SECTION 5
SPECIFICATIONS

SECTION 260500 - BASIC ELECTRICAL REQUIREMENTS

PART 1. -GENERAL

1.1 GENERAL REFERENCE

A. Drawings and general provisions of Contract apply to work of this section.

B. This section specifies the basic requirements for electrical installations and includes requirements common to more than one section of Division 26. It expands and supplements the requirements specified in sections of Division 01.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for electrical installations. The following administrative and procedural requirements are included in this Section:

Shop drawings
Definitions
Discrepancies
Record documents
Equipment
Substitutions
Codes and permits
Interferences
Delivery, storage and handling
Punchlists
Operating and maintenance
Warranties

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 26 Section "BASIC ELECTRICAL MATERIALS AND METHODS", for materials and methods common to the remainder of Division 26.

1.3 SHOP DRAWINGS

A. Refer to the Conditions of the Contract (General and Supplementary): Shop drawings, product data, and samples for submittal definitions, requirements, and procedures.

B. This Contractor shall review, stamp and sign with his approval and submit, with reasonable promptness and in orderly sequence so as to cause no delay in the work or in the work of any other Contractor, all submittal information and samples required by the contract documents. Submittal information not stamped with Contractor approval will be returned for reprocessing.

1. In approving the submittals, the Contractor guarantees that the submittals accurately and completely represent the equipment and materials to be installed.

2. Shop drawings shall be submitted for ALL material items as outlined in these specifications. Any deviations from contract requirements must be clearly indicated on shop drawings, and justification for their consideration must be included.
3. Acceptance of submittal items will not preclude rejection of those items upon later discovery that their suitability for the application or ability to meet the requirements of these specifications was misrepresented in the submittals.
4. Submittals for equipment shall include detailed dimensional drawings which completely and accurately represent the specific piece of equipment to be supplied. When more than one piece of similar equipment is to be supplied, provide accurate dimensional drawings for each unique size and/or configuration of the equipment.

C. In checking shop drawings, the Engineer will make every effort to detect and correct errors, omissions and inaccuracies in such drawings, but his failure to detect errors, omissions and inaccuracies shall not relieve the Contractor of responsibility for the proper and complete installation in accordance with the intent of the Contract Documents.

D. Shop drawings shall be submitted for ALL material items as outlined in these specifications. Any deviations from contract requirements must be shown on shop drawings, and justification for their consideration must be included.

E. Approval or acceptance of submittal items will not preclude rejection of those items upon discovery of defects in them prior to final acceptance of complete work.

F. Shop drawings are required on the following items, where such items are a part of the Electrical Contract:

1. Sports Field Lighting
2. Poles for Sports Field Lighting
3. In ground hand holes.

1.4 DEFINITIONS

A. To achieve brevity in Specification and on Drawings, certain words and phrases not contributing to clarity have been omitted. Unless mentioned specifically as work to be done by Other Trades, all requirements contained in the Specifications and shown on the Drawings shall be performed by the Principal Contractor for this Division of the Contract. The following definitions shall apply:

1. Where the word "provide" is used in connection with a system, equipment, or item, it shall be construed to mean the furnishing and installing of the system, equipment, or item.
2. Where the phrase "as directed" is used it shall be construed to mean as directed by the Engineer or his authorized representative.

B. The term "Contractor" as applied to work specified, shown or reasonably implied in the contract documents for Division 26 shall be defined as the prime contractor who is responsible for the work specified, or indicated. All work subcontracted to each prime contractor must be incorporated by and coordinated by each prime contractor. The electrical prime contract for this project shall include the following:

Prime Contract	Specification Sections	Drawings
Electrical	All Specifications	All Drawings

1.5 DISCREPANCIES

A. Should it appear that there is a duplication on the Drawings or in the Specifications, wherein the same work or items are shown or specified as being provided under different contracts, subcontracts or supply orders, and such duplication is not clarified by Addendum during the bidding period, it shall be assumed that the prime contractors have included duplicate quotations in their proposal to the Owner. The Engineer shall have the option of selecting the contract, subcontract or supply order under which the work or items are to be provided and a credit shall be due the Owner for the duplicate work or items.

B. The design drawings, as submitted, are diagrammatic and are not intended to show exact location of equipment, electrical devices, etc. unless dimensions are given. Drawings are not to be scaled.

1. Equipment shall be installed along the general arrangement indicated on the drawings, and in accordance with the manufacturer's instructions.

a. Provide at least the minimum manufacturer's recommended and code required clearance around the equipment for normal maintenance.
b. Locate and arrange equipment in relationship to other system components to assure that the equipment will be operating under the best possible conditions to meet the scheduled performance requirements.

2. Raceways are to be installed along the general plans shown on the drawings keeping in mind the constraints of the available space and the need to coordinate with the work of other trades. Additional bends, pull and splice boxes shall be provided as necessary to meet space constraints and to facilitate the work of other trades.

C. Electrical equipment, specified hereinafter as shown on the drawings shall be furnished and installed by this Contractor, unless specifically indicated to the contrary.

D. Occasionally, certain references may be indicated on the Drawings to items which are suggested to be furnished and/or installed by various subcontractors. This is done to assist the applicable Prime Contractor in organizing his subcontractor's bids. However, no attempt has been made, nor is it implied, that this specification or plans are attempting to specifically divide all responsibilities for subcontractors. It is the Prime Contractor's responsibility that all items covered on all plans and specifications are included in his bid and are coordinated with his subcontractors. No consideration will be given for Prime Contractor's failure to include all work in his bid.

E. Where more than one manufacturer is named for major items of equipment, the manufacturer noted on the Drawings has been used as a basis for design. If another manufacturer is used, other than the one named on the Drawings, it shall be the responsibility of this contractor to ensure that the equipment will fit the space with all legal clearances, or bear the expense to change the space and structure to accommodate equipment used.

1.6 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements of this division, and General Conditions.

1.7 EQUIPMENT

A. Before entering into a contract, the successful bidder may be required to submit satisfactory evidence to show that an equipment manufacturer has been regularly engaged in the manufacture of such equipment for three (3) years and have not less than three (3) installations of a similar type which have been in successful operation under conditions similar to those specified for not less than two (2) years.

B. When two or more items of same equipment are required they shall be of the same manufacturer.

1.8 SUBSTITUTIONS

A. Refer to the Instructions to Bidders for requirements in selecting products and requesting substitutions.

1.9 CODES AND PERMITS

A. All equipment, materials, and installation shall comply with the National Fire Protection Association's "National Fire Codes" and "National Electrical Code". Equipment shall bear the "UL" label as required by these codes.

B. Install work in full accordance with rules and regulations of State, County and City authorities having jurisdiction over premises. This shall include safety requirements of Ohio State Department of Industrial Relations. Do not construe this as relieving Contractor from compliance with any requirements of specifications which are in excess of Code requirements and not in conflict therewith.

1.10 INTERFERENCES

A. Install additional conduit, pullboxes, spliceboxes, etc. where required to avoid conflict with other work without additional cost to the Owner.

B. Report any interferences between work under this division and that of any other Contractors to the Engineer as soon as they are discovered. The Engineer will determine which equipment shall be relocated, regardless of which was first installed, and his decision shall be final.

1.11 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall make provisions for the delivery and safe storage of his materials and equipment in coordination with the work of others. Materials and equipment shall be delivered at such stages of the work as will expedite the work as a whole and shall be marked and stored in such a way as to be easily checked and inspected. The arrival and placing of large equipment

items shall be scheduled early enough to permit entry and setting when there is no restriction or problem due to size and weight.

B. The site has only limited storage capacity. The contractor shall make provisions for storage of equipment as necessary to accommodate this limited space.

1.12 PUNCHLISTS

A. From time to time throughout the course of the work, or upon completion of the work the Design Professional may perform site observations resulting in written documentation of deviations in the work from the Contract Documents. In such cases the Contractor shall respond in writing to each and every item on this written documentation stating the specific action taken to remedy the deviation. A response shall be provided by the Contractor for each separate observation. This work shall not be considered complete until such satisfactory written response is received by the Design Professional. Contractor shall submit the responses to these items as part of the closeout documentation.

1.13 OPERATING AND MAINTENANCE

A. This Contractor shall furnish competent personal instruction to the Owner's operating personnel for a period of hours as indicated in individual Division 26 specification sections in the proper operation of the electrical equipment. He shall also supply the Owner with three (3) hardbound copies of an operation manual containing the following:

1. Step-by-step procedures for start-up and operation for each system and piece of equipment.
2. Performance data, curves, ratings.
3. Wiring diagrams.
4. Manufacturer's descriptive literature.
5. Manufacturer's maintenance and service manuals.
6. Spare parts and replacement parts list for each piece of equipment.
7. Name of service agency and installer complete with an emergency service phone number for nights, weekends and holidays.
8. Final approved shop drawings.

1.14 WARRANTIES

A. Refer to the General Conditions Section: Specific Warranties for procedures and submittal requirements for warranties. Refer to individual equipment specifications for additional warranty requirements.

PART 2. -PRODUCTS (Not Applicable)

PART 3. -EXECUTION (Not Applicable)

END OF SECTION 260500

SECTION 260501 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1. - GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of Contract apply to work of this section.

B. Division 26 Basic Electrical Requirements and Basic Electrical Materials and Methods section apply to work specified in this section.

1.2. DESCRIPTION OF WORK

A. Extent of electrical related work required by this section is indicated on drawings and/or specified in other Division 26 sections.

B. Furnish and install all miscellaneous steel required for supports, hangers, anchors, etc., required for installation of equipment and materials furnished and installed under this Division. Steel used in a damp or wet environment shall be hot dipped galvanized unless otherwise noted.

C. This Contractor shall perform all selective Division 26 related and indicated demolition including: Nondestructive removal of materials and equipment for re-use or salvage as indicated. All equipment removed shall be offered to the Owner for his retention. If the Owner elects to retain equipment, it shall be turned over to the Owner at the site. If not, the equipment shall be removed from the premises by this Contractor.

1.3. SUMMARY

A. This section includes a limited scope of general construction materials and methods pertaining to Division 26 applications of the following items:

Miscellaneous Metal
Electrical installations

1.4. PROJECT CONDITIONS

1.5. SEQUENCE AND SCHEDULING

A. Coordinate the shut-off and disconnection of electrical service and/or power with the Owner and the utility company. All associated work to be done at Owner's convenience.

B. Notify the Engineer at least 5 working days prior to commencing demolition operations.

C. Perform demolition in phases as required by Engineer.

PART 2. - PRODUCTS

2.1. MISCELLANEOUS METALS

A. Fasteners: Zinc-coated, type, grade, and class as required.

B. Metal Framing: As manufactured by Unistrut or Kindorf unless noted otherwise. Provide framing of sizes required by specific application.

PART 3. - EXECUTION

3.1. EXAMINATION

A. Examine area and conditions under which basic electric materials are to be installed or methods are to be performed and notify Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Engineer.

3.2. ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

3.3. ELECTRICAL INSTALLATIONS

A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment, and materials installation with other site components.
2. Verify all dimensions by field measurements.
3. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work.
4. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
5. Install systems, materials, and equipment level and plumb, parallel, and perpendicular to other systems and components.
6. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
7. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope (such as for underground services, etc.).
8. All wiring other than within an item of equipment, to be in raceways unless shown otherwise on Drawings or covered otherwise in these Specifications.

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 Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. American Bare Conductor.
3. Belden Inc.
4. Cerro Wire LLC.
5. Encore Wire Corporation.
6. General Cable Technologies Corporation.
7. Okonite Company (The).
8. Service Wire Co.
9. Southwire Company.

10. WESCO.
11. West Penn.

C. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

D. Conductors: Copper, complying with ASTM B 3 for bare annealed copper and with ASTM B 8 for stranded conductors.

E. Conductor Insulation:

1. Type THHN and Type THWN-2: Comply with UL 83.

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. 3M Electrical Products.
2. AFC Cable Systems; a part of Atkore International.
3. Gardner Bender.
4. Hubbell Power Systems, Inc.
5. Ideal Industries, Inc.
6. ILSCO.
7. NSi Industries LLC.
8. O-Z/Gedney; a brand of Emerson Industrial Automation.
9. Service Wire Co.
10. TE Connectivity Ltd.
11. Thomas & Betts Corporation; A Member of the ABB Group.

C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.
2. Type: One hole with standard barrels.
3. Termination: Crimp.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders and Branch Circuits: Copper; solid for No. 14 AWG and smaller; stranded for No. 12 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. All Wiring: Type THHN/THWN-2, single conductors in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
2. Perform each of the following tests:

a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.

b. Inspect compression-applied connectors for correct cable match and indentation.
c. Inspect for correct identification.
d. Inspect cable jacket and condition.

B. Cables will be considered defective if they do not pass tests and inspections.

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 Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

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.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advanced Lightning Technology, Ltd.
2. Burndy; Part of Hubbell Electrical Systems.
3. Dossert; AFL Telecommunications LLC.
4. ERICO; a brand of nVent.
5. Fushi Copperweld Inc.
6. Galvan Industries, Inc.; Electrical Products Division, LLC.

7. Harger Lightning & Grounding.
8. ILSCO.
9. O-Z/Gedney; a brand of Emerson Industrial Automation.
10. Robbins Lightning, Inc.
11. Siemens Industry, Inc., Energy Management Division.
12. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

D. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

E. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel;3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Exothermic welded connectors as indicated.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.

C. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 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 they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
2. Use exothermic welds for all below-grade connections.

C. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.5 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

B. Grounding system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

D. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
5. Substations and Pad-Mounted Equipment: 5 ohms.
6. Manhole Grounds: 10 ohms.

E. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS 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. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:

a. Slotted support systems, hardware, and accessories.
b. Sockets.
c. Eye nuts.
d. Fasteners.
e. Anchors.
f. Saddles.
g. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Allied Tube & Conduit; a part of Atkore International.
b. B-line, an Eaton business.
c. CADDY; a brand of nVent.
d. Flex-Strut Inc.
e. Gripple Inc.
f. GS Metals Corp.
g. G-Strut.
h. Haydon Corporation.
i. Metal Ties Innovation.
j. MIRO Industries.
k. Thomas & Betts Corporation; A Member of the ABB Group.
l. Unistrut; Part of Atkore International.
m. Wesanco, Inc.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
3. Material for Channel, Fittings, and Accessories: Galvanized steel.
4. Channel Width: 1-1/4 inches.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

C. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
2. Toggle Bolts: All Stainless-steel springhead type.
3. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA 101
3. NECA 102.
4. NECA 105.
5. NECA 111.

B. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

C. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

B. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Adalet, Inc.

b. AFC Cable Systems; a part of Atkore International.
c. Allied Tube & Conduit; a part of Atkore International.
d. Amp.
e. Anamet Electrical, Inc.
f. Appleton Electric Co.
g. Arlington Industries Inc.
h. Calconduit.
i. Electri-Flex Company.
j. FSR Inc.
k. Hubbell, Inc.
l. Korkap.
m. NEC, Inc.
n. Opti-Com Manufacturing Network, Inc (OMNI).
o. O-Z/Gedney; a brand of Emerson Industrial Automation.
p. Patriot Aluminum Products, LLC.
q. Republic Conduit.
r. Southwire Company.
s. Thomas & Betts Corporation; A Member of the ABB Group.
t. Western Tube and Conduit Corporation.
u. Wheatland Tube Company.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. GRC: Comply with ANSI C80.1 and UL 6.
4. EMT: Comply with ANSI C80.3 and UL 797.
5. FMC: Comply with UL 1; zinc-coated steel.
6. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AFC Cable Systems; a part of Atkore International.
b. Allied Tube & Conduit; a part of Atkore International.
c. Anamet Electrical, Inc.
d. Electri-Flex Company.
e. FSR Inc.
f. Korkap.
g. NEC, Inc.
h. NewBasis.
i. Opti-Com Manufacturing Network, Inc (OMNI).
j. O-Z/Gedney; a brand of Emerson Industrial Automation.
k. Patriot Aluminum Products, LLC.
l. Perma-Cote.
m. Republic Conduit.
n. Southwire Company.
o. Thomas & Betts Corporation; A Member of the ABB Group.
p. Western Tube and Conduit Corporation.
q. Wheatland Tube Company.

2. Comply with NEMA FB 1 and UL 514B.
3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
4. Fittings, General: Listed and labeled for type of conduit, location, and use.
5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
6. Fittings for EMT:

    a. Material: Steel.
    b. Type: Setscrew.

7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. AFC Cable Systems; a part of Atkore International.
    b. Anamet Electrical, Inc.
    c. Arnco Corporation.
    d. CANTEX INC.
    e. CertainTeed Corporation.
    f. Condux International, Inc.
    g. Electri-Flex Company.
    h. FRE Composites.
    i. Lamson & Sessions.
    j. Niedax Inc.
    k. RACO; Hubbell.
    l. Thomas & Betts Corporation; A Member of the ABB Group.
    m. Topaz Electric; a division of Topaz Lighting Corp.

2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. ENT: Comply with NEMA TC 13 and UL 1653.
4. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
5. LFNC: Comply with UL 1660.
6. Rigid HDPE: Comply with UL 651A.
7. Continuous HDPE: Comply with UL 651A.

8. RTRC: Comply with UL 2515A and NEMA TC 14.

B. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AFC Cable Systems; a part of Atkore International.
b. Anamet Electrical, Inc.
c. Arnco Corporation.
d. CANTEX INC.
e. CertainTeed Corporation.
f. Condux International, Inc.
g. Electri-Flex Company.
h. FRE Composites.
i. Kraloy.
j. Lamson & Sessions.
k. Niedax Inc.
l. RACO; Hubbell.
m. Thomas & Betts Corporation; A Member of the ABB Group.
n. Topaz Electric; a division of Topaz Lighting Corp.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.
3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

a. Fittings for LFNC: Comply with UL 514B.

4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Adalet.
2. Crouse-Hinds, an Eaton business.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman; a brand of nVent.
7. Hubbell Incorporated.
8. Hubbell Incorporated; Wiring Device-Kellems.
9. Kraloy.
10. Milbank Manufacturing Co.
11. MonoSystems, Inc.
12. Oldcastle Enclosure Solutions.
13. O-Z/Gedney; a brand of Emerson Industrial Automation.
14. Plasti-Bond.
15. RACO; Hubbell.

16. Spring City Electrical Manufacturing Company.
17. Stahlin Non-Metallic Enclosures.
18. Thomas & Betts Corporation; A Member of the ABB Group.
19. Topaz Electric; a division of Topaz Lighting Corp.
20. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

E. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

F. Device Box Dimensions: 4 inches square by 2-1/8 inches deep for power 5 inches square x 2-1/8” inches deep for telecom.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRCor PVC coated GRC.
2. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Minimum Raceway Size: 3/4-inch trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

D. Do not install nonmetallic conduit where ambient temperature exceeds 90 deg F.

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits.

Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

C. Complete raceway installation before starting conductor installation.

D. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction. Pull point shall be no more than 200 linear feet.

E. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

F. Support conduit within 12 inches of enclosures to which attached.

G. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

H. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

I. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

J. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

K. Cut conduit perpendicular to the length and deburr. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

L. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

M. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

N. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.

b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

O. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.
2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

P. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

3.3 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION 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. Section Includes:

1. Color and legend requirements for raceways, conductors, and warning labels and signs.
2. Labels.
3. Bands and tubes.
4. Tapes and stencils.
5. Tags.
6. Signs.
7. Cable ties.
8. Paint for identification.
9. Fasteners for labels and signs.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

C. Dedicated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

1. Black letters on white field.
2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.

1. Color shall be factory applied.

2. Colors for 240-V Circuits:

a. Phase A: Black.
b. Phase B: Red.
c. Phase C: Blue
d. Neutral: White.

3. Color for Equipment Grounds: Green.
4. Colors for Isolated Grounds: Green with white stripe.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Champion America.
c. emedco.
d. Grafoplast Wire Markers.
e. HellermannTyton.
f. LEM Products Inc.
g. Marking Services, Inc.
h. Panduit Corp.

i. Seton Identification Products.

B. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A'n D Cable Products.
b. Brady Corporation.
c. Brother International Corporation.
d. emedco.
e. Grafoplast Wire Markers.
f. Ideal Industries, Inc.
g. LEM Products Inc.
h. Marking Services, Inc.
i. Panduit Corp.
j. Seton Identification Products.

2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

C. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. A'n D Cable Products.
b. Brady Corporation.
c. Brother International Corporation.
d. emedco.
e. Grafoplast Wire Markers.
f. HellermannTyton.
g. Ideal Industries, Inc.
h. LEM Products Inc.
i. Marking Services, Inc.
j. Panduit Corp.
k. Seton Identification Products.

2. Minimum Nominal Size:

a. 1-1/2 by 6 inches for raceway and conductors.
b. 3-1/2 by 5 inches for equipment.
c. As required by authorities having jurisdiction.

2.4 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlton Industries, LP.
b. Champion America.
c. HellermannTyton.
d. Ideal Industries, Inc.
e. Marking Services, Inc.
f. Panduit Corp.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Brady Corporation.
b. Carlton Industries, LP.
c. emedco.
d. Marking Services, Inc.

C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.5 CABLE TIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HellermannTyton.
2. Ideal Industries, Inc.
3. Marking Services, Inc.
4. Panduit Corp.

B. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 Deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

1. Secure tight to surface of conductor, cable, or raceway.

H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

I. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

J. Vinyl Wraparound Labels:

1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

K. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

L. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.

M. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

N. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

P. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

3.3 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

END OF SECTION 260553

SECTION 265568 – OUTDOOR SPORTS FIELD LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Work covered by this section of the specifications shall conform to contract documents, engineering plans as well as state and local codes.

The purpose of these specifications is to define the lighting system performance and design standards for The City of North Royalon for the York Road Baseball Field(s) using an LED lighting source. The proposal shall include LED luminaires, brackets, mounting hardware, shop drawings, removal of existing sports lighting, full installation of new components, all electrical connections, aiming and control system integration prior to the date specified herein. The manufacturer / contractor shall supply the lighting system to meet or exceed the standards set forth in these specifications. Existing poles and controls shall be reused.

B. The sports lighting system(s) will be for the following venue(s):

1. Baseball Field(s).

C. The primary goals of this lighting project are:

1. Balance of lighting factors: Minimize spill light to adjoining properties and glare to the players, spectators and neighbors. Minimize uplight component to preserve a dark sky. Maximize playability and safety to the players.
2. Life-cycle Cost: To reduce operating costs, the preferred lighting system shall be energy efficient and cost effective to operate. System energy consumption is to be maintained over the life of the system and will not increase as the system ages.

1.2 LIGHTING PERFORMANCE

A. Illumination Levels and Design Factors: Playing surfaces shall be lit to an average target illumination level and uniformity as specified in the chart below. Lighting calculations shall be developed, and field measurements taken on the grid spacing with the minimum number of grid points specified herein.

B. Average illumination level shall be measured in accordance with the latest IESNA Sports and Recreational Area Lighting requirements.

C. Illumination levels to meet target values in accordance with latest IESNA Sports and Recreational Area Lighting.

Area of Lighting	Average Target Illumination Levels	Maximum to Minimum Uniformity Ratio	Grid Points	Grid Spacing
Baseball Infield	50fc	3:1	25	30’ x 30’
Baseball Outfield	30fc	4.5:1	88	30’ x 30’
Softball Infield	50fc	3:1	25	20’ x 20’
Softball Outfield	30fc	4.5:1	92	20’ x 20’

D. Mounting Heights and Locations: Existing poles shall be reused. Refer to drawings for poles and mounting heights.

1.3 ENVIRONMENTAL LIGHT CONTROL

A. Light Control for Luminaires: All luminaires shall utilize multi-layer optical system including silicone TIR and reflector optics designed to minimize glare and spill light while maintaining the poles for aerial play. No full-cutoff luminaires shall be permitted

B. Spill Control: To minimize impact on adjacent properties, maximum horizontal spill shall not exceed 0.5fc 150’ from the edge of the fields. No fixture mounted anywhere on the poles shall be aimed above the horizon. No up-lighting will be permitted.

C. Photometric Report: A photometric report that shows aiming points of each luminaire shall be provided to demonstrate the capability of achieving the specified performance.

PART 2 - SPORTS LIGHTING SYSTEM DESIGN AND CONSTRUCTION

2.1 ACCEPTABLE MANUFACTURERS

A. All components shall be designed and manufactured as a system. Pole structure, luminaires, control and integral driver system shall be provided from the below approved manufacturer.

1. Eaton Ephesus Lighting

2.2 LIGHT STRUCTURE SYSTEM

A. General description: The entire sports lighting system (crossarms, wiring and fixtures) must be supplied by a single entity that underwrites the warranty. The complete lighting system shall consist of the listed equipment as follows.

1. LED luminaires: complete, integral unit, factory assembled and vacuum sealed.
2. Crossarms: Custom manufactured to retrofit existing poles, hot-dip galvanized steel.
3. All wiring from the load side of the breaker to the luminaire.
4. Aiming method for alignment and realignment of fixtures.

2.3 CROSSARM ASSEMBLY

A. All crossarms shall be hot dip galvanized in accordance with the requirements of ASTM A123 specifications

B. All wiring/connections should be weather tight and done in accordance with NEC

C. Strain relief device(s) must be installed in crossarm assembly to ensure no weight or tension is placed on electrical connections.

2.4 SPORTS LIGHTING SYSTEM

A. The fixture shall meet the following specifications:

1. General:

a. UL Certified for wet locations
b. Operating temperature range rating between -40°C and +40°C
c. Certified to UL 844 and ANSI C136.31, 3G vibration requirements
d. IP Rating: IP66
e. Lumen output < 92,000
f. Power consumption < 640W
g. Efficacy of ≥120 lumens/watt
h. Correlated Color Temperature (CCT) of 5700K
i. CRI of ≥ 70
j. L90 lumen depreciation rating: >55,000 hours certified based on IES recommended 6x measured data extrapolation limitation. No extrapolation beyond 6X permitted.
k. Weigh ≤ 75lbs, including power supply, bracket, and controls
l. Fixture weight evenly distributed between 2-piece assembly of light head and power/controls box
m. Effective projected area (EPA) ≤ 1.8 ft2
n. Pre-aiming for orientation around the mounting location bolt
o. Pre-aiming for tilt on the yoke with locking pin with increments under 2o
p. Luminaires must be listed on the QPL of Design Lights Consortium® to ensure minimum quality and energy-efficiency standards are met for qualification in energy efficiency programs.
q. Integrated and Thermally Isolated Power Supply:
r. Wide input range of 120VAC to 277VAC or 277VAC to 480VAC
s. Power factor: >0.96 @ 277VAC and >0.95 @480VAC
t. THD (Total Harmonic Distortion) ≤20%
u. Dim to off capability
v. Luminaire shall contain two power supplies (drivers) such that if one driver is not operational v.the other continues to power all the LEDs in the light head.
w. Drivers, controls connections and all wiring connections shall be contained in an IP66 enclosure. No exposed connections permitted. No additional junction box permitted.
x. Driver case temperature shall be maintained at or below 55°C at 40°C ambient in order to preserve long term reliability

y. No remote driver solutions are permitted because of parasitic power consumption and high installation costs.

2. Optical system:

a. Fixture shall have a glass sealed glass cover to protect the optics and LEDs. No exposed optics permitted.
b. Luminaire shall incorporate silicone TIR optics in combination with reflector optics over each LED source in order to minimize glare perception. LED light source shall be Chip-on-Board (COB) technology.

3. Construction:

b. Luminaire shall and be installed as a 2-piece assembly of light head and power/controls for ease on handling and installation.
c. Power shall be integral to fixture assembly and separated from the LED thermal heatsink by greater than 2 inches to maintain reliability.
d. Aluminum shall be chromate conversion coated and then two-stage architectural grade powder- coated for long term resistance to corrosion and UV exposure

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Illumination Measurements: Upon substantial completion of the project and in the presence of the Contractor, Project Engineer, Owner's Representative, and Manufacturer's Representative, illumination measurements shall be taken and verified. The illumination measurements shall be conducted in accordance with the latest IESNA Sports and Recreational Area Lighting standards.

B. Correcting Non-Conformance: If, in the opinion of the Owner or his appointed representative, the actual performance levels of the system are not in conformance with the requirements of the specifications and submitted information, the Contractor/Manufacturer shall be required to make adjustments to meet specifications and satisfy Owner.

3.2 WARRANTY AND GUARANTEE

A. 10-Year Warranty: Manufacturer shall supply a signed warranty covering the entire system, including labor, for 10 years. Any parts, except fuses, found to be defective shall be replaced during the entire warranty period. System energy consumption is to be maintained for entire warranty period and will not increase as the system ages.

B. Manufacturer shall maintain specifically funded financial reserves to assure fulfillment of the warranty for the full term. Warranty does not cover damage due to weather conditions, acts of God, accidents, misuse, misapplication, abuse, negligence, failure of owner’s electrical service or unauthorized modification of any part of the product.

C. Individual luminaire outages shall be repaired or replaced when the usage of any field is materially impacted.

PART 4 - DESIGN APPROVAL

4.1 SUBMITTAL REQUIREMENTS

A. Sports lighting system shop drawings shall include:

Item	Description
On Field Lighting Design	Lighting design drawing(s) showing: a. Field Name, date, file number, prepared by b. Outline of field(s) being lighted, illuminance levels at grid spacing specified c. Pole height, number of fixtures per pole, horizontal and vertical aiming angles, as well as luminaire information including wattage, lumens and optics d. Height of light test meter above field surface. e. Summary table showing the number and spacing of grid points; average, minimum and maximum illuminance levels in foot candles (fc); uniformity including maximum to minimum ratio, coefficient of variance (CV), uniformity gradient (UG); number of luminaries, total system kilowatts; light loss factor.
Photometric Report	A photometric report that shows aiming points to demonstrate the capability of the system to achieve the specified performance.
Photometric Files	IES files for each NEMA configuration specified in the sports lighting design.
Standard Catalog 'Cut' Sheets	Luminaire specification or 'cut' sheets.

END OF SECTION 265568