the requirements of the State Ordinances and Codes, and the National Electrical Code. The Contractor shall notify the Engineer of his readiness for such test. Final inspections by the N.C. Department of Insurance and N.C. Department of Administration (State Construction Office) are required, as State Inspectors' Certificates are required, prior to authorization of final payment.
 - c. Testing required for compliance with the Contract shall be stated in subsequent sections. 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 the engineer prior to, and as one of the prerequisites for, final acceptance of the project.
 - d. Documentation
 - 1) All tests specified shall be completely documented indicating time of day, date, temperature, and all pertinent test information.
 - 2) All required documentation of readings indicated above shall be submitted to the engineer prior to, and as one of the prerequisites for, final acceptance of the project.
 6. Adjust and Clean
 - a. All equipment and installed materials shall be thoroughly clean and free of all dirt, oil, grit, grease, etc.

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- b. Factory painted equipment shall not be repainted unless damaged areas exist. These areas shall be touched up with a material suitable for the intended service. In no event shall nameplates be painted.
 - c. At a scheduled meeting, the Contractor shall instruct the Owner or the Owner's representative in the operation and maintenance of all equipment installed under his Contract (in the presence of the Engineer).

END OF SECTION 26 00 00

SECTION 26 05 20 - WIRES AND CABLES

A. GENERAL

1. All conductors shall be properly marked showing manufacturer's name, insulation type, voltage rating and wire size. All insulation is to be rated for minimum of 600 volts.
2. Wire sizes shall be as shown. No wire smaller than No. 12 AWG shall be used. The maximum conductor size shall be 500 KCMIL.
3. Where the conductor length from the panel to the first outlet on a 120 volt exceeds 50 feet, the branch circuit conductors from the panel to the first outlet shall be increased by at least one size. Provide associated drawing modifications as needed for compliance with NEC Art 250.122(B) proportional increase in equipment ground conductor wherever ungrounded conductor sizes are increased for voltage drop.
4. Conductors shall be manufactured by US Wire and Cable, Triangle, Okonite, Southwire, or approved equivalents.

B. PRODUCT

1. All conductors shall be copper and shall conform to Underwriters' Standards. Wires No. 10 and smaller shall be solid. Wires 8 and larger shall be stranded.
2. All wire shall be labeled two (2) feet on centers giving size, type voltage, rating, and manufacturer's name. Wire #6 and smaller #6 shall be factory color coded. Wire larger than #6 may be color coded with 2000-volt colored tape at all terminals of the run, and at all junctions.
3. Where applicable, all wire shall be color coded as follows, or approved by the Engineer:

- a. 120/208-volt system:

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green

4. Insulation type shall be UL labeled for the appropriate type of use and temperature. Insulation types are as follows:
 - a. The insulation type for interior wiring shall be dual-rated THHN/THWN or XHHW.
 - b. The insulation type for wiring in exterior wet locations shall be THWN-2 or XHHW-2.

C. EXECUTION

1. Conductors shall be run in conduit and shall be continuous from outlet to outlet. Splices will not be made except within accessible outlet or junction boxes, troughs, or gutters.

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2. Solid conductors shall be spliced by using wire nuts and connectors for branch circuit splices. Crimp connectors will not be allowed for branch circuit splicing.
 3. 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 U/L-approved insulating covers, may be used instead of mechanical connectors plus tape.
 4. On mechanical splices, taps or joints taping shall be with at least two (2) layers of approved gum rubber tape which will be laid on the half-lap followed by at least one (1) layer of friction or plastic tape laid on with half-lap. It is intended that all taping shall be a permanently secured insulation equal to that of the wire.
 5. All conductors in any conduit shall be at one specific voltage. Conductors of different voltages shall be run in separate conduits.
 6. Neutral conductors shall be properly installed to prevent grounding of the neutrals in any conduit. Multi-wire circuits with shared neutral conductors are not allowed. Each single pole load shall have individual neutral for each circuit.
 7. Neatly train and lace wiring inside boxes, equipment, and panelboards.
 8. Make conductor lengths for parallel circuits equal.
 9. Pull all conductors into a raceway at the same time. Use third party approved wire pulling lubricant for pulling #4 AWG and larger wires.
 10. Insulation Resistance Testing.

All current carrying phase conductors and neutrals shall be tested as installed, and before connections are made, for insulation resistance and accidental grounds. This shall be done with a 500-volt insulation resistance testing. The procedures listed below shall be followed:

- a. Minimum readings shall be one million (1,000,000) or more ohms for #6 AWG wire and smaller, 250,000 ohms or more for #4 AWG wire and larger, between conductors and between conductor and the grounding conductor.
- b. After all fixtures, devices and equipment are installed and all connections completed to each panel, the contractor shall disconnect the neutral feeder conductor from the neutral bar and take an insulation resistance testing reading between the neutral bar and the grounded enclosure. If this reading is less than 250,000 ohms, the contractor shall disconnect the branch circuit neutral wires from this neutral bar. He shall then test each one separately to the panel until the low readings are found. The contractor shall correct troubles, reconnect, and retest until at least 250,000 ohms from the neutral bar to the grounded panel can be achieved with only the neutral feeder disconnected.
- c. The contractor shall send a letter to the engineer certifying that the above has been done and tabulating the insulation resistance testing readings for each panel. This shall be done at least four (4) days prior to the final inspection.
- d. At the final inspection, the contractor shall furnish an insulation resistance testing and demonstrate to the engineer and State Construction Office representative (applicable for state projects) that the panels comply with the above requirements. The contractor

shall also furnish a hook-on type ammeter and a voltmeter to take current and voltage readings as directed by the engineer and Construction office representative.

11. Use of split bolt connectors is not acceptable.
12. Prior to energizing, feeders and service conductor cables shall be tested for electrical continuity and short circuits. A copy of these tests shall be included with the project record document.
13. Voltage Drop:
 - a. Conductors for branch circuits shall be sized to prevent a voltage drop exceeding three percent (3%) at the farthest outlet of power, heating and lighting loads, or any combination of such loads. The maximum total voltage drops on both feeders and branch circuits to the farthest outlet shall not exceed five percent (5%).
 - b. Where the conductor length from the panel to the first outlet on a 277-volt circuit exceeds 125 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG. Conductor size of remaining branch circuit shall increase as needed to meet above voltage drop limitations.
 - c. Where the conductor length from the panel to the first outlet on a 120-volt circuit exceeds 50 feet, the branch circuit conductors from the panel to the first outlet shall not be smaller than #10 AWG. Conductor size of remaining branch circuit shall increase as needed to comply with above voltage drop limitations.
 - d. Provide associated drawing modifications as needed for compliance with NEC Art 250.122(B) proportional increase in equipment ground conductor wherever ungrounded conductor sizes are increased for voltage drop.

END OF SECTION 26 05 20

SECTION 26 05 33 BOXES AND CABINETS

A. GENERAL

1. The Electrical Contractor shall provide junction boxes, pull boxes, cable, support boxes, and wiring troughs as required by NEC and as otherwise indicated in the Drawings.
2. All necessary mounting hardware and accessories shall be provided for complete installation.

B. PRODUCT

1. Outlet and junction boxes shall be 4" minimum size, octagonal in ceilings, 4" square or rectangular (4" x 4" minimum for walls) except as noted below. Ceiling outlet boxes shall not be less than 1 1/2" deep, but in no case shall the size and depth of boxes be less than the required by the NEC.
2. Outlet boxes shall be equipped with plaster rings of appropriate depth to finish flush with finished walls. Outlets in exposed masonry wall shall be equipped with extra deep square corner tile rings so that box may be installed in the core of the block.
3. Outlets for concealed work and ceiling outlets for exposed work shall be galvanized stamped steel. Boxes shall be manufactured by ABB-Steel City, Hubbell-RACO, Appleton or approved equal.
4. Wall outlets for exposed conduit work shall be Crouse-Hinds, Appleton, Hubbell-Killark or approved equal, series FS and FD switch and receptacle threaded hub boxes, with matching FS and FD covers.
5. Junction boxes for change of direction or feeder taps shall be furnished where required, shall be of adequate size to prevent crowding conductors in accordance with the requirements of the electrical code and job requirements and shall be accessible.
6. Junction boxes on finished wall and ceilings shall be flush with covers.
7. Junction boxes larger than 5" square shall be galvanized and without pre-formed knockouts.

C. EXECUTION

1. Boxes and troughs shall be supported independently of conduit entering them. Brackets, threaded rod hangers with lock nuts, bolts, or other suitable supporting methods may be used.
2. Thru-the-wall outlet boxes shall not be permitted. Outlet boxes shown back-to-back on plans, shall be separate boxes connected where required using a loop of flexible metallic conduit with ground wire. Boxes shall be separated a minimum of 18 inches apart.
3. In general, outlets shall be installed at the heights indicated on the fixture and symbol legend.
4. Each outlet designated on the plans shall be provided with an outlet box.
5. Each outlet box which supports a fixture shall be provided with a fixture stud into the outlet box. Outlet box and/or fixture stud shall be attached with not less than three screws or bolts.
6. Exterior outlets shall be provided with watertight gaskets and covers.

END OF SECTION 26 05 33

SECTION 26 05 45 - CONDUIT AND CONDUIT FITTINGS

A. GENERAL

1. Conduit shall be delivered to the project site in bundles of full-length pipes, each length marked with the trademark of the manufacturer and the Underwriters' Laboratories, Inc. stamp. Each conduit length shall be straight, true, and free from scales, blisters, burrs, and other imperfections.
2. Within the building parameters and above the floor slab, the rigid steel conduit specified shall be used unless specifically noted otherwise.
3. Conduit size for control wiring shall be a minimum of one-half (1/2) inch conduit. All branch circuit conduit shall be a minimum of one-half (1/2) inch. Percent filled and derating shall be in accordance with the National Electrical Code. Flexible metal and water-tite ("sealtite") conduit in size 1/2" and larger shall be acceptable for motor, appliance, and fixture connections from fixture junction boxes or appliance/motor disconnects provided a ground wire is installed in the flex and the flex assembly is an integral part of the fixture, shipped from the same factory as the fixture, and 3rd party agency approved for such use. The third-party agencies shall be amongst those accredited by the NCBCC (North Carolina Building Code Council) to Label Electrical & Mechanical Equipment. This same requirement shall apply for motor/appliance connections.
4. All conduit shall be installed in accordance with the National Electrical Code.
5. Metallic conduits shall be manufactured by Allied, Wheatland, Cruse-Hinds, or approved equal.
6. Non-metallic conduits shall be manufactured by Prime Conduit, Cantex, Champion Fiberglass or approved equal.
7. Conduit fittings shall be manufactured by Rayco, T & B, Crouse Hinds, O-Z/Gedney or approved equal.
8. Conduit fittings shall be manufactured by Rayco, T & B, Crouse Hinds, or approved equal.
9. Surface mounted raceway shall be used as noted on the plans in lieu of exposed conduit. Surface mounted raceway shall be manufactured by Wiremold, Panduit, Hubbell, or approved equal. A separate ground wire shall be run in the surface mounted raceway.

B. PRODUCT

1. Thin Wall Conduit and Fittings
 - a. Electrical metallic tubing (EMT) shall be cold-rolled steel tubing with zinc coating on the outside and protected on the inside by a zinc, enamel or equivalent corrosion-resistant coating conforming to the latest requirements of ANSI. Conduit shall meet the Rigid Conduit Association Standards.
 - b. Electrical metallic tubing fittings shall be all steel plated hexagonal threaded compression type. No pot metal, indenter, or set screw fittings, shall be used. EMT connectors shall have insulated throats.

2. Rigid Steel Conduit and Fittings

- a. Rigid steel conduit, including elbows and nipples, shall be standard weight, mild steel pipe, hot dipped galvanized, sherardized, or zinc-coated conforming to the requirements of ANSI C80.1, 1966 or later edition. Rigid steel conduit shall also meet the latest requirements of Underwriters' Laboratories, Inc. Standards for Rigid Metallic Conduit.
- b. Fittings shall be all steel plated hexagonal threaded fitting.

3. Flexible Metal Conduit and Fittings

- a. Flexible metal conduit shall be of the best grade interlocking spiral strip steel. The interlocking spiral strip construction shall be such as to permit bending of the conduit to a radius of four (4) times its internal diameter without distorting at any point. The interior and the exterior of the flexible conduit shall be smooth and free of burrs, sharp edges, or other defects which could damage the wire.
- b. Fittings shall be of the approved types, made of malleable iron and hot dipped galvanized.
- c. All connectors shall be steel compression fittings with insulated throats.
- d. Where watertight flexible conduit is required, it shall have an outer sheath of material similar to PVC.

4. Non-metallic Conduit

- a. Non-metallic conduit shall be UL listed, for its particular application. It shall be resistant to sunlight and chemical and moisture atmospheres and rated for use with 90 degrees Celsius conductors.
- b. The installation and usage of rigid non-metallic conduit shall comply with Article 352 of the National Electrical Code, along with any related or referenced sections.

C. EXECUTION

1. General

- a. All conduit shall be run tight against walls, columns, or ceilings.
- b. The conduit shall bend cold 90 degrees about a radius equal to ten (10) times its own diameter without signs of flaw or fracture in either pipe or protective coverings. All bends and offsets shall be made on a forming tool to prevent the conduit or its coating from being damaged in the bending. Conduit bends shall have a radius not less than ten (10) times the conduit diameter.
- c. Where conduits join any couplings or threaded fittings, the ends shall be made watertight. (All conduit runs, including boxes, couplings, and fittings used therein, shall be so installed, and equipped as to prevent water from entering the conduit.)

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- d. All conduits shall be carefully cleaned before and after erection. After cleaning, all ends of conduits shall be free from burrs and inside surfaces shall be free from imperfections likely to injure the wires or cables.
 - e. In every instance, conduit shall be installed in such a manner that the conductors may readily and easily be drawn or pulled in without strain or damage to the insulation; and, also, so that defective conductors may be readily and easily withdrawn and replaced by new conductors. Long radius bends and a sufficient number of approved pull and junction boxes shall be approved for this purpose, and as may be directed by the Engineer. All conduit shall be securely supported and grounded.
 - f. In unfinished areas, exposed conduit shall be run to conform to the building lines with special emphasis on neatness. Turns shall be made with galvanized outlet boxes, junction boxes, factory fittings and/or symmetrical bends. Locknuts and bushings shall be employed to provide full grounding and adequate protection of insulation. Double locknuts shall be used on all conduits entering sheet metal enclosures.
 - g. Support for all conduit shall be in accordance with the National Electrical Code. Conduit shall be supported by approved pipe straps or clamps, secured by means of toggle bolts on hollow masonry, expansion shields and matching screws or standard pre-set inserts on concrete or solid masonry, machine screws or bolts on metal surfaces, and wood screws on wood construction. Powder actuated fasteners are not allowed on State projects.
 - h. All empty conduit systems shall be capped or terminated in a junction box and shall be provided with nylon pull cord inside for future use.
 - i. Conduit terminating below grade shall be provided with means to prevent entry of dirt or moisture. Depth of burial shall not be less than two (2) feet below grade. All termination points shall be accurately marked and dimensioned on the As-Built Plans.
 - j. Where conduits of any type pass over a building expansion joint, a standard "expansion joint fitting" compatible with the type of raceway shall be provided.
 - k. Conduits installed on the interior of exterior building walls shall be spaced off the surface a minimum of 1/4" using "clamp-backs" or strut.
2. Thin Wall Conduit and Fittings
- a. Except for service and feeder conduits, electrical metallic tubing and fittings may be installed in lieu of rigid conduit in dry construction in furred spaces, ceiling cavities, chase spaces, interior portions other than concrete and solid plaster, or for exposed work except on mechanical structure or supports.
 - b. Electrical metallic tubing shall not be installed.
 - 1) Where exposed to severe corrosive conditions and/or severe physical damage,
 - 2) Nearer than four (4) feet from finished floor in exposed areas
 - 3) In trade sizes larger than two (2) inches
 - 4) Located in exterior walls or in poured concrete.

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- 5) Any location outdoors.
 - 6) Where tubing, coupling, elbows, and fittings would be in direct contact with the earth or underground (in/below slab-on-grade or in earth).
 - c. A transition between a run of rigid conduit concealed in a wall and a run of thin wall conduit along a ceiling shall be made in an outlet box above the ceiling, if accessible, near the wall.
3. Rigid Steel Conduit and Fittings
- a. All conduit terminations shall be provided with insulating bushings.
 - b. Condulet fittings shall not be used in lieu of pull boxes.
 - c. Except where located under the ground floor slab, all service and feeder conduit shall be heavy wall (rigid galvanized).
 - d. Rigid steel conduit shall be installed in exterior masonry walls, in wet locations subject to severe physical damage, or where conduit trade size is two and one half (2 1/2) inches or larger.
4. Flexible Metal Conduit and Fittings
- a. Flexible metallic conduit shall be provided at the end of each conduit run terminating at the conduit box on electric motors, transformers, or other equipment.
 - b. The length of flexible conduit shall be in accordance with the National Electric Code.
5. Non-Metallic Conduit
- a. Thin wall rigid non-metallic conduit (schedule 40 PVC) shall only be used for concrete encasement.
 - b. Except where embedded in concrete, conduit shall be supported to permit adequate lineal movement to allow for expansion and contraction of conduit due to temperature change. Where a temperature change in excess of 14 degrees Celsius is anticipated, such as direct burial, exposed outside of the building, or in un-insulated spaces inside the building (attics, crawl spaces, etc.), expansion joints shall be installed in accordance with the manufacturer's specifications.
 - c. Heavy wall non-metallic conduit (schedule 80 PVC) shall be used where conduits are directly buried exterior to the building or exposed exterior to the building.
 - d. PVC schedule 40 shall not be used exposed or concealed in gypsum wall but may be used in CMU walls. PVC schedule 40 may be used in elevated floor slabs and in foundation slabs. Minimum concrete cover shall be $\frac{3}{4}$ inch at finished or formed surface and shall be 3 inches at concrete surface cast against earth or for slabs placed on-grade. Greater amounts of concrete cover shall be used in areas subject to damage. The placement of conduit in floor slabs must be thoroughly coordinated with the structural design. Potential conflicts with steel reinforcing bars and reductions in net concrete sections are among the issues that must be considered by the structural engineer.

6. Underground Raceways

- a. Where conduit is installed under the ground floor slab within the building foundations, schedule 40 PVC conduit shall be used. At the Contractor's option, this installation may consist of galvanized steel conduit encased with three (3) inches of concrete or rigid steel conduit with a minimum of 15 mils of PVC coating. Where thin wall non-metallic conduit is used under the ground floor slab, the elbows and turn out required to turn the raceway up into cabinets, equipment, boxes, etc. shall be of rigid steel.
- b. Raceways run external to building foundation walls, with the exception of branch circuit raceways, shall be encased with a minimum of three (3) inches of concrete on all sides.
 - 1) Encased raceways must have a minimum cover of eighteen (18) inches, except for raceways containing circuits with voltages above 600 volts, which must have a minimum cover of thirty (30) inches.
 - 2) Encased raceways shall be of a type approved by the NEC as "suitable for concrete encasement."
- c. Branch circuit raceways run underground external to building foundation walls shall be run in raceways installed in accordance with the NEC and shall be of a type approved by the NEC as "suitable for direct burial." Minimum raceway size shall be 1 inch.
- d. All underground raceways shall be identified by underground line marking tape located directly above the raceway at 6 to 8 inches below finished grade. Tape shall be permanent, bright-colored, continuous printed, plastic tape compounded for direct burial not less than 6 inches wide and 4 mils thick. Printed legend shall be indicative of general type of underground line below.
- e. Raceways run underground internal to building foundation walls shall be of a type and installed by a method approved by the NEC.
- f. Where underground raceways are required to turn up into cabinets, equipment, etc., and on to poles, the elbow required and the stub-up out of the slab or earth shall be of rigid steel.
- g. The raceway system shall not be relied on for grounding continuity.
- h. When passing through a "below grade" wall from a conditioned interior building space, raceways shall be sealed utilizing fittings similar and equal to OZ/GEDNEY type "FSK" thru wall fitting with "FSKA" membrane clamp adapter if required.

END OF SECTION 26 05 45

SECTION 26 24 16 - PANEL BOARDS AND CIRCUIT BREAKERS

A. GENERAL

1. The Electrical Contractor shall provide circuit breakers as shown on the plans in accordance with this specification.
2. All equipment shall meet UL, NEC and NEMA Standards as applicable to the equipment specified herein.

B. PRODUCT

1. Molded Case Circuit Breakers
 - a. This specification covers molded case circuit breakers rated 15 through 1200 amperes 120VAC, 240VAC, 277VAC and 480VAC. Breakers covered under this specification may be installed in switchboards, panelboards, motor control centers, combination motor starters, busway plugs and individual enclosures.
 - b. Circuit breakers shall be manufactured by the same company as the existing panel where the circuit breaker will be added.
 - c. All circuit breakers shall have a quick-make, quick-break over center toggle type mechanism. The handle mechanism shall be trip-free to prevent holding contacts closed against a short circuit or sustained overload. All circuit breakers shall assume a position between on and off when tripped automatically. Multi-pole circuit breakers shall be common trip such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Arc extinction is to be accomplished by magnetic arc chutes. All ratings shall be clearly visible.
 - d. Automatic operation of all circuit breakers shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. Circuit breakers shall be calibrated to carry 100% rated current in an ambient of 40 degrees Celsius. Circuit breakers shall be ambient compensating in that, as the ambient temperature increases over 40 degrees Celsius, the circuit breaker automatically derates itself so as to better protect its associated conductor. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes 250 amps and above.
 - e. The interrupting rating of each circuit breaker shall be as indicated on the drawings. The interrupting rating of the circuit breakers shall be at least equal to the available short circuit current at the line terminals of the circuit breaker and correspond to UL listed integrated short circuit current rating specified for the panelboards and switchboards.
 - f. UL Class A (5 milliamperere sensitivity) ground fault circuit protection and UL GFPE protection shall be provided on 120 V ac branch circuits as specified on the plans or panelboard schedule. This protection shall be an integral part of the branch circuit breaker which also provides overload and short circuit protection for branch circuit wiring. Tripping of a branch circuit containing ground fault circuit interruption shall not disturb the feeder circuit to the panelboard. A single pole circuit breaker with integral ground fault circuit interruption shall require no more panelboard branch circuit space than a conventional single pole circuit breaker.

- g. Motor starters, and other applications as indicated on drawings, shall be furnished with magnetic-only type molded case circuit breakers. Each breaker shall be provided with a single magnetic adjustment that will set all poles to the same trip current. Adjustment shall be continuous throughout the adjustable trip range. The magnetic trips shall be accessible from the front of these circuit breakers.

C. EXECUTION

- 1. Panel enclosures shall not be used as junction or pull boxes for splicing conductors.
- 2. All panels shall be equipped with neatly typed directory cards attached on the inside of the door.
- 3. GFI and GFPE circuits shall be tested by the Contractor prior to the pre-final inspection.
- 4. Testing shall be performed by a qualified factory technician at the job site. All readings shall be tabulated by the contractor.
- 5. The number of branch circuit shall be identified with permanent wire tag attached to the wire.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

A. GENERAL

1. Switches, dimmer switches, photocell, contactors, and receptacles, with proper cover plates, shall be provided where indicated on the Drawings.

B. PRODUCT

1. Switches, dimmer switches, photocell, contactors and receptacles shall be as specified in the Symbol Schedule of the Drawings.
2. All switches and receptacles shall be federal specification grade meeting NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL-498 and shall be approved third-party listed.
3. Switches and receptacles shall be manufactured by Hubbell, Pass and Seymour, Leviton, or Eaton. Photocells shall be manufactured by Tork, Paragon, Bryant, or approved equal.
4. Cover plates for all wall mounted devices shall be provided as scheduled on the Drawings. Where covers are not specified, they shall be as follow:
 - a. Interior: type 302 stainless steel. Cover plate mounting screws shall be slotted head oval screws and shall match the finish and material of the plate and shall be furnished with the plate by the plate manufacturer.
 - b. Exterior, exposed work and wet locations: cover plates shall be extra-duty rated (NEC 406.9(B)(1)) galvanized cast ferrous metal, standard size, and shall be single or ganged as indicated on the drawings. Exterior mounted switch and receptacle plates, and those noted to be weatherproof, shall be weatherproof cover plates, standard size, single or ganged as indicated on the drawings, and shall be "approved" third party listed as "rain-tight while in use."
5. All devices shall have a hex-head green grounding screw for use in connecting device to green grounding conductor run in the conduit system.
6. All GFI devices shall be the feed through type.
7. All standard duplex receptacles shall be 20-amp, 125 volt rated.
8. All devices subject to use in a wet location shall be listed as weather resistant.
9. All switches shall be rated 20-amp, 120/277 volt. Toggle switches shall have quiet operating mechanisms without the use of mercury switches.

C. EXECUTION

1. Mounting height shall be as indicated on the Drawings. Coordinate with other trades so that devices will miss equipment installed by others.
2. Where two or more devices are ganged, they shall be in a common box with a ganged plate.
3. All devices shall have a green ground conductor to run parallel with the phase conductor back to the electrical panel.
4. In all areas where carpet is to be installed as finished floor material, unless otherwise specified, the Electrical Contractor will furnish solid brass carpet flanges for installation on floor outlet boxes. Flanges will be furnished and installed on all active outlets after the carpet is installed. Where a specified number of outlet fittings are to be furnished to the Owner, for each fitting not installed during the construction period, it will be turned over to the Owner with the receptacle, carpet flange and all necessary appurtenances.
5. Provide quantity of 2% spare cover plates of each type to the owner.

END OF SECTION 26 27 26

SECTION 26 27 27 – DISCONNECTS

A. GENERAL

1. Disconnect switches shall be provided where indicated on the drawings, or as required by the National Electrical Code (NEC).

B. PRODUCT

1. Disconnects shall be heavy duty as manufactured by Square D Company, Siemens, Eaton, or ABB.
2. Disconnects shall be furnished with factory finish paint and appropriate knockouts for conduit connections.
3. All disconnects shall have side hinged type doors. Front operated handles will not be permitted.
4. All fused disconnects shall be equipped with positive pressure fuse clips and shall have visible disconnecting blade switches.
5. NEMA 1 enclosures shall be provided where installed indoors. NEMA 3R enclosures shall be provided where exposed to the elements, unless noted otherwise.
6. All disconnects shall have copper bus.
7. Disconnects shall have provisions for locking in on and off positions.
8. Disconnects shall have defeatable door interlocks that prevent the door from opening when the operating handles is in the "on" position.
9. Disconnects shall have handles whose positions are easily recognizable in the "on" or "off" position. For safety reasons, padlock shall be provided for switches located in the public areas.
10. Provide appropriate auxiliary contacts if the disconnect switch is used upstream of elevator controllers, variable drives, etc. that require signal before power is removed.

C. EXECUTION

1. Disconnect switches shall be mounted as indicated on the Drawings and shall be independently supported. Conduits entering the disconnect switch shall not be used to support switches.
2. Where fused disconnect switches are required or shown on the plans, standard fuses shall be used unless the switch protects an individual motor circuit, then dual element fuses shall be used.
3. The electrical contractor shall provide to the owner the spare fuses, 10% of the quantity of fuses used of each type and rating, with a minimum of one set of each type.

END OF SECTION 26 27 27

SECTION 26 51 00 – LIGHTING FIXTURES

A. GENERAL

1. The Contractor shall provide all fixtures and lamps where indicated on the Drawings.
2. Work shall include all stems, canopies, and accessories necessary for a complete lighting fixture installation.
3. No PCB ballasts shall be accepted.
4. All lighting systems shall comply with the 2018 North Carolina State Energy Code and North Carolina Senate Bill 1946 and G.S. 143-64.17.

B. PRODUCT

1. Fixtures shall be as specified in the Fixture Schedule on the Drawings or approved equivalents.
2. All outdoor fixtures shall bear the approved third-party test label for damp or wet locations as applicable. Where the ambient falls below 50°F that all fluorescent lamps and ballasts shall be rated for operation at 0°F.
3. Unless otherwise noted, all fixtures shall be new, free of defects and imperfections. Damaged fixtures shall be replaced at this Contractor's expense.
4. LED Luminaries:
 - a. LED driver manufacturers should have a minimum of five years of experience with the manufacture of LED drivers. All drivers shall have a minimum warranty of five years.
 - b. Where dimming is required, fixtures shall be dimmable down to 1% with standard 120/277-volt, electronic, low voltage dimmers.
 - c. Minimum color rendering index (CRI) shall be 80. Color temperature and performance shall conform to the parameters established by ENERGY STAR SSL standards (refer to ANSI-C78.377-2008).
 - d. Optical design shall be low glare, 50% cut-off.
 - e. Rated for 50,000 hours at 70% lumen maintenance.
 - f. LED driver shall be high efficiency with a minimum power factor of .90.
 - g. 5 year, 100% warranty coverage for the driver, LED module, housing, and trim. For the 1st year this shall be a complete parts and labor warranty. The 4th and 5th years shall cover parts only.
 - h. Total harmonic distortion: $\leq 20\%$ (at full luminaire output and across specified voltage range)

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- i. Transient and surge protection: ANSI C62.41-2002 Category A surge protection standards up to and including 2.5 kV for interior fixtures.
 - j. Sound: Class A not to exceed a measured value of 24dB.
 - k. Maximum standby power: 1W
 - l. LED arrays in the product(s) will be considered defective in material or workmanship if a total of 10% or more of the individual light-emitting diodes in the product(s) fail to illuminate during normal operation after installation.
5. Emergency Exit Lights per the State Construction Office requirements.
- It shall be completely self-contained, provided with maintenance-free battery, automatic charger, and other features. Luminaire must be third-party listed as emergency lighting equipment, and meet or exceed the following standards: NEC, N.C. Building Code, Energy Code, NFPA-101, and NEMA Standards.
- a. Battery

It shall be sealed, maintenance-free type, with minimum of 90 minutes operating endurance. Must have a normal life expectancy of 10 years. Batteries shall be a high temperature type with an operating range of 0 degree C to 60 degrees C and contain a resealable pressure vent, a sintered + positive terminal and – negative terminal.
 - b. Charger

It shall be fully automatic solid-state type, full wave rectifying, with current limiting. Charger shall restore the battery to its full charge within 24 hours after a discharge of 90 minutes under full rated load. The unit shall be activated when the voltage drops below 80 percent. A low voltage disconnect switch shall be included if LEAD Battery is used, to disconnect the battery from the load and prevent damage from a deep discharge during extended power outage.
 - c. Additional Features

Pilot light to indicate the unit is connected to AC power. The battery shall have high-rate charge pilot light unless self-diagnostic type. A test switch to simulate the operation of the unit upon loss of AC power by energizing the lamps from the battery. This simulation must also exercise the transfer rely.
 - d. Warranty

The entire unit shall be warranted for three years. The battery must have an additional two more years pro-rated warranty. Warranty shall start from the date of project final acceptance. Warranty shall be included in the contract document.
 - e. LED

The use of LED is required due to their reliable performance, low power consumption, and limited maintenance requirements. Maximum LED failure rate

shall be 25% within a seven (7) year period; otherwise, if exceeded, manufacturer shall replace the complete unit at no charge to the owner.

f. Unit Test

Contractor shall perform a test on each unit after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes, in accordance with NEC 700. The battery test shall be done 10 days prior to final inspection by the State Construction Office. Any unit which fails the test must be repaired or replaced and tested again. Copy of the test report shall be included with the project record documentation.

6. Emergency Lights per the State Construction Office requirements

Shall be completely self-contained, provided with maintenance-free 12-volt battery, automatic charger, two lamps and other features. Fixture shall be third party listed as emergency lighting equipment, and meet or exceed the following standards: NEC, N.C. Building Code, UL 924, NC Energy Code, NFPA-101, and NEMA Standards.

a. Additional Features

Pilot light to indicate the unit is connected to AC power. The battery shall have high-rate charge pilot light unless self-diagnostic type. A test switch to simulate the operation of the unit upon loss of AC power by energizing the lamps from the battery. This simulation must also exercise the transfer relay. If fluorescent emergency unit is used, a LED charging indicator light must be easily visible after installation and a remote test switch shall be installed adjacent to the fixture.

b. Battery

It shall be sealed, maintenance-free type, with minimum of 90 minutes operating endurance. Must have a normal life expectancy of 10 years. Batteries shall be a high temperature type with an operating range of 0 degrees C to 60 degrees C and contain a resealable pressure vent, a sintered + positive and -negative terminal.

c. Charger

It shall be fully automatic solid state type, full wave rectifying, with current limiting. Charger shall restore the battery to its full charge within 24 hours after a discharge of 90 minutes under full rated load. The unit shall be activated when the voltage drops below 80%. A low voltage disconnect switch shall be included in LEAD battery that is used, to disconnect the battery from the load and prevent damage from a deep discharge during extended power outage.

d. Warranty

The entire unit shall be warranted for three years. The battery must have an additional two more years pro-rated warranty. Warranty shall start from the date of project final acceptance. Warranty shall be included in the contact document.

e. Unit Test

Contractor shall perform a test on each unit after it is permanently installed and charged for a minimum of 24 hours. Battery shall be tested for 90 minutes, in accordance with NEC 700. The battery test shall be done 10 days prior to final inspection by the State Construction Office. Any unit which fails the test must be repaired or replaced and tested again. Copy of the test report shall be included with the project record documentation.

7. Emergency Power Backup unit.

The unit is used for controlling designated light fixtures as shown on plan to be used as emergency light. The unit shall have rating as shown on plan. Unit shall be third party listed as emergency power backup unit for emergency light, and meet or exceed the following standards: NEC, N.C. Building Code, UL 924, NC Energy Code, NFPA-101, and NEMA Standards.

a. Battery

It shall be sealed, maintenance-free type, with minimum of 90 minutes operating endurance. Must have a normal life expectancy of 10 years. Batteries shall be a high temperature type with an operating range of 0 degree C to 60 degrees C and contain a resealable pressure vent, a sintered + positive terminal and – negative terminal.

b. Output characteristic.

It shall provide 60Hz sinusoidal waveform output and compatible with LED and fluorescent light fixtures. Transfer time shall be less than 1 second.

c. Warranty

The entire unit shall be warranted for three years. The battery must have an additional two more years pro-rated warranty. Warranty shall start from the date of project final acceptance. Warranty shall be included in the contract document.

C. EXECUTION

1. All fixtures shall be installed in accordance with the National Electric Code.
2. All fixtures other than the lay-in type shall be individually supported from building structure with 1/4" threaded rods and nuts.
3. Where a recessed or downlight fixture replaces a section or part of a ceiling tile, fixture is to be supported at the two (2) opposite ends to the steel frame of the building. Supports shall be provided with the same type of wire as used to support the lay-in ceiling track. Attach one end of the wire to one corner of the luminaire and the other end to the building's structural system. The lay-in luminaire shall then be screwed to the main runners of the lay-in ceiling track at all four (4) corners using sheet metal screws. For fire rated suspended ceiling, luminaire shall be supported to the Building Structure as per the Ceiling Design Criteria, luminaire shall then be screwed to the main runners of the suspended ceiling track at all four (4) corners using sheet metal screws.

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4. The complete emergency lighting system shall be tested by throwing the circuit breakers feeding the emergency lighting circuits. One and one-half hours thereafter, the battery voltages shall be recorded in a report to be submitted to the Engineer. This test shall be performed just prior to final inspection, under witness of the state electrical inspector, and in accordance with NEC Articles 700.4 (A) and (D).

END OF SECTION 26 51 00