

Miami University

**UTL Pad Switch Replacement
Oxford, Ohio 45056**

**Specifications
Project No. 201464**

BID SET

PROJECT MANUAL
FOR
MIAMI UNIVERISTY

UTL PAD SWITCH REPLACEMENT
OXFORD, OHIO 45056

January 14, 2022
Project Number 201464

ENGINEER

FISHBECK
11353 Reed Hartman Highway, Suite 500
Cincinnati, Ohio 45241
513.469.2370

Copyright 2022 - Fishbeck
All rights reserved.

SECTION 00 01 10 – TABLE OF CONTENTS

DIVISIONS 00 AND 01 – MIAMI UNIVERSITY

DIVISION 26	ELECTRICAL
26 00 10	Electrical General Provisions
26 05 00	Common Work Results for Electrical
26 05 13	Medium-Voltage Cables
26 05 20	Conductors and Cables - 600V and Below
26 05 27	Grounding and Bonding
26 05 29	Hangers and Supports for Electrical Systems
26 05 34	Raceways for Electrical Systems
26 05 35	Boxes for Electrical Systems
26 05 43	Underground Ducts and Raceways for Electrical Systems
26 05 53	Identification for Electrical Systems
26 08 13	Electrical Testing
26 12 19	Padmounted, Liquid-Filled, Medium Voltage Transformers
26 13 21	Medium Voltage Switchgear
DIVISION 32	EXTERIOR IMPROVEMENTS
32 01 90	Operations and Maintenance of Planting
32 12 16	Asphalt Paving
32 13 13	Concrete Paving
32 16 00	Curbs, Gutters, Sidewalks, and Driveways
32 92 00	Turf and Grasses

END OF TABLE OF CONTENTS

SECTION 26 00 10 – ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of a complete extension to the existing electrical systems.

1.3 SYSTEM DESCRIPTION

- A. Work Included:
 - 1. This Division includes all labor, materials, and equipment, tools, supervision, start-up services, Owner's instructions, including all incidental and related items necessary to complete installation and successfully test and start-up and operate in a practical and efficient manner all electrical work and systems indicated on Drawings and described in each Section of Division 26 and conforming with all Contract Documents.
 - 2. This Section defines certain terms used in the Specifications and explains the language, abbreviations thereof, format and certain conventions used in the Specifications and associated Contract Documents.
 - 3. The following are not intended to supersede but to clarify the definitions in the General Conditions, the Supplementary Conditions, and Division 01.
- B. Temporary Facilities: Provide temporary facilities in accordance with Division 01 Section "Temporary Facilities and Controls" and as indicated on the Drawings.
- C. Site and Contract Documents Examination: Submission of a Bid is considered evidence Contractor has visited Site, examined Drawings and Specifications of all trades, and is fully informed with all Project and Site conditions, and is proficient and experienced and knowledgeable of all standards, codes, ordinances, permits, and regulations which affect every trades' completion, cost and time required, and that all costs are included in their Bid.
- D. Responsibility:
 - 1. Contractor shall be responsible for all subcontractors and Suppliers, and include in their Bid and apportion all materials, labor, and equipment to several trades involved in accordance with all local customs, rules, regulations, jurisdictional awards, decisions and secure compliance of all parts of Specifications and Drawings regardless of Sectional inclusion in these Specifications.
 - 2. Each electrical subcontractor and sub-subcontractor shall be responsible for all parts applicable to their trade in accordance with Specifications and Drawings and for coordinating locations and arrangements of Contractor's work with all other relevant Specifications, Drawings, Shop Drawings, and details.
- E. Demolition:
 - 1. Contractor shall be responsible to remove and/or relocate any electrical equipment in conflict of new construction.
 - 2. Determination by Owner shall be made concerning all items to be removed from Project as to if Owner shall keep or if Contractor is to remove from Site.
- F. Drawings and Specifications:
 - 1. Drawings and Specifications are intended to supplement each other and all work specified or indicated in either shall be provided.
 - 2. Drawings are diagrammatic and indicate general arrangement of systems and work included in Contract and shall serve only as design drawings and not as working drawings for general layout of various equipment and systems. Drawings do not necessarily indicate every required junction box, pull box, off-set, mounting support, access panel, etc., which shall be provided as required.

3. Each Contractor shall examine all Drawings and Specifications of their trade and work of Drawings, Shop Drawings, and field layouts of all other trades on the Project, including Architectural, and Electrical. If any discrepancies occur between these various Drawings or between these Drawings and these Specifications, Contractor shall report same to Engineer in writing and obtain written instructions for changes in construction. Should interferences develop during construction which cannot be avoided, Engineer shall decide which work is to be relocated regardless of which was first installed. This work shall be done at no extra cost to Owner.
 4. Should Drawings disagree in themselves or with Specifications, the better quality or greater quantity of work shall be provided.
 5. All schedules on Drawings and Specifications are only for convenience of Contractor. Contractor shall make their own counts.
 6. Manufacturer's Model Number:
 - a. Wherever on Drawings or in Specifications that a Manufacturer's catalog number or model or type designation is made, it is intended as a general qualification and it is Contractor's responsibility before ordering, to determine the proper type or model with arrangement, mounting, and accessories applicable for each location on the Project.
 - b. Approval of Shop Drawings by Engineer will not obviate Contractor's responsibility.
 7. Drawings shall not be scaled for measurement and shall not serve as Shop Drawings.
- G. Definitions:
1. Furnish: Supply and deliver to Project Site, ready for unloading, unpacking, assembly, installation, and similar subsequent requirements.
 2. Install: Operations at Project Site including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, protection, cleaning, and similar requirements.
 3. Provide: Furnish and install, test, and place in working order, complete and ready for intended use.
 4. Minimum Requirements:
 - a. Indicated requirements are for a specific minimum acceptable level of quality and quantity as recognized in the industry. Actual work must comply, within specified tolerances, or may exceed minimums within reasonable limits.
 - b. Refer uncertainties to Engineer before proceeding.
 5. Abbreviations, Plural Words:
 - a. Abbreviations, where not defined in Contract Documents, will be interpreted to mean the normal construction industry terminology determined by recognized grammatical rules by Engineer.
 - b. Plural words will be interpreted as singular and singular words will be interpreted as plural where applicable for context of Contract Documents.
 - c. "In conformity herewith" "shall be" "as noted or indicated on Drawings" "according to Drawings" "a" "the" "and" "all", etc., are omitted in places but shall be supplied by inference.
 6. Raceway: Conduit, wireway, channels, boxes, fittings, hangers, supports, and items necessary or required in connection with or relating to raceway to provide a complete installation.
 7. Concealed: Embedded in masonry or other construction below floor slabs, installed behind wall furring, within double partitions of hung ceiling, in trenches, tunnels or crawl spaces.
- H. Substitution and Changes:
1. Substitutions and changes shall be in accordance with Division 01 requirements for Product Requirements.
 2. When a material, method or product is listed by trade names or catalog number for one use, it is basis of design. Other Manufacturers are listed as acceptable providing specific item is comparable with basis and intent of design.
 3. Contractor and/or equipment supplier may propose other materials, methods or products of equal quality, function, durability, and appearance. Proof of equality must be submitted to Engineer at least 10 days prior to due date for Bids and, if approved, an Addendum naming the material or product so approved will be issued to all Bidders prior to Building. Acceptance and approval is responsibility of Engineer.
 4. Contractor is liable for all added costs to himself or others and is responsible for verifying adequate available space for variations in dimensions, clearance, weight, and roughing-in requirements when product not named as basis of design is used and is responsible for advising all other trades of variations and, when requested shall submit revised drawing layout for approval of Engineer.

1.4 QUALITY ASSURANCE

- A. Qualifications: Compliance with standard codes and permits shall be in accordance with the General and Supplementary Conditions.
- B. Regulatory Agencies Requirements: All work under Division 26 shall comply with latest edition of applicable standards and codes of following:
 - 1. NEC (NFPA 70), National Electric Code.
 - 2. AWS Standards for welding.
 - 3. ANSI C2, National Electrical Safety Code.
 - 4. ANSI C73, Dimensions of Attachment Plugs and Receptacles.
 - 5. NECA Standards for installation.
 - 6. NEMA Standards for materials and products.
 - 7. ASTM American Society for Testing Materials.
 - 8. ASA American Standards Association.
 - 9. NFPA National Fire Protection Association.
 - 10. UL Underwriters' Laboratories, Inc.
 - 11. OSHA Occupational Safety and Health Act.
 - 12. Ohio Building Codes.
 - 13. UBC Uniform Building Code.
 - 14. Americans With Disabilities Act (ADA).
- C. All labor, materials, and equipment shall comply with all applicable:
 - 1. City, county, and state laws, ordinances, codes, and regulations.
 - 2. Ohio and County Department of Health.
 - 3. Applicable fire marshal's office.
 - 4. Federal specifications.
- D. Excess Quantities and Sizes: Where quantities, sizes or other requirements on Drawings or Specifications are in excess of code requirements, Drawings or Specifications govern.
- E. Conflicts: When conflicts exist between referenced Specifications or standards, more stringent requirements govern. No extra compensation for such compliance allowed.
- F. Notices and Payments: Contractor shall give all notices, file all Drawings, obtain necessary approvals, obtain all permits, pay all fees, deposit and expenses required for installation of all work under this Contract. Within 10 days after the contract award, Contractor shall show proof that permits have been obtained and fees paid.
- G. Inspections and Certificate of Inspection:
 - 1. No work shall be covered or enclosed until work is tested in accordance with applicable codes and regulations and successful tests witnessed and approved by authorized inspection authority.
 - 2. Provide to Engineer's office evidence that the installation has been inspected and approved by authorized governmental inspector having jurisdiction over that phase of work involved.
- H. UL Labels: In general, all material where applicable shall be labeled or listed by Underwriter's Laboratories, Inc.

1.5 COORDINATION OF ELECTRICAL WORK

- A. Coordination: Advise other trades of openings required in their work for the subsequent move in of large units of electrical work (equipment).
- B. Locations: Locate operating and control equipment properly to provide easy access and arrange entire electrical work with adequate access for operation and maintenance. Allow for clearance around equipment in accordance with NEC.

1.6 SUBMITTALS

- A. General: Shop and installation drawings shall serve the purpose of checking Contractor's interpretations of the design Drawings and Specifications, aid in correlation and coordination of the various trades and be used by Contractor's field personnel as installation instructions. Rough-in and connections to equipment furnished by this Contractor or by other trades shall be according to Shop Drawings, furnished for this equipment. Contractor shall coordinate all their work with various other trades and check these Shop Drawings before installing services.
- B. Schedule of Equipment and Subcontractors:
 - 1. Submit to Engineer for approval 2 copies of schedule of all equipment and materials on which Bid is based, including all items being provided by all Subcontractors.
 - 2. After schedule of Equipment and Subcontractors is approved, no deviation will be permitted without written consent of Engineer.
- C. Shop Drawings Include the following:
 - 1. After schedule of Equipment and Subcontractor is approved, submit 1 electronic/PDF copy of Shop Drawings on all equipment and materials. Shop Drawings shall be submitted bound and separated, forming booklets containing one drawing of each item. Mark clearly on the cover which project these drawings pertain to. Mark each drawing with the corresponding marking by which the item is listed on the Drawings.
 - 2. Shop Drawing submittals shall include signatures of Contractor and Subcontractor certifying they have inspected submittal as to substantial compliance with Contract Documents, space allowance for installation and service, and work of other trades. Submittals not complying with the above will be returned unchecked.
 - 3. Submit complete Manufacturer's Shop Drawings of all equipment, accessories, and controls, including dimensions, weights, capacities, construction details, installation, operating, and maintenance instructions, controls and wiring diagrams; all applicable Manufacturers' warranties; and all details involving other trades.
 - 4. Itemize required accessory items not specifically included in submittal being provided on separate submittal.
 - 5. Submittals containing items not applicable to Project must be distinctly and completely identified.
 - 6. General catalog cuts without detailed Engineering and installation details will not be accepted.
 - 7. Engineer's approval of Shop Drawings is a service only and not considered as a guarantee of compliance with or as relieving Contractor of basic responsibilities under Contract Documents and does not approve changes in time or cost.
 - 8. After approval, Contractor shall provide information to all affected trades.
- D. "As-Built" Drawings: Provide one set of redlined "as-built" drawings to Engineer at the completion of the project.
- E. Extra Copies of Submittals: Refer to "Final Acceptance, Guarantees, and Warranties" item in this Section for requirements of extra copies of Shop Drawings and operating and maintenance information.

1.7 TEMPORARY FACILITIES

- A. Refer to Division 01 Section "Temporary Facilities and Controls" for general requirements on temporary facilities and any notes on Drawings.

1.8 DELIVERY, STORAGE, HANDLING, AND PROTECTION

- A. Delivery, storage, handling, and protection shall be in accordance with the General and Supplementary Conditions, and in accordance with each Division 26 Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Product Listing:
 - 1. Prepare the product listing for electrical work, separately from the listing(s) of products for other work.
 - 2. Include listing of each significant item of equipment and material used in the work and indicate the generic name, product name, Manufacturer, model number, related specification section number(s), and estimated date for start of installation.
 - 3. Materials such as conductors, conduit, and boxes taken from installer's stock need not be listed.
 - 4. For principal equipment items, list the input/output ratings.
 - 5. Submit list within 14 days of contract date.
- B. Compatibility:
 - 1. Provide products which are compatible with other products of the electrical work and with other work requiring interface with the electrical work, including electrical connections and control devices.
 - 2. For exposed electrical work, coordinate colors, and finishes with other work.

PART 3 - EXECUTION

3.1 CUTTING AND PATCHING

- A. General:
 - 1. Perform cutting and patching in accordance with Division 01 Section "Cutting and Patching", and this Section.
 - 2. Except as individually authorized by Engineer, cutting and patching of electrical work to accommodate the installation of electrical work is not permitted.

3.2 EXCAVATING FOR ELECTRICAL WORK

- A. General:
 - 1. The work of this Article is defined to include whatever excavating and backfilling is necessary to install the electrical work.
 - 2. Coordinate the work with other excavating and backfilling in the same area, including dewatering, flood protection provisions, other temporary facilities, other underground services (existing and new), landscape development, paving, and floor slabs on grade.
 - 3. Coordinate with weather conditions and provide temporary facilities needed for protection and proper performance of excavating and backfilling.
 - 4. See Division 32 Section "Turfs and Grasses" for additional information.
- B. General Standards: Refer instances of uncertain applicability to Engineer for resolution before proceeding.

3.3 CONCRETE FOR ELECTRICAL WORK

- A. Refer to Division 03 "Cast-in-Place Concrete" for requirement on concrete for electrical work.

3.4 PAINTING ELECTRICAL WORK

- A. Except as otherwise indicated, comply with the applicable provisions of Division 09 Section "Painting and Coatings," for painting of electrical work.

3.5 ELECTRICAL WORK CLOSE-OUT

- A. General: Except as otherwise indicated in this Section, close-out shall be in accordance with Division 01 Section "Closeout Procedures."

- B. Coordination with Mechanical:
1. Coordinate close-out operations with existing mechanical systems and other power consuming equipment.
 2. Accurately record locations of conductors which are underground or otherwise concealed.
 3. Test run electrical equipment in coordination with the Owner.
 4. Clean and lubricate operational equipment.
 5. Check all fuses and thermal overload units for proper sizing as per load, as determined in the field.
 6. Instruct Owner's operating personnel thoroughly in the operation, sequencing, maintenance, and safety/emergency provisions of the electrical systems.
 7. Turn over the operations to Owner's personnel at the time(s) of Substantial Completion.
 8. Until the time of final acceptance of the total Work of the Contract, respond promptly with consultation and services to assist Owner's personnel with operation of electrical systems.

END OF SECTION 26 00 10

SECTION 26 05 00 – COMMON WORK RESULTS FOR ELECTRICAL

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.
- B. Excess Quantities and Sizes: Where quantities, sizes or other requirements on Drawings or Specifications are in excess of code requirements, Drawings or Specifications govern.
- C. Conflicts: When conflicts exist between referenced Specifications or standards, more stringent requirements govern. No extra compensation for such compliance allowed.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Duct seals and plugs.
 - 6. Common electrical installation requirements.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with
 - 1. NECA 1 - Standards Practices for Good Workmanship in Electrical Construction.
 - 2. NEC – National Electrical Code (NFPA 70).

1.4 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.5 SUBMITTALS

- A. Product Data: For sleeve seals.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration, damage, contamination with foreign matter, and damage by weather or elements, and according to Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, weather tight wrapping.
- D. Reject damaged, deteriorated or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

1.7 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To ensure that mounting heights and locations of electrical equipment do not interfere with all other building appurtenances such as, but not limited to, containment areas, special coatings, and other equipment.
 - 3. To allow easy access and disconnection of electrical equipment while ensuring the least amount of interference with other installations.
 - 4. To allow right-of-way for piping and conduit installed at required slopes.
 - 5. To ensure that connecting raceways, cables, and wireways will be clear of obstructions and outside of the dedicated working and access space of other equipment.
- B. Coordinate installation of required supporting devices.
- C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated on the Drawings.

2.2 SLEEVE SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - e. Proco Products, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Plastic.
 - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonshrink; recommended for interior and exterior for sealing openings in non-fired-rated walls or floors.
- B. Standard: ASTM C1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5,000 psi, 28 day compressive strength.
- D. Packaging: Premix and factory packaged.

2.4 DUCT SEALS AND PLUGS

- A. Cable duct seals and plugs shall be designed to effectively seal conduits, reducing the cost of cable placement and maintenance in underground construction projects and routine work.
 - 1. All plastic construction – corrosion proof.
 - 2. Pull 'Rope Eye' attachment (can be supplied with security hex nut).
 - 3. Water tight.
 - 4. Simple to install.
 - 5. Removable and reusable.
 - 6. Full range of sizes.
 - 7. Full range of forms (round, square).
 - 8. Full range of supported cable count (simplex, duplex, triplex, quadplex and specials).
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. TE Connectivity.
 - 2. Or equal.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1 and NEC.
- B. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in a manner as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- D. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways or cables penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless otherwise indicated on the Drawings.
- G. Seal space outside of sleeves with grout for penetrations of concrete and masonry. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.

- I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials.
- J. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- K. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL SYSTEM INSTALLATION

- A. Install sleeve-seal systems onto sleeves of exterior concrete walls and slab-on-grade at raceway entries into buildings.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly.

3.5 DUCT SEALS AND PLUGS INSTALLATION

- A. Where conduits penetrate into the building, seal duct openings at conduit termination points with duct seals and plugs for all conduits entering the building to prevent migration of water and gases into the building and to prevent the condensation of water vapor inside the enclosures where the conduits terminate.
- B. Duct seals and plugs shall be applied after all cables have been installed.
- C. Install duct seals and plug materials in strict accordance with the Manufacturer's instructions.
- D. Where conduit will be simultaneously exposed to different temperatures, such as where it passes through the outside wall of a heated building or between two different rooms, the inside of the conduit shall be sealed with duct seals and plugs.
- E. All raceways that penetrate in to or out of manholes, vaults, buildings, freezers, coolers, roofs, or like installations shall require duct seals and plugs to be installed,
- F. All open ended riser conduits shall require duct seals and plugs to be installed.

END OF SECTION 26 05 00

SECTION 26 05 13 – MEDIUM-VOLTAGE 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. This Section includes the furnishing and installation of all medium-voltage (2,001V to 35,000V) cables and related splices, terminations and accessories.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the standards of the following organizations as applicable to materials, construction and testing of medium-voltage cables:
 - 1. AEIC – Association of Edison Illuminating Companies: AEIC CS 8 – Specification for Extruded Dielectric Shielded Power Cables Rated 5 through 46kV.
 - 2. IEEE – Institute of Electrical and Electronics Engineers:
 - a. IEEE 48-2009 – Standard Test Procedures and Requirements for Alternating-Current Cable Terminations Used on Shielded Cables Having Laminated Insulation Rated 2.5 kV through 765 kV or Extruded Insulation Rated 2.5 kV through 500 kV.
 - b. IEEE 386-2006 – Standard for Separable Insulated Connector Systems for Power Distribution Systems above 600 V (ANSI).
 - c. IEEE 404-2012 – Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500-500000 V (ANSI).
 - d. IEEE 576-2000 – Recommended Practice for Installation, Termination, and Testing of Insulated Power Cable as Used in Industrial and Commercial Applications (ANSI).
 - e. IEEE C2-2012 – National Electrical Safety Code (ANSI).
 - 3. ICEA – Insulated Cable Engineers Association:
 - a. ICEA S-93-639-2012 – 5-46 kV Shielded Power Cables for the Distribution and Transmission of Electrical Energy.
 - b. ICEA S-94-649-2013 – 5-46 kV Concentric Neutral Cables Rated 5000 to 46000 Volts.
 - c. ICEA S-97-682-2013 – Utility Shielded Power Cables Rated 5000 to 46000 Volts.
 - d. ICEA T-31-610-2007 – Test Method for Conducting a Longitudinal Water Penetration Resistance Test on Blocked Conductor.
 - 4. NETA – InterNational Electrical Testing Association: NETA ATS-2013 – Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
 - 5. NFPA – National Fire Protection Association: NFPA 70-2014: National Electrical Code.
 - 6. UL – Underwriters Laboratories: UL 1072-2006: Medium-Voltage Power Cables.

1.4 SUBMITTALS

- A. Product Data: For each type of cable indicated, include splice and terminations for cables and cable accessories.
- B. Qualifications Data: For testing agency.
- C. Field quality-control test reports.
- D. Provide splice and termination installer certification for review of Miami University Electrical System Manager.

1.5 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed submittals.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Manufacturers: Okonite, General Cable, Kerite or equal by approval of Miami University Electrical Systems Manager.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.
- D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 CABLES

- A. See Plans.
- B. Manufacturers:
 - 1. Basis of Design: Okonite Okoguard® Okoseal® (see Okonite Product Data Specification Section 2: Sheet 9).
 - 2. General Cable approved equal.
 - 3. Kerite approved equal.
- C. Cable Type: MV-105.
- D. Comply with UL 1072, AEIC CS 8, ICEA S-94-649.
- E. Conductor: Compressed, Class B, annealed uncoated copper.
- F. Conductor Shield: Extruded semi-conducting copolymer compound.
- G. Insulation: 105 degrees C rated Ethylene Propylene Rubber (EPR) in accordance with ICEA S-93-639 and UL 1072.
 - 1. Voltage Rating: 15kV.
 - 2. Insulation Thickness: 133-% insulation level.

- H. Insulation Shield: Extruded semi-conducting copolymer compound applied directly over the insulation. Conductor shield, insulation, and insulation shield to be applied in one tandem operation.
- I. Shield: Uncoated helically applied 5 mil bare copper tape with a nominal overlap of 12.5%.
- J. Jacket for 1-Conductor Cable: Jacket to be UL listed sunlight-resistant polyvinyl chloride per UL1072, ICEA S-93-639/Nema WC74 and S-97-682.

2.2 SPLICE KITS

- A. Connectors and Splice Kits: Include all components required for complete splice of specific size, rating, and configuration of cable(s) to be spliced. Comply with IEEE 404; type as recommended by cable or splicing kit Manufacturer for the application. QS Series by 3M, or equal.
- B. Where splicing to 1/3 concentric neutral cables, match cable type as required.
- C. Load break and dead break termination shall be provided with capacitive test points.
- D. Splices in manholes shall only be heat-shrink type.

2.3 SOLID TERMINATIONS

- A. Termination Kits: Include all components required for complete termination of specific size, rating, and configuration of cable(s) to be terminated. Terminations to be Class 1 complying with IEEE 48. Insulation class to be equivalent to that of cable. Include shield ground strap for shielded cable terminations. Type as recommended by cable or termination kit Manufacturer for the application. QT Series by 3M; or equal.

2.4 SEPARABLE INSULATED CONNECTORS

- A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.
- B. Load-Break Cable Terminators: Elbow-type units with 200-A load make/break, capacitive test points, and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Manufacturers: Elastimold, Cooper or 3M.
- C. Dead-Break Cable Terminators: Elbow-type unit with 600-A continuous-current rating; capacitive test points designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated.
- D. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.
- E. Dead-Front Terminal Junctions: Modular bracket-mounted groups of dead-front stationary terminals that mate and match with above cable terminators. Two-, three-, or four-terminal units as indicated, with fully rated, insulated, watertight conductor connection between terminals and complete with grounding lug, Manufacturer's standard accessory stands, stainless-steel mounting brackets, and attaching hardware.
 - 1. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.
 - 2. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
 - 3. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
 - 4. Standoff Insulator: Portable, single dead-front terminal for removable mounting on accessory stand of stationary terminal junction. Insulators suitable for fully insulated isolation of energized cable-elbow terminator.

2.5 ARC-PROOFING MATERIALS

- A. Tape for First Course on Metal Objects: 10-mil-thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.
- B. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3-inch thick, compatible with cable jacket.
- C. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1/2 inch wide.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install cables according to IEEE 576. Install only in code conforming raceway.
- B. Pull Conductors: Do not exceed Manufacturer's recommended maximum pulling tensions and sidewall pressure values.
 - 1. Where necessary, use Manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation.
 - 2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.
 - 3. Pull conductors together where more than 1 conductor is being installed in a raceway.
- C. Unless otherwise indicated, install warning tape 12 inches above conduit containing cables.
- D. Install cable splices at pull points and as required; use standard heat-shrink kits. Keep splices to a minimum.
- E. Identify all splice locations on as-builts.
- F. In manholes, handholes, pull boxes, junction boxes, and cable vaults, train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag. In manholes, provide a full loop of cables around outside of manhole for future considerations.
- G. Install terminations at ends of conductors and seal cable ends with standard kits.
 - 1. Provide splice and termination installers certification for review of Miami University Electrical System Manager prior to installation.
- H. Arc Proofing: Unless otherwise indicated, arc proof medium-voltage cable at locations not protected by conduit, cable tray, direct burial, or termination materials. In addition to arc-proofing tape Manufacturer's written instructions, apply arc proofing as follows:
 - 1. Clean cable sheath.
 - 2. Wrap metallic cable components with 10-mil pipe-wrapping tape.
 - 3. Smooth surface contours with electrical insulation putty.
 - 4. Apply arc-proofing tape in 1 half-lapped layer with coated side toward cable.
- I. Band arc-proofing tape with 1-inch wide bands of half-lapped, adhesive, glass-cloth tape 2 inches on center.
- J. Ground shields of shielded cable at terminations, splices, and separable insulated connectors. Ground metal bodies of terminators, splices, cable and separable insulated-connector fittings, and hardware.
- K. Identify cables according to Division 26 Section "Identification for Electrical Systems."

- L. Testing: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
 - 1. Perform each visual and mechanical inspection and electrical tests stated in NETA ATS. Certify compliance with test parameters.
 - 2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
 - 3. Remove and replace malfunctioning cables and retest as specified above.

END OF SECTION 26 05 13

SECTION 26 05 20 – CONDUCTORS AND CABLES – 600V AND BELOW

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of all electrical conductors, cables, splices, and connectors.
- B. Major Systems Include:
 - 1. 600V and below feeders and electrical distribution.
 - 2. Branch circuit wiring.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the standards of the following organizations as applicable to materials, construction and testing of wire cables:
 - 1. NEMA - National Electrical Manufacturer Association Standards.
 - 2. IEEE Standards.
 - 3. Insulated Cable Engineers Association - Standards.
 - 4. ASTM Standards.
 - 5. NEC - National Electric Code

1.4 SUBMITTALS

- A. Product Data: For each type of product.

1.5 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed submittals.
- B. Manufacturers: Firms regularly engaged in the manufacture of electrical conductor and cable products of the types and ratings required, whose products have been in satisfactory use in similar service for not less than 5 years.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.
- D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Except as otherwise indicated, provide conductors, cables, and connectors of Manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by the Manufacturer and as required for the installation.

B. Power Wire:

1. All conductors and cables shall be new with a minimum wire size of No. 12 AWG. Manufacturer's name, type, and size shall be permanently marked on the outer covering at regular intervals and delivered in complete coils or reels.
2. Provide factory fabricated conductors of size, rating, material, and type as indicated for each service. Where not indicated, provide proper selection as determined by installer to comply with installation requirements and with NEC standards, from only following types and conductors:
 - a. Match existing wire types where splicing of existing cables is required.
 - b. For new cables above ground, type THHN/THWN, 600 Volt, 75/90 Degrees C Rated with Nylon Jacket: Stranded copper for all sizes.
 - c. For new cables below ground, type XHHW-2, 600-Volt, 90 degrees C rated. Stranded copper for all sizes.
 - d. Bare Conductors: Stranded copper for all sizes.

3. Wire Color Code:

a. The following color codes are used:

	120/208 Volt	277/480 Volt
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Neutral	White*	Gray
Equipment Ground	Green	Green

Match existing color code where different.

* - Neutral conductors serving AFCI protected circuits shall be white in color with a permanent tracer or stripe matching the phase conductor color used. (black, red, or blue.)

- b. On 3 way and 4 way switching, the travelers shall be the same color as the phase used. An off color may be used to allow for ease of identification. (I.e.: pink for red, purple for blue. Different shades are acceptable.)
- c. Conductors #10 AWG or smaller to have the insulation color as noted above.
- d. Conductors #4 AWG or larger to have the insulation color as noted above or be colored as noted above using colored phasing tape. Install tape wraps minimum 1/2", wrapped twice at the following locations:
 - 1) At each terminal
 - 2) At each conduit entrance
 - 3) At intervals not more than 12 inches apart in all boxes, panel tubs, switchboards, etc.
- e. All equipment grounding conductor insulation shall be green.

C. Control Cable: No. 14 AWG minimum, type THHN/THWN.

D. Power Wiring Cable Accessories: For Connectors:

1. Wing nuts by Ideal.
2. Sta-Kon by Thomas & Betts.
3. Scotchlox Spring by Minnesota Mining & Manufacturing Company.
4. Compression Type 53200 by Thomas & Betts.
5. Hydent by Burndy.
6. Insulated multi-cable mechanical connector blocks by Polaris, or IlSCO.
7. Thomas & Betts Co. Type "PT".

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install electrical conductors, cables, and connectors as indicated on the Drawings, in accordance with the Manufacturer's written instructions, the applicable requirements of NEC and the National Electrical Contractors Association's "Standard of Installation," and in accordance with recognized industry practices to ensure that products serve the intended functions.
2. Conductors and cables shall be sized in accordance with the Drawings or, in the absence thereof, in accordance with NEC requirements. Except where indicated herein, conductor sizes greater than No. 12 AWG are indicated on the Drawings.
3. Provide a dedicated grounded conductor (neutral) for each circuit that requires a neutral for proper operation. Unless indicated otherwise on the Drawings, shared neutrals are not allowed.
4. Provide an equipment grounding conductor in all raceways. Conductor shall be sized in accordance with the National Electrical Code.

B. Voltage Drop Compensation:

1. Provide No. 10 AWG conductors in lieu of No. 12 AWG conductors to compensate for voltage drop for each 120V, 20 ampere branch circuit that exceeds 100 feet in length between the branch circuit panelboard and the last outlet.
2. When conductor size is increased to compensate for voltage drop, provide equipment grounding conductor increased in size in accordance with NEC.

C. Installation Procedures:

1. Each conduit shall be free of moisture and debris before conductors are installed.
2. Remove moisture from conduits by swabbing.
3. Install conductors so insulation is not damaged. Replace all conductors that are damaged.
4. Install conductors and cables only in code conforming raceway.
5. Pull conductors together where more than 1 conductor is being installed in a raceway.
6. Use manufacturer-approved pulling compound or lubricant, where necessary. Compound shall not deteriorate conductor and insulation. Compounds shall be UL listed.
7. Use a pulling means, including fish tape, cable or rope, and basket-weave wire/cable grips, that will not damage the raceway or the wire.
8. Keep conductor splices to a minimum.
9. Install splices and taps which have equivalent or better mechanical strength and insulation as the conductor.
10. Use splice and tap connectors which are compatible with the conductor material.
11. Make all joints, splices, and connections only at accessible junction or outlet boxes, never inside conduit or fitting. Make splices in No. 10 AWG and smaller wire with insulated spiral mechanical connectors.
12. Connections: Joints in #8 AWG and larger or joints in any wires above this range of threaded-on connectors will be made using pressure type mechanical connectors applied after wires are cleaned and insulated using 2 layers of "Scotchfil" brand electrical insulation putty and covered by 2 half-lapped layers of "Scotch 88", or approved equal. Connectors may be installed and sealed against moisture by installing Raychem "TCS (indoor) or MCSM (exterior)" sealant coated heat shrink tubing or approved equal.
13. All splices located in utility tunnels and wet locations shall be rated for wet locations.
14. Insulate all joints at splices with "Scotch" brand electrical pressure sensitive tape to 150% of conductor insulation value.
15. Make conductor length for parallel feeds identical.
16. Where exposed cables are installed, cables shall be installed parallel and perpendicular to exposed structural members and building lines.
17. Do not lace, strap or tie feeder or branch circuit conductors together in panels, switchboards, variable speed drives, motor control centers, automatic transfer switches, boxes, and wireways.
18. Feeders and service entrance conductors entering electrical equipment shall be adequately secured with cable cleats.
19. Conductor ampacity derating shall be adhered to for all conductors in accordance with the National Electrical Code.
20. At devices, wrap terminals/device with electrical tape after all connections are made at device.

21. Marking: All signal and control wires shall be marked at all termination points, such as cabinets, terminal boxes, equipment racks, control panels, consoles, etc. The wire markers shall be Thomas and Betts vinyl tape type WM wrapped once around the wire and the adhesive sides placed together to form a flag. These wire markers shall be installed when wire is pulled.

3.2 FIELD QUALITY CONTROL

A. General:

1. Prior to energization, check conductors and cables for continuity of circuitry and for short circuits. Correct malfunctions when detected.
2. Subsequent to conductor and cable hook-ups, energize circuitry and demonstrate functioning in accordance with requirements.

END OF SECTION 26 05 20

SECTION 26 05 27 – GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the furnishing and installation of a complete and continuous grounding system.

1.3 DESIGN AND PERFORMANCE REQUIREMENTS

- A. All equipment, raceway systems, interior wiring systems with neutrals, receptacles, and power outlets, motors and motorized equipment shall be grounded.

1.4 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design.
- B. Grounding system shall be in accordance with the current National Electrical Code (NEC).
- C. Grounding system rods, connectors and clamps shall be UL labeled.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. General: A portion of the required materials for grounding systems are specified in the Division 26 – Electrical Sections.
- B. Grounding Electrodes:
 - 1. Ground Rods: Copper-clad steel; 3/4-inch diameter by 10-feet in length.
 - 2. Where ground grids are required they shall consist of copper clad steel driven rods with underground ring bus, sized as indicated on Drawings, of bare stranded copper interconnecting cable.
 - 3. Ground rods to be as manufactured by Copperweld or equal.
- C. Connectors:
 - 1. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions as manufactured by Thermoweld, Cadweld or equal.
 - 2. Irreversible Compression Connectors: Compression connections shall be irreversible, cast copper, high conductivity as manufactured by Thomas and Betts; or equal.

PART 3 - EXECUTION

3.1 POWER SYSTEM GROUNDING

- A. Provide ground rod or ground rod grids as indicated on Drawings and in the Specifications. Provide a ground grid around all outdoor pad mounted equipment.
- B. Make cable to rod and cable to cable connections by using exothermic-welding process.
- C. Welds on ground cables shall be cleaned and painted with an asphalt base paint where buried underground or embedded in concrete.

- D. Irreversible compression connectors shall be factory filled with an oxide inhibitor and installed with the connector manufacturer's die such that the die index matches the listed index on the connector. Connectors shall be fully crimped with a 14 ton or larger hydraulic tool such that the index number is embossed on the connector. Irreversible compression connectors may be used in below grade, above grade, building steel, electrode connections and concrete encased applications. Connectors shall comply with IEEE 837, UL467 and CSA22.2.
- E. Connect grounding electrode conductors to service entrances and separately derived systems in accordance with the NEC.
- F. Provide a grounding electrode connection to the water service in accordance with the NEC.
- G. Provide a grounding electrode connection to the building steel, where available, in accordance with the NEC.
- H. Provide a grounding electrode connection to a concrete encased electrode, where available, in accordance with the NEC.
- I. Top of ground rods to be within 2-feet – 0-inches of finish grade. Rod to extend 10-feet into undisturbed soil.
- J. When ground conductor enters building, use an exothermic weld splice on the copper cable so the cable becomes a solid cable. Seal around weld at wall to stop any water infiltration through cable strands.

3.2 DISTRIBUTION SYSTEM GROUNDING

- A. Provide a green, insulated, equipment grounding conductor in each raceway (metallic and non-metallic; rigid and flexible). Equipment grounding conductors shall be sized in accordance with Article 250 of the NEC unless noted otherwise on Drawings.
- B. Circuit Grounding: Install grounding bushings, grounding studs, and grounding jumpers at distribution centers, pull boxes, panelboards, and all like equipment.
- C. Bonding Jumpers:
 - 1. Provide green insulation, size correlated with overcurrent device protecting the wire, attached to grounding bushings on conduits, to lugs on boxes, and other enclosures.
 - 2. Bond to neutral only at service neutral bar.
- D. Receptacles and Power Outlets: Ground receptacles and power outlets to the conduit system with a green grounding conductor sized in accordance with Article 250 of the NEC and connected between the device grounding screw and outlet box.
- E. Metallic Conduit: When bare grounding electrode conductors are enclosed in metallic conduit, the conduit shall be bonded to the grounding electrode conductor(s) at both ends utilizing equipment UL listed for this purpose.
- F. Ground motor bases and frames by pulling a separate equipment grounding conductor in with the motor branch circuit.
- G. Expansion Joints: Provide a bonding jumper around expansion fittings in metallic conduit to maintain ground continuity. Expansion fittings may include an internal bonding jumper constructed of a tinned copper braid, sized to meet UL fault current test requirements and complying with the bonding requirements of Article 250 of the NEC.
- H. Separately Derived Systems: Grounding of separately derived systems, i.e., secondary transformers, shall be in accordance with Article 250 of the NEC. Use suitable ground lugs and clamps approved for this purpose.

END OF SECTION 26 05 27

SECTION 26 05 29 – 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. This Section includes the furnishing and installation of hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

- A. Electrical Supports: Angles, channels, brackets, and mounting accessories for supporting all conduit, luminaires, switches, and other electrical equipment which are hung or mounted above floor.

1.4 DESIGN AND PERFORMANCE REQUIREMENTS

- A. This Section defines general criteria for the selection and installation of supporting devices, but does not cover all types specifically required for the Project.
- B. Choose or design supporting devices in accordance with these general criteria.

1.5 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed submittals.
- B. Regulatory Agencies Requirements:
 - 1. Provide supporting devices listed by Underwriters' Laboratory for their application as installed.
 - 2. Comply with National Electrical Code (NFPA 70) as applicable to construction, installation, and requirements for supporting devices.
 - 3. Comply with Metal Framing Manufacturers Association Standard Publication (MFMA-4); factory-fabricated components for field installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.
- D. Reject damaged, deteriorated, or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduit Supports:

1. Where information indicated on Drawings conflicts with information herein, the more stringent requirements shall take precedence and the better quality or greater quantity of work shall be provided.
2. Single Runs: Galvanized conduit straps or ring bolt type hangers with spring clips. Do not use plumber's perforated straps.
3. All supports, such as, but not limited to, metal channel (strut) framing systems, angles, straps, hangers, etc. shall match the raceway type that is being supported. For example, galvanized conduit requires galvanized metal channel (strut) framing systems and straps, PVC coated conduit requires PVC coated metal channel (strut) framing systems and straps.
4. In general, all hardware, such as anchors, nuts, bolts, washers, threaded rod, etc. shall match the conduit type: Galvanized steel hardware shall be used with galvanized steel rigid metal conduit, etc.
5. Multiple Runs: Conduit rack with 25% spare capacity.
6. Vertical Runs: Channel support with conduit fittings.
7. Manufacturers:
 - a. Cooper B-Line; a division of Eaton Corporation.
 - b. ERICO International Corporation.
 - c. Power-Strut; Power Engineering Co., Inc.
 - d. GS Metals Corp.
 - e. Michigan Hanger Co., Inc.; O-Strut Div.
 - f. National Pipe Hanger Corp.
 - g. Thomas & Betts Corporation.
 - h. Unistrut; a brand of Atkore International, Inc.
 - i. Wesanco Channel Systems; ZSi-Foster, Inc.
 - j. Or equal.

B. Mounting, Anchoring, and Attachment Components

1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials where used. See item 2.1 A 4 above for clarification.
2. Manufacturers:
 - a. Hilti, Inc.
 - b. ITW Construction Products.
 - c. MKT Fastening, LLC.
 - d. Or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Layout to maintain headroom, neat mechanical appearance, and to support equipment loads.
2. Secure Engineer's approval before welding or bolting to steel framing or anchoring to concrete structure.

END OF SECTION 26 05 29

SECTION 26 05 34 – RACEWAYS 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.
- B. See Division 26 Section “Underground Ducts and Raceways for Electrical Systems.”

1.2 SUMMARY

- A. This Section includes the furnishing and installation of conduits and fittings for electrical wiring.

1.3 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design.
- B. Regulatory Agencies Requirements:
 - 1. ACI – American Concrete Institute: Standards pertaining to conduits embedded in concrete (Section 6.3 in ACI 318 – Building Code Requirements for Structural Concrete and Section 6.3 in ACI 350R – Environmental Engineering Concrete Structures.)
 - 2. NEMA – National Electrical Manufacturer's Association – Standards pertaining to raceways.
 - 3. NEC – National Electric Code – As applicable to construction and installation of conduit system.
 - 4. Provide conduit which is listed and labeled by Underwriters' Laboratories.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner that will prevent deterioration or damage (e.g., bending, end damage, finish scoring), contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping. Provide color coded end cap thread protectors on exposed threads of threaded metal conduit.
- D. Reject damaged, deteriorated, or contaminated material and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Rigid Metal Conduit (RMC):
 - 1. Galvanized Steel RMC: Galvanized steel, heavy wall conduit with threaded fittings, 3/4-inch trade size minimum, insulated bushings.
- B. Electrical Metallic Tubing (EMT):
 - 1. Thin wall, hot galvanized, steel tubing, 3/4-inch trade size minimum with insulated throat steel connector.
 - 2. Fittings: Steel Compression or setscrew type (die cast fittings are expressly prohibited).

- C. Rigid Nonmetallic Conduit (RNM):
 - 1. Schedule 40 (Schedule 80 for direct burial only) rigid polyvinylchloride, rated for 90 degrees C conductors, 3/4-inch trade size minimum, solvent cement connectors and couplings.
 - 2. Nonmetallic strap hangers allowing thermal expansion movement.
 - 3. Conduit to meet NEMA TC-2; fittings to meet NEMA TC-3.
 - 4. Expansion Coupling: Nonmetallic to compensate for thermal expansion.
- D. Flexible Metal Conduit (FMC): 3/4-inch trade size minimum with galvanized steel flexible conduit insulated throat steel connectors.
- E. Liquid Tight Flexible Metal Conduit (LTFMC): 3/4-inch trade size minimum. Flexible conduit with flexible, moisture-proof PVC jacket and liquid tight connectors.
- F. Seal-off Fittings:
 - 1. Malleable iron with zinc electroplated finish.
 - 2. Threaded for connection of RMC or IMC.
 - 3. Provide sealing compound and fiber as required.
- G. Joint Compound for RMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.
- H. Conduit Hubs for RMC:
 - 1. Suitable for environment served.
 - 2. Grounding screw.
 - 3. O-ring gasket.
 - 4. Material: Malleable Iron with zinc electroplate.
 - 5. Manufacturer:
 - a. Cooper Myers Hubs.
 - b. Thomas & Betts.
 - c. Killark.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Unless otherwise specified or indicated on the Drawings, conceal conduit to the extent possible.
 - 1. In finished areas where conduit cannot physically be concealed due to existing conditions, surface mount conduit. Finished areas are generally, but not always: above grade, heated spaces with finished walls (e.g., painted, drywall, etc.), finished floors (e.g., painted concrete, carpet, tile, etc.), and finished ceilings (e.g., drywall, suspended ceiling grids, wood, etc.).
- B. Exposed conduit permitted in:
 - 1. Tunnels.
 - 2. Main electric and service equipment rooms.
 - 3. Rooms without finished ceilings (overhead only).
 - 4. Unfinished rooms.
- C. Install conduit products in accordance with:
 - 1. The Drawings.
 - 2. The Manufacturer's written instructions.
 - 3. Applicable requirements of NEC and National Electrical Contractors Association's "Standard of Installation."
 - 4. Recognized industry practices to ensure that products serve intended function.
- D. Conduit Joints: Cut square, reamed smooth and drawn up tight.
- E. Threaded Conduit Joints: Apply listed anti-corrosion/anti-seize compound to threads of raceway and fittings before making up joint. Follow compound manufacturer's written instructions.

- F. Bends:
1. Number per run for conduit that support feeder and branch circuits: Do not exceed the equivalent of 4 quarter bends (360 degrees) between pull points.
 2. Number per run for conduit that supports data/communications cabling: Do not exceed the equivalent of 2 quarter bends (180 degrees) between pull points.
 3. Make bends and offsets so as not to reduce the inner diameter of the conduit.
 4. To the extent possible, avoid using large junction boxes as 90 degree junctions.
- G. Routing:
1. Concealed Conduits: Run in a direct line with long sweep bends and offsets.
 2. Exposed Conduits: Run parallel to, and at right angles to, building lines.
 3. Run continuous from outlet to outlet and from outlets to cabinets, pull or junction boxes.
 4. Secure to boxes and cabinets with locknuts and bushings in such a manner that each system is electrically continuous throughout.
- H. Cap conduit ends to prevent entrance of foreign materials during construction.
- I. Provide insulated bushings on threaded conduit run terminations. Where entering the bottom of open-bottom switchboards, motor control centers, transformers, primary switches, and similar equipment provide bonding bushings and bonding jumpers.
- J. Conduit entering control panels shall not obstruct internal components and shall allow for neat and workmanlike wire management.
- K. Completely install conduit systems before installing conductors.
- L. Refer to Division 26 Section "Common Work Results for Electrical" for sealing underground and above grade conduit that is exposed to temperature differences to prevent the passage of air and condensation.
- M. Support:
1. Where information on Drawings conflicts with information herein, the more stringent requirements shall take precedence and the better quality or greater quantity of work shall be provided.
 2. Adequately support conduit from structural elements of the building.
 3. Do not drill or tap structural building steel without approval from Engineer.
 4. Do not rest raceways or wiring systems on, nor support it from, ceiling suspension systems, ceiling tiles or mechanical equipment including, but not necessarily limited to ductwork and fans.
 5. Conduit shall be supported in accordance with the NEC and Division 26 Section "Hangers and Supports for Electrical Systems".
- N. Provide conduit expansion couplings where conduits cross building or structure expansion joints.
- O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200 pound (90 kg) tensile strength. Label and leave at least 12 inches of slack at each end of pull wire.
- P. FMC and LTFMC Installation:
1. Provide separate grounding conductor in accordance with Division 26 Section "Grounding and Bonding."
 2. Connection to light fixtures shall not exceed 6 feet in length within an accessible ceiling and 3 feet in length where exposed. Connection to solenoids, pressure switches, motors, fans, HVAC equipment, and similar equipment shall not exceed 3 feet in length.
- Q. Rigid Nonmetallic Conduit Installation:
1. Provide separate grounding conductor in accordance with Division 26 Section "Grounding and Bonding."
 2. Support conduit in accordance with the NEC.
 3. Provide expansion couplings where length change due to temperature variation exceeds 1/4-inch.
 4. When penetrating concrete surfaces or grade, make a transition to rigid steel conduit, sweep elbow before turning for exposed installation or maintain PVC where under equipment like a switchboard or transformer. Provide corrosion protection by coating the RMC with a bituminous coating from inside the encasing material to 4 inches of exposed conduit; vinyl corrosion protection tape may be installed, but must be reviewed with the Engineer prior to installation.

5. Where RNMC is embedded in concrete, conduit shall be securely fastened and supported in accordance with the NEC to prevent damage during concrete pours.
- R. Firestopping: Firestop all conduit penetrations of fire rated barriers by using approved material to ensure integrity of the rating.
- S. Underground Installation:
1. As indicated on the Drawings, including the excavating, pumping, backfilling, shoring and removal of surplus excavated material.
 2. Underground Obstructions:
 - a. Locate all that may interfere with excavation.
 - b. Be responsible for damage to existing underground systems and assume all cost of repairing the same.
 3. Backfilling:
 - a. Use only clean sand thoroughly compacted to prevent settling of trenched areas.
 - b. In the event that backfilled areas do settle, fill and compact to finish grade, and repair all damage caused by settling.
 4. Repair all disturbed surface to match existing.
 5. Unless otherwise indicated on the Drawings, install top of conduit 30 inches below grade when located outside the walls of the building
 6. Provide warning ribbon 12 inches above conduits.
- T. Embedment in Concrete:
1. Where conduit is embedded in concrete, follow the requirements of Section 6.3 in ACI 318 – Building Code Requirements for Structural Concrete and Section 6.3 in ACI 350R – Environmental Engineering Concrete Structures.
 2. Embedded conduit shall be installed between top and bottom reinforcement, in a manner that prevents concrete from entering the conduit system.

3.2 CONDUIT SCHEDULE

- A. Where information on Drawings conflict with information herein, the more stringent requirements take precedence and the better quality or greater quantity of work shall be provided.
- B. Feeders and Branch Circuits:
1. Underground and In or Below Concrete: RMC, RNMC.
 2. Above Slab or Grade:
 - a. Exposed Conduit Below 8'-0" AFF: RMC.
 - b. Exposed Conduit Above 8'-0" AFF: EMT or RMC. Where conduit enters into top of equipment at 6-feet – 0-inches AFF or above, conduit may be EMT.
 - c. Concealed Above Ceiling: EMT.
 - d. Wet Locations: RMC.
 3. Underground Duct Banks:
 - a. Encased In Concrete: RNMC (Schedule 40).
 - b. Direct Buried: RNMC (Schedule 80).
- C. Data/communications conduits in dry locations not subject to physical damage and not installed underground nor in or below concrete: EMT.
1. Data/communication conduits shall be bonded.
 2. Data/communication sleeves, provide plastic bushings.
 3. Data/communication conduits shall be 3/4-inch minimum.
- D. Connection To Equipment:
1. Lighting Fixtures and Control Devices (including, but not necessarily limited to solenoids, pressure switches, and field instruments):
 - a. Dry Locations: FMC.
 - b. Wet or Damp Locations: LTFMC.

2. Vibrating Equipment (including, but not necessarily limited to transformers):
 - a. Transformers:
 - 1) Dry Locations: FMC.
 - 2) Wet or Damp Locations: LTFMC.
 - b. Equipment Mounted On Vibration Isolators:
 - 1) Dry Locations: FMC.
 - 2) Wet or Damp Locations: LTFMC.

- E. Provide separate raceway systems for:
 1. Normal power wiring.
 2. Emergency power wiring.
 3. Data/communication wiring.
 4. Fire alarm system wiring.
 5. A.C. signal and control wiring.
 6. Low voltage signal and control wiring.

- F. Do not utilize panelboards, distribution equipment or like devices as raceways.

- G. For conduits that enter NEMA Type 2, 3, 3R, 4, 4X, and 12 enclosures, provide conduit hubs with o-ring gaskets. Hubs shall be suitable for the environment served and shall match the conduit type. Grounding hubs shall be used with nonmetallic enclosures.

END OF SECTION 26 05 34

SECTION 26 05 35 – 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. This Section includes the furnishing and installation of all electrical boxes and the major items listed below:
 - 1. Junction boxes.
 - 2. Pull boxes.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. NEMA - National Electrical Manufacturer's Association: Standards as applicable to nonmetallic fittings for underground installation.
 - 2. NECA - National Electrical Contractor's Association's: Applicable portions of "Standard of Installation".

1.4 QUALITY ASSURANCE

- A. Fabrication and Installation Personnel Qualifications:
 - 1. Trained and experienced in the fabrication and installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed submittals.
- B. Regulatory Agencies Requirements:
 - 1. Provide boxes which are listed and labeled by Underwriters' Laboratories.
 - 2. NEC - National Electrical Code (NFPA 70) - As applicable to construction and installation of electrical boxes.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.
- D. Reject damaged, deteriorated, or contaminated materials and immediately remove from the Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Junction and Pull Boxes: Sheet steel junction and pull boxes, with screw-on covers; of the type and shape and size to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws, and washers. Dry interior location boxes shall have baked enamel finish. Damp location and exterior boxes shall have galvanized finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install electrical boxes as indicated, in compliance with NEC requirements and in accordance with the Manufacturer's written instructions and recognized industry practices to ensure that the boxes and fittings serve the intended purposes.
2. Provide weatherproof boxes for interior and exterior locations exposed to weather or moisture.
3. Provide knockout closures to cap unused knockout holes where blanks have been removed.
4. Locate boxes and conduit bodies so as to ensure accessibility of electrical wiring.
5. Secure boxes rigidly to the substrate upon which they are being mounted.
6. Locate pull boxes and junction boxes above accessible ceilings or in electrical rooms, utility rooms or storage areas such that boxes will be accessible.
7. All boxes shall have covers installed at completion of construction.
8. Locate pull boxes and junction boxes above removable ceilings or in electrical rooms, utility rooms, or storage areas such that boxes will be accessible after completion of building.

END OF SECTION 26 05 35

SECTION 26 05 43 – UNDERGROUND DUCTS AND RACEWAYS 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. This Section includes the furnishing and installation of the major items listed below for conduit duct banks:
 - 1. Handholes.
 - 2. Duct banks, concrete encased and non-concrete encased.

1.3 SUBMITTALS

- A. Shop Drawings: For vault.
 - 1. Name of Manufacturer.
 - 2. Model number.
 - 3. Details of construction and installation.
 - 4. Assembly drawings, including elevations, plans, sections, dimensions, and weight.
 - 5. Bill of materials.
 - 6. Options and accessories.
- B. Layout Drawings: For handhole and duct banks. Plans shall be to scale and identify invert elevations where duct banks enter handholes and buildings.

1.4 QUALITY ASSURANCE

- A. General: All concrete work including precast shall meet ACI Standards.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver all materials in original, unbroken, brand marked containers or wrapping as applicable.
- B. Handle and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- C. Store materials indoors and protect from weather. When necessary to store outdoors, elevate materials above grade and enclose with durable, watertight wrapping.
- D. Reject damaged, deteriorated, or contaminated material, and immediately remove from Site. Replace rejected materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Conduit: As specified in Division 26 Section "Raceways for Electrical Systems."

2.2 MATERIALS

- A. Nonmetallic Pull Boxes and Handholes:
 - 1. Quazite - Hubbell Power Systems.
 - 2. Oldcastle Precast Inc.
 - 3. MacLean Highline Products.

- B. Concrete: In accordance with Division 03 Section "Cast-in-Place Concrete."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Underground Duct Banks:

1. Where underground conduits terminate at buildings or tunnels, provide mechanical link seal inside and outside to seal and make watertight all conduit penetrations into buildings.
2. Concrete Encased Duct Banks:
 - a. Install top of duct banks a minimum of 24-inches below finished grade with metallic warning tape 12-inches above concrete encasement.
 - b. Stagger conduit joints in concrete encasement at 6-inches minimum.
 - c. Securely anchor conduit to prevent movement during concrete placement.
 - d. Provide No. 4 steel reinforcing bars in each corner of duct bank for full length of run. Steel shall comply with ASTM A615 with steel yield stress of 60,000 psi. Where ducts are spaced four or more wide, add additional rebar as needed for proper support.
 - e. Provide minimum 3-inch concrete cover at bottom, top, and sides of duct bank.
 - f. Provide 3,000 psi concrete.
 - g. Use plastic base and intermediate duct spacers by Ipex Electrical, Inc. or equal to provide minimum 3-inch conduit separation. Install no more than 6-foot on center.
 - h. Mark all underground duct runs with both of the following methods:
 - 1) Concrete to have red dye placed on top of concrete and worked in while concrete is still wet. Concrete colored red throughout is acceptable.
 - 2) 6-inch to 12-inch wide red traceable tape labeled "DANGER UNDERGROUND ELECTRIC" and centered continuously 12-inches above entire duct bank.
 - i. Duct run shall be covered only after inspection and approval by the Owners Representative and the State Code Official.
 - j. For terminating ducts at manholes:
 - 1) Duct conduits to be Schedule 40 PVC entering manholes with end bells.
 - 2) Where entering through knock-out panels (windows): Extend duct bank concrete through foundation walls and manhole openings so that the envelope encloses the window and ducts flush with end bells.
 - 3) Where entering through cored holes: install #4 rebar dowels (minimum of 4) into the manhole or building wall and tie to rebar runs in duct bank. Seal watertight around ducts with link seal and hydraulic cement.
 - k. Place duct plugs in ends of all spare conduits.
 - l. Ducts shall cross under gas piping without exception.
 - m. Provide a 4/0 bare copper ground wire encased within concrete extended into manholes, switch vaults, and buildings and exothermically welded to ground rods or bolted to bus bars as required for the application.
 - n. Install no more than three (3) 90° bends between pull points.
 - o. In duct runs greater than 200 feet, use long sweeping elbows.
3. Duct Banks Not Encased in Concrete:
 - a. Install top of duct banks minimum 24-inches below finished grade with metallic warning tape 12-inches above conduits.
 - b. Use Schedule 80 PVC.
4. Install conduit with minimum gradient of 4-inches per 100 feet. Slope duct banks away from buildings to prevent drainage into the building.
5. Terminate conduits in end bells at vault, manhole and handhole entries. Seal and make watertight around all conduit entries into manholes, handholes, and pull boxes.
 - a. Securely anchor conduit to prevent movement during backfill placement.
 - b. Provide clean sand backfill.
6. Where duct bank passes beneath footings or slabs resting on grade, excavate to provide a minimum of 6-inch clearance between the conduits and the structure. Backfill to the base of the structure with concrete.
7. Repair all disturbed surfaces to match original condition.
8. For spare ducts, provide a No. 10 TW copper pull wire or a 200-pound nylon test pull string in duct tied to plastic duct plugs.

- B. Nonmetallic Pull Boxes:
 - 1. Size in accordance with NEC for conduits entering.
 - 2. Constructed of fiberglass reinforced polymer, rated for the environment they are installed in. (i.e., road ways, parking lots, green spaces, etc.
 - 3. With heavy duty bolt down cover with lettering cast in top to identify conduit system served (i.e., ELECTRICAL, COMMUNICATIONS, TELEPHONE).
 - 4. With conduit terminations sealed to prevent leakage around conduits.

- C. Concrete: In accordance with Division 03 Sections "Cast-in-Place Concrete."

END OF SECTION 26 05 43

SECTION 26 05 53 – 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. This Section includes the furnishing and installation of proper identification for electrical system components.
- B. Items requiring identification or labeling include:
 - 1. Cables and conductors.
 - 2. Distribution Equipment:
 - a. Disconnect switches.
 - b. Switchboards.
 - c. Transformers.
 - 3. High voltage equipment.

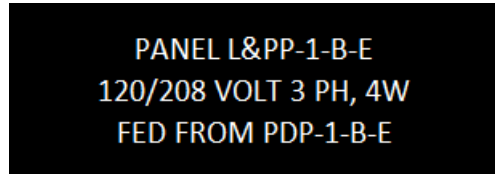
PART 2 - PRODUCTS

2.1 ELECTRICAL LABELS

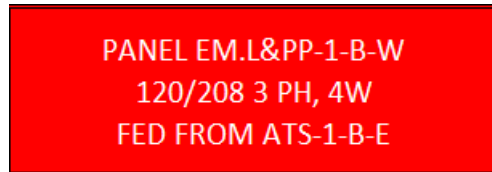
- A. Phenolic engraved nameplates shall have double-faced tape attached to the back and shall include (2) 1/8" holes for tap-in type rivets, where applicable.
- B. Abbreviation Designations for Electrical Equipment Identification:
 - 1. Main Switchboard = MSWBRD
 - 2. Main Distribution Panel = MDP
 - 3. Power Distribution Panel = PDP
 - 4. Lighting & Power Panels = L&PP (typically 120/208 Volts; feeding lighting & receptacle loads)
 - 5. Lighting Panels = LP (typically 277/480 Volts; feeding lighting only)
 - 6. Power Panels = PP (could be either voltage; feeding equipment, receptacles, loads, etc.)
- C. For Emergency Feeds:
 - 1. Add an "EM." prefix to any panel that has a Generator back-up power source and is serving Life Safety loads.
- D. For Standby Emergency Feeds:
 - 1. Add an "EM.STB." (Standby) prefix to any panel that has a Generator back-up power source but is not serving Life Safety loads.
- E. Electrical Equipment Identification Formats:
 - 1. Equipment-Number-Floor Level-Location (North, South, East, West, or Central)
 - a. Examples:
 - MDP-2-B-C (Main Distribution Panel-#2-Baement-Central)
 - PDP-1-1-E (Power Distribution #1-First Floor-East)
 - L&PP-2-4-S (Lighting & Power Panel-#2-Attic-South)
 - EM.L&PP-1-1-W (Emergency Lighting & Power Panel-#1-First Floor-West)
 - EM.STB.PP-2-A-C (Emergency Standby Power Panel-#2-Attic-Central)
 - TR.PP-3-B-W (Transformer feeding Power Panel-#3-Basement-West)

F. Layout Formats:

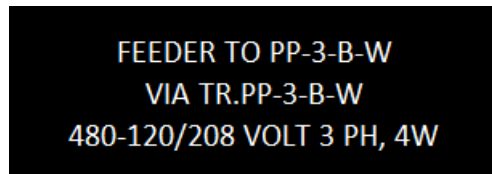
1. Normal Power-Electrical Equipment and Panelboard Tags:
 - a. Tag shall be 1-inch x 4-inch is size.
 - b. Black background with White lettering.
 - c. Text size to be 3/16-inch tall.
 - d. Tag to have three lines of text. See example below:



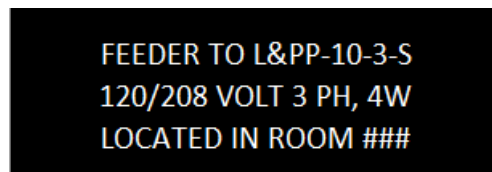
2. Emergency Power-Electrical Equipment and Panelboard Tags:
 - a. Same format as Normal power except Red Background with White Lettering.
 - b. See example below:



3. Stepdown Transformer, feeders using a transformer stepping down from 480 Volt to 120/208 Volts.
 - a. Same format as Normal Power.
 - b. See example below:



4. At the MSWBRD, MDP, PDP, etc.:
 - a. Same format as Normal Power.
 - b. Install tag next to the feeder breaker serving a panelboard.
 - c. See example below:



G. Medium Voltage Cable Tags:

1. Tag shall be no smaller than 3 inches x 6 inches. Size may vary due to text required.
2. White background with Bold Black letters.
3. MV cable tags do not require double face tape.
4. Text to be 3/8-inch tall.
5. Provide holes in all four corners to affix tags to cables with weatherproof nylon tie wraps.
6. Information required on tag:
 - a. Circuit feeder Identification
 - b. Voltage
 - c. Year cable was installed
 - d. Cable quantity
 - e. Cable size

- f. Cable type
 - g. Ground wire size
 - h. Ground wire type
 - i. Identify on tag if cable is Abandoned
7. Coordinate tag information closely with the Electrical Systems Operation Manager at 513-529-8036 and the MU Project Manager.
- H. Wiring Devices and Covers – Circuit Identification:
- 1. Label to be self-adhesive durable printed label. Clear background with 1/4-inch black lettering. To be installed on top front face of the cover.
 - 2. Label shall have panel designation and circuit number listed.
 - a. Example: L&PP-2-1-N - 18 (Panel L&PP-2-1-N – Circuit #18)
- I. Provide engraved laminated plastic nameplate to identify each piece of electrical equipment:
- 1. Nameplate shall have 3/8-inch minimum black letters on a white background.
 - 2. Punched or drilled for mechanical fasteners.
- J. Provide printed labels by Brady or T&B to identify conductors.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
- 1. Attach nameplates directly to each piece of electrical equipment.
 - 2. Where several conductors pass through a pull box, junction box, or enclosure, provide wire labels. Group wires before labeling.
- B. Cables and Conductors: In accordance with Division 26 Section “Conductors and Cables – 600V and Below.”
- C. Distribution Equipment: For each of the following types of distribution equipment, provide label attached to enclosure cover.
- 1. Disconnect Switches.
 - 2. Switchboards: Provide label near each feeder/branch breaker identifying name of equipment served, number of poles, and circuit breaker size (example, “L&PD-1-B-E”).
 - 3. Transformers.
- D. Circuits with More Than 600 V: Identify raceway, junction boxes, and cable with “12,470 Volts” in black letters 1-inch high over an orange background at 10-foot intervals. Use of plastic self-adhesive is allowed when approved by Engineer.

END OF SECTION 26 05 53

SECTION 26 08 13 – ELECTRICAL TESTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes electrical testing.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. NFPA 70 – National Electrical Code.
 - 2. NFPA 70E – Standard for Electrical Safety in the Workplace.
 - 3. InterNational Electrical Testing Association (NETA) – Standard for Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems, ANSI/NETA ATS-(Latest Edition).
 - 4. IEEE - Institute of Electrical and Electronics Engineers.

1.4 SUBMITTALS

- A. Within 30 days after Notice to Proceed, submit certification of the qualifications of the Electrical Testing Firm (ETF).
- B. Within 30 days after Notice to Proceed, submit a complete project-specific list (based on project-specific nomenclature), of all equipment to be tested and the descriptions of the tests to be performed, for approval.
- C. For items to be tested, a test report shall be generated for each piece of electrical equipment, device, installation and system as indicated in the Specifications and shall include the following:
 - 1. Check list of visual and mechanical inspections.
 - 2. Check list of electrical tests performed.
 - 3. Test reports, including test values where applicable, for all required electrical tests.
 - 4. Obvious indication on the first page of the test report, where test results fall outside of the limits of recommended values.
 - 5. Summary and interpretation of test results.
 - a. Describe the problem in detail.
 - b. Offer suggestions for correction or potential solution.
 - 6. Signed and dated by the testing firm stating that all required tests have been completed.
- D. Test reports shall be furnished to the Engineer within 14 days of completion of each test on an ongoing basis for approval. Final copies of the approved reports shall be included in the Contractor's Operation and Maintenance (O&M) Manual.
- E. Submit a final report of testing and inspection at the completion of the project. Include the following:
 - 1. Summary of the project.
 - 2. Description of the equipment tested (based on project-specific nomenclature for all applicable equipment).
 - 3. Visual and mechanical inspection report for each piece of equipment.
 - a. Report shall include a clear statement or verbiage that all visual and mechanical inspections have been performed in accordance with the NETA guidelines for all equipment and or items listed in the approved Submittal of a project specific list indicated in paragraph 1.4 B.
 - 4. Description of the NETA required electrical tests.
 - 5. Test results as described in the latest edition of NETA.
 - a. Include a pass or fail grade as compared to the reference tables provided in ANSI/NETA ATS-(Latest Edition) and industry standards for all individual tests.

- b. Report shall include all test results. This includes all failed tests and retests.
- c. Infrared report shall include all pictures taken of all equipment, not just equipment with issues. If issues are found, the report shall include a picture of the issue and a picture after the problem has been resolved.
- 6. Conclusions and recommendations.
- 7. Appendix including appropriate test forms.
- 8. Identification of the test equipment used, including model number, and calibration date.
- 9. Signature of test engineer.

1.5 QUALITY ASSURANCE

- A. The ETF shall be a corporately and financially independent NETA certified testing organization or the installing contractor as noted next to each section of INSPECTION TESTS AND PROCEDURES.
- B. The ETF shall function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm unless the ETF indicated above allows the installing contractor to perform the testing.
- C. The ETF shall be regularly engaged for minimum of 5 years in testing of electrical materials, devices, electrical installations, and systems for purpose of preventing injury to persons or damage to property and other equipment
- D. The ETF shall have successfully completed not less than 5 acceptance testing, inspection and calibration projects of similar scope to this Project.
- E. The ETF shall meet OSHA criteria for accreditation of testing laboratories, 29 CFR Parts 1907, 1910, and 1936, or be a Full Member company of NETA (unless paragraph 1.5 A allows the installing contractor to perform the testing).
- F. The ETF lead, on-site, technical person shall be currently certified by NETA or National Institute for Certification in Engineering Technologies (NICET) in electrical power distribution system testing, unless paragraph 1.5 A allows the installing contractor to perform the testing.
- G. The ETF shall only utilize engineers and technicians who are regularly employed by the firm for testing services.
- H. The ETF shall have a calibration program to maintain applicable test instrumentation within rated accuracy. Accuracy shall be traceable to National Institute of Standards and Technology (NIST) in an unbroken chain. Instruments shall be calibrated as follows:
 - 1. Field Instruments: 6 months maximum.
 - 2. Laboratory Instruments: 12 months maximum.
 - 3. Specialty Leased Equipment: 12 months maximum.
 - 4. Dated calibration labels shall be visible on test equipment.
- I. Submit certification of the above qualifications; refer to the SUBMITTALS Paragraph of this Section.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 VISUAL INSPECTIONS

- A. The ETF shall perform all visual and mechanical inspections in accordance with ANSI/NETA ATS-(Latest Edition) "Testing and Test Procedures" chapters in addition to the list below for all applicable electrical equipment to be installed at the Site.

- B. The ETF prior to testing, shall perform the following visual and mechanical inspections (in addition to the NETA requirements listed above):
 - 1. The equipment is installed in accordance with manufacturer's installation instructions and the current National Electrical Code (NEC).
 - 2. The equipment is installed completely and properly.
 - 3. The equipment is free from damage and defects.
 - 4. Shipping blocks and restraints have been removed.
 - 5. Electrical terminations have been properly torqued to manufacturer's recommendations and torque marks applied.
 - 6. The equipment has been properly aligned.
 - 7. The equipment has been properly lubricated.
 - 8. The ventilation louvers are open and unobstructed.
 - 9. The equipment is ready to be tested.

3.2 TEST PROCEDURES

- A. Many electrical tests will need to be performed prior to making terminations and connections and ahead of system start-up. The electrical contractor is required to coordinate this work with all parties involved to avoid delays in construction or obtaining permanent power.
- B. The ETF shall perform all test procedures on-site, no exceptions allowed. It will not be acceptable to remove equipment or components and ship items off-site to be tested then ship items back to the site to be reinstalled.
- C. All disassembly and reassembly of equipment for testing purposes shall be performed or witnessed by the approved testing agency.
- D. The ETF shall perform test procedures in accordance ANSI/NETA ATS-(Latest Edition) "Inspection and Test Procedures" chapters (see list below; not all may be applicable for this project) for all applicable electrical equipment to be installed at the Site.
 - 1. 7. INSPECTION AND TEST PROCEDURES.
 - a. 7.3.3 Cables, Medium- and High-Voltage. Test all medium voltage cables using VLF and Tan Delta testing.
 - b. 7.6.1.1 Circuit Breakers, Air, Insulated-Case/Molded-Case. Test main circuit breakers on existing equipment.
 - c. 7.6.1.2 Circuit Breakers, Air, Low-Voltage Power. Test main circuit breakers on existing equipment.
 - d. 7.6.4 Circuit Breakers, SF6.
 - e. 7.13 Grounding Systems.

3.3 CORRECTION ACTION

- A. Equipment that fails a test shall be repaired or replaced as needed and retested. Both the failed test and the passing test shall be submitted for approval and included in the contractors O&M Manual. For failed test, add note to refer to follow-up test.

END OF SECTION 26 08 13

SECTION 26 12 19 – PADMOUNTED, LIQUID-FILLED, MEDIUM VOLTAGE TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the receipt, off loading, and installation of Miami purchased new 3-phase and 1-phase, liquid-filled padmount transformer for outdoor application.

1.3 REFERENCES

- A. Except as herein specified or as indicated on the Drawings, the work of this Section shall comply with the following:
 - 1. ANSI:
 - a. C57.12.00 - General Requirements for Liquid-Immersed Distribution, Power and Regulatory Transformers.
 - b. C57.12.21 – Padmounted Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with High-Voltage Bushings; High-Voltage 34500 Gr YD/18829 Volts and Below; Low-Voltage 240/120 Volts; 167 kVA and smaller.
 - c. C57.12.22 - Padmounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers with High-Voltage Bushings (High-Voltage, 34500 Grd Y/19920 Volts and Below), 2500 kVA and Smaller.
 - d. C57.12.26 - Padmounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage 34500 Grd Y/19920 Volts and Below; 2500 kVA and Smaller.
 - e. C57.12.28 - Padmounted Equipment - enclosure integrity.

1.4 QUALITY ASSURANCE

- A. Installation Personnel Qualifications:
 - 1. Trained and experienced in the installation of the materials and equipment.
 - 2. Knowledgeable of the design and the reviewed submittals.

1.5 RECEIPT, DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store materials in a manner which will prevent deterioration or damage, contamination with foreign matter, damage by weather or elements, and in accordance with Manufacturer's directions.
- B. Store materials and protect from weather. When stored outdoors, elevate materials above grade and enclose with durable, watertight wrapping.
- C. Lift equipment only via lifting lugs provided for that purpose.
- D. Avoid mechanical shock of any kind which would damage enclosure or equipment.
- E. Replace materials damaged after receipt and immediately remove from the Site. Replace damaged materials with new materials at no additional cost to Owner.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Rating: Verify proper ratings of transformers upon arrival at Site. Coordinate with Miami to ensure compatibility with available power.

3.2 INSTALLATION:

- A. Concrete Pads: Set padmount transformers on concrete pads. Provide openings in pads filled with crushed stone, for passage of conduits.
- B. Connections:
 - 1. Connect surge arresters to primary and to ground.
 - 2. All secondary connections shall be with conductors connected in parallel, with lugs at the spade terminals of size and quantity as required for the secondary service.
- C. Grounding:
 - 1. Provide a ground rod grid around all transformer pads in accordance with Division 26 Section "Grounding and Bonding."
 - 2. Extend a ground lead into each transformer terminal compartment, and bond to neutral, housing and surge arrester.
- D. Coordination: Coordinate all work with Miami and take voltage readings in combination with them.
- E. Literature and Keys: Turn over to the Owner all keys and obtain signed receipts.

3.3 ADJUSTING

- A. Adjust the transformer taps to allow for the proper voltage at the service entrance [switchgear]. Set at no load, and check after the load has been connected. Readjust at that time as required.

3.4 CLEANING

- A. Clean interior and exterior of transformers and leave them free of dust and particles that accumulate during construction, prior to energizing.

END OF SECTION 26 12 19

SECTION 26 13 21 – MEDIUM VOLTAGE SWITCHGEAR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the connection to a recently installed pad mounted medium voltage switchgear.

1.3 REFERENCES

- A. Except as herein specified, or as indicated on the Drawings, the work of this Section shall comply with the following:
 1. ANSI C57.12.28.
 2. ASTM Standards: G53 - Practice for Operating Light-and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials.
 3. InterNational Electrical Testing Association (NETA) or a nationally recognized testing laboratory (NRTL).
 4. NEC Article 490.
 5. NEMA (National Electrical Manufacturers Association) Standards.

1.4 QUALITY ASSURANCE

- A. Installation Personnel Qualifications:
 1. Trained and experienced in the installation of the materials and equipment.
 2. Knowledgeable of the design intent.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Where indicated, in accordance with the equipment Manufacturer's written instructions and recognized industry practices, to ensure that equipment complies with the requirements and serves the intended purposes.
- B. Connections: Connect new and existing cables.
- C. Grounding: Connect to existing conduit and switchgear grounding system.

3.2 FIELD QUALITY CONTROL

- A. Independent Testing Agency: Engage a qualified independent testing agency to perform tests and inspections and prepare test reports. Agency shall be a member of InterNational Electrical Testing Association (NETA) or be a nationally recognized testing laboratory (NRTL).
 1. Schedule the following:
 - a. As soon as practicable after installation. Schedule shall be coordinated with related Work.
 - b. At times approved by Owner.
 2. Independent Testing Agency:
 - a. Check work.
 - b. Provide startup services as recommended by Manufacturer, including all items listed in commissioning, acceptance testing, and startup procedures, instructions, and guidelines.

- c. Assist with testing.
- d. Demonstrate operation and maintenance of equipment to Owner's personnel.
- 3. Promptly make all changes and additions required by Manufacturer's representative.

B. Field Performance:

- 1. Performance Testing (to be performed by Independent Testing Agency):
 - a. All test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Calibration records shall be available for examination upon request.
 - b. Perform visual, mechanical, and electrical inspections and testing for medium voltage padmount switchgear as specified in the latest edition of NETA Acceptance Testing Specification (ATS). Certify compliance with test parameters.

3.3 CLEANING

- A. Cleaning: Clean interior and exterior of medium voltage switchgear and leave free of dust and particles that accumulated during construction prior to turning system over to Owner.

END OF SECTION 26 13 21

SECTION 32 01 90 – OPERATIONS AND MAINTENANCE OF PLANTING

PART 1 - GENERAL

1.1 SCOPE

- A. Site Protection: protect existing grounds, plants, lawns and vegetation to remain.
- B. Contractor is responsible for all damage to plants to remain. Cost for tree replacement shall be determined in accordance with the "Guide for Plant Appraisal" by the Council of Tree and Landscape Appraisers (International Society of Agriculture, Publication #P1209).

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Sodding Fertilizer shall be granular and non-burning type, composed of not less than 50% organic slow acting, guaranteed analysis professional fertilizer.
 - 1. Type A: Starter Fertilizer: Containing 20% nitrogen, 26% phosphoric acid, and 6% potash by weight, or similar approved composition.
 - 2. Type B: Secondary Fertilizer: Containing 31% nitrogen, 3% phosphoric acid, and 10% potash by weight, or similar approved composition.
- B. Water: Free of substances harmful to turf growth.

PART 3 - EXECUTION

3.1 EXECUTION

- A. Apply Type A (starter fertilizer) to turf areas indicated at a rate equal to 1.0 lb. of actual nitrogen per 1,000 sq. ft. or as directed by University.
 - 1. Apply fertilizers by mechanical drop or rotary distributor, thoroughly and evenly incorporated with soil to a depth of 3-inches by dicing or other approved method. Fertilize areas inaccessible to power equipment with hand tools and incorporate into soil.
- B. Apply Type B (secondary fertilizer) to lawns approximately 30 days after installation at a rate equal to 1.0 lb. of actual nitrogen per 1,000 sq. ft.
 - 1. Apply with mechanical drop or rotary type distributor. Water the fertilizer thoroughly into the soil.
- C. Maintenance
 - 1. Review required maintenance on a per-project basis with University. Provide noted maintenance below as basis of design and standard policy.
 - 2. Watering
 - a. Review required watering on a per-project basis with University.
 - b. Water seeded areas daily to maintain adequate surface soil moisture for proper seed germination. Continue daily watering for not less than 30 days. Thereafter apply 1/2-inch water every two or three days until accepted.
 - c. Water trees and vegetation to remain with 1-inch of rain (rain gauge or NOAA local weather verified) per week for duration of construction project.
 - d. Hoses and other lawn watering equipment, as required, shall be furnished by Contractor.
 - 3. Mowing: Set mower blades at a minimum height of 2-1/2 inches. Not more than 30% of the grass leaf/blade shall be removed at the initial or subsequent mowing. Mow all lawns before turf reaches a height of 4 inches.
 - 4. Weeding: If infestation of weeds or crabgrass develops, treat infestation by hand weeding or herbicidal control. Furnish and install weed chemical control as recommended by manufacturer. Herbicidal controls, including renovation before seeding operations, shall be acceptable to the University.

D. Site Protection:

1. Trees: Protect existing trees to remain in place against unnecessary cutting, breaking, skinning, or bruising of roots and bark, smothering of trees by compaction or stockpiling construction materials or excavated materials within 5 ft. of outer edge of drip line/crown.
 - a. Erect minimum of 4 ft. high fence at 5 ft. outside of drip line of the trees to remain.
 - b. Erect tree protection before starting site work of any kind. Maintain fencing during construction period.
 - c. Interfering branches may only be removed with prior consent from University.
 - d. Identify any trees the University would like vertically mulched, trimmed or repaired as result of construction impact at end of project. All work shall be done by a certified arborist and shall be approved by University. (Carry an allowance for arborist if job is of size and scope to dictate.)
2. Water trees and vegetation to remain with 1-inch of rain (using rain gage or NOAA local weather verified) per week for duration of construction project.
3. If traffic must go over existing tree drip line/crown (avoid this condition as much as possible), place 3/4-inch plywood at drip line/crown for all vehicular crossings and hardwood mulch at all pedestrian crossings.

END OF SECTION 32 01 90

SECTION 32 12 16 – ASPHALT PAVING

PART 1 - SCOPE

1.1 SCOPE

- A. Hot-mix asphalt patching.
- B. Hot-mix asphalt paving.
- C. Hot-mix asphalt paving overlay.
- D. Asphalt surface treatments.
- E. Pavement-marking paint.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. All components of asphalt mix, auxiliary materials, and installation procedures shall be in compliance with the Ohio Department of Transportation Construction and Material Specifications.
- B. Mixes are to be plant-mixed and hot-laid.
- C. Auxiliary Materials:
 - 1. Herbicide:
 - a. Commercial chemical for weed control, registered by the EPA
 - 2. Joint Sealant:
 - a. Hot-applied, single-component polymer-modified bituminous sealant.
 - 3. Pavement-Marking Paint:
 - a. Color: White, Yellow, or Blue as indicated on drawings.

PART 3 - EXECUTION

3.1 EXECUTION

- A. Verify that subgrade is dry and in suitable condition to begin paving. Verify that all utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed prior to installation.
- B. Patching:
 - 1. Saw cut perimeter of patch and excavate existing pavement section to sound base.
 - 2. Remove all soft or unsatisfactory material. Recompact subgrade and any existing unbound-aggregate base course to form new subgrade.
 - 3. Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact.

END OF SECTION 32 12 16

SECTION 32 13 13 – CONCRETE PAVING

PART 1 - SCOPE

1.1 SCOPE

- A. Plant-mixed Cast-In-Place Exterior Cement Concrete for pavement for driveways, roadways, parking lots, curbs, gutters, and walkways.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Forms - Provide plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces. Treat forms with a commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
- B. Steel Reinforcement:
 - 1. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
 - 2. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.
 - 3. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A 615/A 615M, Grade 60 deformed bars.
 - 4. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M; with ASTM A 615/A 615M, Grade 60 deformed bars.
 - 5. Steel Bar Mats: ASTM A 184/A 184M; with ASTM A 615/A 615M, Grade 60, deformed bars; assembled with clips.
 - 6. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60, plain steel bars.
 - 7. Tie Bars: ASTM A 615/A 615M, Grade 60, deformed.
 - 8. Hook Bolts: ASTM A 307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
 - 9. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete, and as follows:
 - a. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 - b. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 - 10. Epoxy Repair Coating: Liquid two-part epoxy repair coating, compatible with epoxy coating on reinforcement.
 - 11. Zinc Repair Material: ASTM A 780.
- C. Concrete Materials:
 - 1. Cementitious Material: Use one of the following cementitious materials, of the same type, brand, and source throughout the Project:
 - a. Portland Cement: ASTM C 150, Type I., gray. Supplement with the following
 - 1) Fly Ash: ASTM C 618, Class F.
 - 2) G round Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 - 2. Normal-Weight Aggregates: ASTM C 33, Class 4S coarse aggregate, uniformly graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar pavement applications and service conditions using similar aggregates and cementitious materials.
 - a. Maximum Coarse-Aggregate Size: 1-inch nominal.
 - b. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 - 3. Water: Potable, ASTM C 94/C 94M
 - 4. Air-Entraining Admixture: ASTM C 260.

5. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material when steel reinforcement is called out in exterior installations.
- D. Fiber Reinforcement:
1. Synthetic Fiber: Monofilament polypropylene fibers engineered and designed for use in concrete pavement, complying with ASTM C 1116, Type III, 1/2 to 1-1/2-inches long.
- E. Curing Materials:
1. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. Dry, delivered pre-wetted and soaked.
 2. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
 3. Water: Potable.
 4. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
 5. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.
- F. Related Materials:
1. Expansion and Isolation-Joint-Filler Strips: ASTM 1752 Vinyl full depth, with joint sealant.
- G. Concrete Mixtures:
1. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.
 2. Unless noted otherwise in drawings, proportion mixtures to provide normal-weight concrete with the following properties:
 - a. Compressive Strength (28 Days): 4000 psi.
 - b. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45
 - c. Slump Limit: 3-inches, or up to 5-inches with the use of a water-reducing chemical admixture.
 3. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
 - a. Air Content: 6 percent plus or minus 1.5 percent for 1-inch nominal maximum aggregate size.
 4. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
 5. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
 - a. Use water-reducing admixture in concrete, as required, for placement and workability.
 - b. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 6. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement according to ACI 301 requirements and as follows:
 - a. Fly Ash or Pozzolan: 25 percent.
 - b. Ground Granulated Blast-Furnace Slag: 50 percent.
 - c. Combined Fly Ash or Pozzolan, and Ground Granulated Blast-Furnace Slag: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
 7. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. Yd.
- H. Concrete Mixing:
1. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.
 - a. When air temperature is between 85 degrees F and 90 degrees F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 degrees F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 EXECUTION

- A. Schedule and coordinate any traffic disruptions with the University in advance of work.
- B. Engage a qualified independent testing agency to perform material evaluation tests.

- C. Tolerances:
1. Comply with tolerances of ACI 117 and as follows:
 2. Elevation: 1/4-inch.
 3. Thickness: Plus 3/8-inch, minus 1/4-inch.
 4. Surface: Gap below 10-foot-long, unlevelled straightedge not to exceed 1/4-inch.
 5. Lateral Alignment and Spacing of Tie Bars and Dowels: 1-inch.
 6. Vertical Alignment of Tie Bars and Dowels: 1/4-inch.
 7. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2-inch.
 8. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4-inch per 12 inches.
 9. Joint Spacing: 3 inches.
 10. Contraction Joint Depth: Plus 1/4-inch, no minus.
 11. Joint Width: Plus 1/8-inch, no minus.
- D. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. Maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur

END OF SECTION 32 13 13

SECTION 32 16 00 – CURBS, GUTTERS, SIDEWALKS, AND DRIVEWAYS

PART 1 - SCOPE

1.1 SCOPE

- A. Work in this Section includes, but is not necessarily limited to, concrete paving, walkways, curbing/gutters, and related concrete improvements as shown on drawings and specified below.
- B. Shoring, including shoring for structural foundations, structures, and trenching, that is required to complete the Work, is considered a method or technique and is the sole responsibility of the Contractor. If a regulatory agency requires a licensed Engineer to design, approve, or provide drawings for shoring, then it is the sole responsibility of the Contractor to contract with a qualified Engineer for shoring design services.
- C. Provide all necessary construction means, methods, techniques, sequences and procedures, including shoring design, for coordinating and completing all portions of the Work.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Provide complete list of proposed materials for University review / approval.
- B. Cast-In-Place Concrete:
 - 1. All concrete shall be transit mixed, complying with ASTM C94.
 - 2. All concrete shall be supplied from a single source, using a single cement supplier.
 - 3. All cement shall be Portland cement, Type II, low alkali per ASTM C150, and produced within the United States.
 - 4. Product Characteristics: Paving/Flatwork: Integral Color.
 - a. Compressive Strength: 3250 psi per "Standard Specifications".
 - b. Coarse Aggregate:
 - 1) Class C, No. 4 sieve, per Standard Specification Section 200-1.4.
 - 2) Aggregate shall be non-reactive per ASTM C 289, and shall comply with ASTM C 33, Table 3, Class 4M.
 - 3) Aggregate shall be batch plant selected to provide University-approved color range.
 - c. Cement Content: 560 pounds per cubic yard of concrete.
 - d. Slump: 4 in. maximum.
 - e. See Division 03 - Concrete for additional cast-in-place concrete information.
 - 5. All concrete shall be supplied from a single source, using a single cement supplier.
 - 6. All cement shall be Portland cement, Type II, low alkali per ASTM C150, and produced within the United States.
 - 7. Standard sidewalk shall be 6-inches thick, 6 percent air entrained with 21 lb. 6 x 6 WWF mesh (no fiberglass).
 - 8. Standard service drive/fire lane shall be 9-inches thick, 6 percent air entrained with no. 4 rebar 16-inch o.c. both ways (no fiberglass).

PART 3 - EXECUTION

3.1 EXECUTION

- A. Mix Design: Prior to installing concrete paving, and after completion and acceptance of mock-ups, provide complete mix design for each approved mock-up, including batch plant source.
 - 1. Shall be prepared by batch plant supplying concrete.
 - 2. Changes in batch plant shall require complete resubmittal process.

END OF SECTION 32 16 00

SECTION 32 92 00 – TURF AND GRASSES

PART 1 - SCOPE

1.1 SCOPE

- A. Establish sodded lawn areas as identified within the University Landscape plan.
- B. Seed and straw is not an acceptable means of turf restoration unless specifically approved by the University on a case by case basis.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Sodding:
 - 1. Furnish sod machine stripped and of supplier's standard width and length; uniformly 1 inch to 1-1/2 inch thick with clean cut edges. Sod shall be relatively free of thatch, up to 1/2 inch is permissible.
 - 2. Only nursery grown, tall turf type fescue blend, suitable for job specific exposure, durability, and disease resistance, shall be used. Selection requires approval from University.
 - 3. Provide well-rooted, healthy sod, free of diseases, nematodes, and soil borne insects.
 - 4. Provide sod in uniform color, leaf, texture, density, and free of weeds, undesirable grasses, capable of growth and development when planted.
 - 5. Sod is considered free of weeds if less than 5 weeds are found per 100 sq. ft.
 - 6. Lawn seed: Trophy XRE tall turf type fescue blend, fresh, clean, new crop seed mixture.
 - 7. Mulch: Green dyed cellulose or wood fiber mulch such as Conwed Hydromulch, Weyerhaeuser Silva-Fiber or clean fresh straw.

PART 3 - EXECUTION

3.1 EXECUTION

- A. Sodding:
 - 1. Perform sodding work only after planting and other work affecting ground surface have been completed.
 - 2. Delivery, Storage, and Handling:
 - a. Cut, deliver, and install within a 24 hour period.
 - b. Do not harvest or transport sod when moisture content may adversely affect sod survival.
 - c. Protect sod from sun, wind, and dehydration prior to installation.
 - d. Do not tear, stretch, or drop sod during handling and installation.
 - 3. Sod immediately after preparation of bed.
 - 4. To enhance rooting, moisten the soil to a depth of 4 inches – 6 inches 24 hours before laying sod.
 - a. Do not lay sod on a hot, dry soil surface.
 - 5. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips. Do not overlay edges. Stagger to offset joints. Remove excess sod to avoid smothering of adjacent grass. Provide sod pad top flush with adjacent curbs, sidewalks, drains, and seeded areas.
 - 6. Do not lay, place or install dormant sod pads on saturated or frozen soil.
 - 7. Install initial row of sod in a straight line, beginning at bottom of slopes, perpendicular to direction of the sloped area. Place subsequent rows parallel to and tightly against previously installed row.
 - 8. On slopes greater than 3:1, peg sod to prevent slippage at a rate of two stakes per yd. of sod.
 - 9. Water sod thoroughly with a fine spray immediately after laying/installation.
 - 10. Roll with light lawn roller to ensure contact with sub-grade.
 - 11. Mow sod before stripping.
 - 12. Maintenance: Review watering and maintenance required on a per-project basis with University. Unless approved to do otherwise, noted requirements are listed below for maintenance and final acceptance.
 - a. Maintain newly installed sodded lawn areas in an acceptable manner until final acceptance of project, including watering, spot weeding, mowing trimming, removal of clippings, leaf removal, application of herbicides, fungicides, insecticides, and re-seeding until a full, uniform stand of grass free of weed, undesirable grass species, disease and insects is achieved and accepted by the University.

- b. Water sod daily to maintain adequate moisture for proper rooting of sod. Continue watering daily for not less than 15 days. Thereafter apply 1/2 inch of water every two or three days until accepted.
- 13. Repair, re-work, re-seed, and/or re-sod all respective areas that have washed out, are eroded, or did not catch.
- 14. Acceptance: Upon acceptance, the University shall assume lawn maintenance.
 - a. An inspection to determine acceptance of installed lawns shall be made by the University, upon Contractor's request. Provide notification at least three (3) working days before requested inspection date.
 - b. New lawn areas shall be acceptable provided all requirements, including maintenance, have been complied with, and a healthy uniform, close stand of grass is established, free of weeds, undesirable grass species, disease and insects.
 - c. No individual lawn areas shall have bare spots or unacceptable cover totaling more than 2% of the individual areas, in those areas requested for inspection.

END OF SECTION 32 92 00