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BuildingName
The Description of the Project
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SPECIFICATION DIVISION 26

NUMBER SECTION DESCRIPTION

DIVISION 26 ELECTRICAL
SECTION 260513 - MEDIUM, LOW AND CONTROL VOLTAGE CABLES

END OF CONTENTS TABLE

DIVISION 26 ELECTRICAL
SECTION 260513 - MEDIUM, LOW AND CONTROL VOLTAGE CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

INCLUDE PARAGRAPH 1.1.A AND B IN EVERY SPECIFICATION SECTION. EDIT RELATED SECTIONS 1.1.B TO MAKE IT PROJECT SPECIFIC.

A. Drawings and general provisions of the Contract, Standard General and Supplementary General Conditions, Division 01 Specification Sections, and other applicable Specification Sections, in particular the Related Sections listed below, apply to this Section.

VERIFY ALL RATINGS, DIMENSIONS AND REQUIREMENTS SPECIFIED TO BE AS SHOWN ON THE DRAWINGS ARE CLEARLY SHOWN ON THE DRAWINGS.

IN 2 BELOW, SELECT PROPER COMMISSIONING SPEC SECTION NUMBER APPLICABLE TO THE PROJECT.

B. Related Sections:

1. Section 017823 - Operation and Maintenance Manual
2. Section 019100/019110 - Commissioning
3. Section 260526 - Grounding and Bonding for Electrical
4. Section 260533 - Electrical Materials and Methods
5. Section 260800 - Electrical Acceptance Tests

1.2 SUMMARY

EDIT THE SUMMARY TO MAKE IT PROJECT SPECIFIC.

A. Furnish, install, terminate, splice (where permitted), test and label electrical cables and wires as shown.

1. Unless shown otherwise on the drawings, medium voltage cables, splices, terminations and labels will be provided by the U-M Plant High Voltage Shop.
2. Unless shown otherwise on the drawings, telecommunications voice and data cables, terminations and labels will be provided by others.

1.3 REFERENCES

A. Cables shall comply with the latest versions of the following codes and standards as applicable.

1. ANSI/NEMA WC 74/ICEA S-93-639, “5-46 kV Shielded Power Cable for Use in Transmission and Distribution of Electric Energy”.
2. ANSI/NEMA WC 70/ICEA S-95-658, “Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy”.
3. Michigan Electrical Code (MEC) which invokes NFPA 72, the National Electrical Code (NEC).

1.4 SUBMITTALS

A. Medium Voltage Cables, Terminations, Splices and Labels: Submit for approval product literature identifying the following:

1. Manufacturers' names, catalog numbers and illustrations.
2. Weights and overall diameters.
3. Conductor AWG sizes, materials, dimensions and stranding.
4. Insulation NEC Type letters, materials, thicknesses, voltage ratings, temperature ratings, dry or wet location ratings and percent insulation levels.
5. Shield types, materials, thicknesses and percent coverage.
6. Jacket materials and thicknesses.
7. Surface markings including special ratings, characteristics, approved uses and NRTL listings.
8. Maximum allowable pulling tensions and side wall pressures.
9. Minimum pulling and training bend radii.
10. Lubrication requirements and lubricant compatibilities.
11. Cold weather pulling limitations.
12. Cable reel dimensions and weights.

B. Cables 600 Volts and Below: Submit for approval product literature identifying the following (as applicable to each cable type):

1. Manufacturers' names and catalog numbers.
2. Conductor AWG sizes, materials, dimensions and stranding.
3. Insulation NEC type letters, materials, voltage ratings, temperature ratings and dry or wet location ratings.
4. Shield types, materials, thicknesses and percent coverage.
5. Jacket materials and colors.
6. Metallic sheath types and materials.
7. Surface markings indicating special characteristics, special ratings, approved uses and UL listings.
8. Crimp-type terminals for aluminum feeder cables (if permitted).

C. Test Reports:

1. Factory quality control test reports (medium voltage cables only).
2. Written test reports, signed and dated, for specified field tests prior to acceptance of the cables by the Owner.

1.5 QUALITY ASSURANCE

A. Manufacturers and Products: The products and manufacturers specified in this Section establish the standard of quality for the Work. Subject to compliance with all requirements, provide specified products from the manufacturers named in Part 2.

B. Reference Standards: Products in this section shall be built, tested, and installed in compliance with the specified quality assurance standards, latest editions, unless noted otherwise.

1. Cables: Applicable ANSI, ICEA, IEEE and NEMA standards.
2. Cables, Terminations, Splices and Accessories: Listed, labeled and marked for intended use by Underwriters Laboratories (UL), Electrical Testing Laboratories (ETL), MET Laboratories (MET), or the Canadian Standards Association (CSA).

1.6 DELIVERY, STORAGE, AND HANDLING

A. Shipping and Handling Requirements: Store materials raised off the floor on pallets and protected with coverings to prevent damage due to weather and construction activities. Store in areas that prevent damage due to freezing and extreme temperatures or sunlight. Seal cable ends from absorption of water. Protect materials from damage, dirt and debris at all times.

1.7 WARRANTY

A. Provide a complete warranty for materials and labor for a minimum of one year from the date of Substantial Completion. A manufacturer's warranty in excess of one year shall remain in effect for its entire time period.

PART 2 - PRODUCTS

2.1 CABLE (MEDIUM VOLTAGE)

A. Medium voltage cable shall be single conductor stranded copper, with ethylene propylene rubber (EPR) insulation rated 15kV, 105 degrees C, 133 percent insulation level, a 5-mil thick minimum tape shield with 12-1/2 percent minimum overlap, and a polyvinyl chloride (PVC) jacket approved for use in cable trays. The cable shall be suitable for use on a 13.2 kV, 3-phase, 3-wire, ungrounded, system. General Cable, Kerite, Okonite, or Prysmian.

2.2 CABLE (600 VOLTS AND BELOW)

A. Secondary distribution and power cables for indoor use and for above ground outdoor use shall be single conductor stranded copper, No. 12 AWG minimum, with NEC Type THHN insulation rated 90 degrees C in dry and damp locations, 600 volts, color coded as specified. Aetna Wire and Cable, Alan Wire, American Insulated Wire, Cerro Wire, Encore, General Cable, Republic Wire, Rockbestos-Surprenant, Service Wire, Southwire or United Copper Industries.

IF ALUMINUM FEEDER CABLES ARE PERMITTED, PROVIDE AN ALUMINUM CABLE AND CONDUIT SIZING CHART. PROVIDE U-M STANDARD DETAIL 26051301. IDENTIFY CIRCUITS WHERE ALUMINUM FEEDER CABLES ARE PROHIBITED BY THE EQUIPMENT MANUFACTURERS, SUCH AS FOR CHILLER AND ELEVATOR FEEDERS.

Where the drawings permit, indoor secondary feeder cables only may be single conductor stranded, Type AA-8000 Series aluminum, No. 1 AWG minimum, with NEC Types THHN or XHHW-2 insulation rated 90 degrees C, 600 volts, color coded as specified. Aetna Wire and Cable, Alan Wire, American Insulated Wire, Cerro Wire, Encore, General Cable, Republic Wire, Rockbestos-Surprenant, Service Wire, or Southwire. Terminations shall be Burndy or Thomas & Betts.

1. Aluminum cables may be used for indoor feeder circuits only, not for branch circuits or outdoor circuits.
2. Size conduits and device enclosure wiring gutters for the larger diameters and bend radii of aluminum cables.

3. Pre-train Electricians in aluminum cable preparation and termination.
4. Terminate cables using crimp-type terminals in accordance with U-M Standard Detail 26051301. The die and crimp numbers shall be clearly visible after the lugs are crimped. Burndy or Thomas & Betts.
5. Identify where aluminum conductor cables were installed on the project as-built drawings.

B. Lighting cable for indoor use and for above ground outdoor use shall be single conductor stranded copper, No. 12 AWG minimum, with NEC Type THHN insulation rated 90 degrees C in dry and damp locations, 600 volts, color coded as specified. Aetna Wire and Cable, Alan Wire, American Insulated Wire, Cerro Wire, Encore, General Cable, Republic Wire, Rockbestos-Surprenant, Service Wire, Southwire or United Copper Industries.

C. Secondary distribution, power and lighting cable for underground use in conduit shall be single conductor stranded copper, No. 12 AWG minimum, with NEC Type XHHW insulation rated 90 degrees C in dry locations and 75 degrees C in wet locations, 600 volts, color coded as specified. Aetna Wire and Cable, Alan Wire, American Insulated Wire, Cerro Wire, Encore, General Cable, Republic Wire, Rockbestos-Surprenant, Service Wire, Southwire or United Copper Industries.

D. Control cable shall be single conductor stranded copper No. 14 AWG minimum, with NEC Type THHN insulation rated 90 degrees C in dry and damp locations, 600 volts, color coded as specified. Aetna Wire and Cable, Alan Wire, American Insulated Wire, Cerro Wire, Encore, General Cable, Republic Wire, Rockbestos-Surprenant, Service Wire, Southwire or United Copper Industries.

E. Instrumentation, telecommunications, fire alarm, security, card access control, audio/visual and other special systems wire shall be in accordance with system manufacturer’s recommendations, but shall not be less than 20 AWG. Conductors shall be stranded copper unless manufacturer’s instructions require the use of solid conductor. Conductors or jackets shall be color coded as specified.

F. Manufactured wiring systems shall consist of multiple solid or stranded copper conductors as specified above, an insulated grounding conductor, a corrugated aluminum or galvanized steel jacket, and locking-type connectors from the same manufacturer and product line as the mating fixture connectors. Conductors shall be color coded as specified.

G. Type MC cable for power and lighting use shall consist of multiple stranded copper conductors as specified above, an insulated grounding conductor and a corrugated aluminum or galvanized steel jacket. Conductors shall be color coded as specified. AFC, Encore, Kaf-Tech, Rockbestos-Surprenant, Service Wire, Southwire or United Copper Industries.

H. Type MC cable for fire alarm system use shall consist of multiple solid or stranded copper conductors sized in accordance with the fire alarm system manufacturer’s instructions, with NEC Type THHN insulation rated 90 degrees C in dry and damp locations, 600 volts, an insulated grounding conductor and a corrugated aluminum or galvanized steel jacket. Cable shall be plenum rated. Conductors and jacket shall be color coded as specified. AFC, Encore, Kaf-Tech, Rockbestos-Surprenant, Service Wire, Southwire or United Copper Industries.

I. Type MI mineral-insulated cable shall be nickel-clad copper conductor, magnesium oxide insulated and copper alloy sheathed, rated 600 volts, with either factory installed terminations or field termination kits from the same manufacturer as the cable. Cable shall be UL labeled as 2 hour fire rated. Pentair Pyrotenax only.

J. Grounding electrode conductors and equipment grounding conductors shall be single conductor stranded copper, No. 12 AWG minimum, bare where shown or with NEC Type THHN insulation rated 90 degrees C in dry and damp locations, 600 volts, color coded as specified.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. Install cables and wires in raceways, except low voltage control, instrumentation, telecommunications, fire alarm, security, audio/visual and other power limited circuit wiring may be installed in J-hooks where shown on the drawings.

B. Use cable lubricant when pulling medium voltage cables and secondary feeder cables. Avoid exceeding manufacturer’s recommendations on pulling tensions, sidewall pressures and cable bend radii.

C. Route cables in J-hooks, manufactured wiring systems and Type MC cable parallel to or perpendicular to building lines, and in a neat and workmanlike manner. Coil the excess and support independently of the ceiling grid system.

D. Terminate Type MC cable with steel set screw connectors that have integral insulating bushings. Self-locking, twist-in type connectors are not acceptable.

E. Install Type MI and other 2-hour fire rated cable in strict accordance with manufacturer's instructions on pulling, bending, raceways, additional supports, protection from moisture, and installation of field termination kits.

F. Segregate wiring of different voltage levels. Except as follows, circuits operating at different voltages shall not share raceways.

1. Power wiring to rooftop motors and rooftop receptacles may be routed together.
2. Power and control wiring between variable speed drives and motor disconnect switches may be routed together.
3. Class 1 power limited cables may share the same cable tray.

G. Splice power cables with solderless compression butt splices or ring lugs. Terminate power cables including motor leads with solderless compression ring lugs. Splice branch circuit wiring, lighting wiring, and control and instrumentation wiring with wire nut connectors. Terminate control and instrumentation wiring with solderless compression ring or spade lugs. Compression splices and lugs shall be crimped with tools specifically designed for the terminations being crimped. Compression splices and lugs used with aluminum feeder cables shall be identified as accepting aluminum cables.

H. If no color coding system exists for each indicated system function and voltage, color code circuits as follows:

1. Three Phase Power Over 600 Volts:
   Phase X (A): Black
   Phase Y (B): Red
   Phase Z (C): Blue
2. Three Phase Power 480/277 Volts:
   Phase X (A): Brown
   Phase Y (B): Orange
   Phase Z (C): Yellow
   Neutral: Gray
   Ground: Green
3. Three Phase Power 208/120 Volts:
   Phase X (A): Black
   Phase Y (B): Red
   Phase Z (C): Blue
   Neutral: White
   Ground: Green
4. Single Phase Power 240/120 Volts:
   Phase X (A): Black
   Phase Y (B): Red
   Neutral: White
   Ground: Green
5. Fire Alarm Wiring:
   Addressable Initiating Device: #18 Shielded Twisted Pair (STP) Red with Black Stripe.
   Horn, Horn/Strobe or Controlled Output Positive (+) 24 VDC: #14 Stranded Red.
   Horn, Horn/Strobe or Controlled Output Negative (-) 24 VDC: #14 Stranded Black.
   Horn, Horn/Strobe or Controlled Output MC Cable Jacket (if MC cable is used): Red.
   Speakers: #18 STP Red.
   Clear Strobe Light Positive (+): #14 Stranded Yellow.
   Clear Strobe Light Negative (-): #14 Stranded Blue.
   Clear Strobe Light MC Cable Jacket (if MC cable is used): Red with Blue Stripe.
   Amber Strobe Light Positive (+): #14 Stranded Yellow with Black Stripe.
   Amber Strobe Light Negative (-): #14 Stranded Blue with Black Stripe.
   Amber Strobe Light MC Cable Jacket (if MC cable is used): Red with Yellow Stripe.
   NOTE: When clear and amber strobe lights are addressable and require only one pair of wires, color code the wires

and MC cable jacket as specified for the clear strobe light.
Panel Communications: #18 STP Red with Black Stripe.
Fireman's Telephone: #18 STP Red with Yellow Stripe.

6. Synchronized Clock Wiring:
   Line: Black
   Neutral: White
   Clock Correction: Red
7. Control wires to light fixtures for light dimming shall be:
   Hot control wire: Black with white stripe
   Neutral control wire: White with Black stripe
8. Less Than 120 Volts: Use Industry Standard Methods

I. For University Hospital projects, color code circuits as follows:

1. Three Phase Power Over 600 Volts:
   Phase X (A): Black
   Phase Y (B): Red
   Phase Z (C): Blue
2. Three Phase Power 480/277 Volts:
   Phase X (A): Red
   Phase Y (B): Blue
   Phase Z (C): Black
   Neutral: Gray
   Ground: Green
3. Three Phase Power 208/120 Volts:
   Phase X (A): Yellow
   Phase Y (B): Orange
   Phase Z (C): Brown
   Neutral: White
   Ground: Green
4. Control wires to light fixtures for light dimming shall be:
   Hot control wire: Black with White Stripe
   Neutral control wire: White with Black Stripe
5. Less Than 120 Volts: Use Industry Standard Methods

J. Provide home runs of No. 10 AWG wire for 20 amp branch circuits that exceed 150' in length.

K. Ground the shields of shielded instrumentation and control cables at one end only. The shields at the other end shall be insulated from ground.

L. Provide identification tags on all cables and conductors terminated in panels.

3.2 FIELD QUALITY CONTROL

A. Prior to any testing, perform visual inspections to verify the following:

1. Conductor and jacket color coding is correct.
2. Labeling is correct.
3. Electrical terminations have been properly tightened.
4. The cables are ready to be tested.

B. Perform a continuity test, 2,500-volt DC Megger test, a DC high potential test, and a second 2,500-volt DC Megger test on medium voltage cables. The high potential test shall be performed at 45kV for new cable and at 30kV when new cable has been spliced to existing cable. Submit a test report.

C. Perform a continuity check and a 1,000 volt DC Megger test on 600 volt power cables No. 4 AWG and larger.

1. The Megger test shall be performed between each pair of conductors and from each conductor to ground.
2. The Megger test shall be performed for 15 seconds or until the insulation resistance value stabilizes.
3. The insulation resistance between conductors and from each conductor to ground shall be 100 megohms minimum in one minute or less. In addition, the lowest insulation resistance value shall not differ from the highest resistance value by more than 20 percent. But if the lowest value is above 1,000 megohms, the 20% balance requirement may be waived.

D. Perform a continuity check on control and instrumentation wiring.

3.3 COMMISSIONING

A. Perform commissioning activities in accordance with Related Sections.

END OF SECTION 260513