CITY OF FORT WAYNE MASTER UPDATED: 11/16/18

SECTION 26 05 13

MEDIUM VOLTAGE CABLES

NTS: This specification section should be used on projects with distribution cables rated for 1KV to 35 KV.

1. GENERAL
	1. DESCRIPTION
		1. Scope:
			1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish and install medium voltage cable.
			2. This Section includes cables and related splices, terminations, and accessories for medium-voltage electrical distribution systems.
	2. REFERENCES

NTS: Retain applicable standards and add others as required.

* + 1. Standards referenced in this Section are:
			1. AEIC CS8, Specification for Extruded Dielectric Shielded Power Cables Rated 5 through 46 kV.
			2. ANSI C2, National Electrical Safety Code.
			3. ANSI/NETA ATS, Acceptance Testing Specifications for Electrical Power Equipment and Systems
			4. ASTM B3, Specification for Soft or Annealed Copper Wire
			5. ASTM B8, Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.
			6. ASTM B33, Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.
			7. ICEA S‑93‑639, 5-46 KV Shielded Power Cables for use in the Trans-mission and Distribution of Electric Energy.
			8. IEEE 48, Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5kv through 765kv.
			9. IEEE 404, Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500 000 V
			10. IEEE 400.2-2013, Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)
			11. UL 1072, Medium-Voltage Power Cables.
	1. DEFINITIONS
		1. NETA ATS: Acceptance Testing Specification.

NTS: Edit article “1.4” below to suit the Project. DO NOT DELETE (NOT USED) ITEMS.

* 1. SUBMITTALS
		1. Action Submittals: Submit the following:
			1. Product Data
				1. Manufacturer’s literature and technical information indicating compliance with the Contract Documents.
				2. Literature identifying the methods and materials proposed for making splices and terminations. Submittal shall consist of manufacturer literature for cables, splices, and accessories evidencing compatibility of conductor insulation, shield, and jacket of cable with splicing or terminating materials, and methods proposed for use.
			2. Shop Drawings
				1. Listing of locations where splices are proposed.
			3. Samples (NOT USED)
		2. Informational Submittals: Submit the following:
			1. Certificates(NOT USED)
			2. Delegated Design Submittal: Project specific cable pulling calculations from cable Manufacturer including:
				1. Acceptable cable tensions that shall not be exceeded during installation
				2. Project cable tension calculations, not exceeding allowable limits
				3. Splice locations
				4. Pull points
			3. Test and Evaluation Reports (NOT USED)
			4. Manufacturers’ Instructions (NOT USED)
			5. Source Quality Control Submittals
				1. Submit results of factory tests.
				2. Include testing procedures utilized.
			6. Field Quality Control Submittals
				1. Submit results of field quality control testing.
				2. Include testing procedures utilized.
			7. Manufacturer Reports (NOT USED)
			8. Sustainable Design Submittals (NOT USED)
			9. Special Procedure Submittals (NOT USED)
			10. Qualifications Statements
				1. Qualifications of splicing and termination personnel
				2. Independent testing agency.
		3. Closeout Submittals.
			1. Maintenance Contracts (NOT USED)
			2. Operation and Maintenance Data
				1. Maintenance data for cables and accessories
				2. Manufacturer’s written instructions for periodic tests of cables in service
				3. Submit in accordance with Section 01 78 23
				4. Operating instructions for fault indicators and separable insulated connectors and their accessories.
			3. Bonds (NOT USED)
			4. Warranty Documentation (NOT USED)
			5. Record Documentation
				1. a. Include on record documents actual location and routing of medium voltage cable installations in accordance with Section 01 78 39, Project Record Documents.
			6. Sustainable Design Closeout (NOT USED)
			7. Software (NOT USED)
		4. Maintenance Material Submittals. (NOT USED)
			1. Spare Parts (NOT USED)
			2. Extra Stock Materials (NOT USED)
			3. Tools (NOT USED)
	2. QUALITY ASSURANCE
		1. Qualifications:
			1. Independent Testing Agency:
				1. Contractor shall retain services of testing agency for field quality control testing of installed medium voltage cables.
				2. Testing agency shall have experi­ence inspecting and testing cables of type specified, and shall be a member company of NETA.
				3. Test Equipment, Calibration and Reporting: Test equipment, instrument calibration, and test reports shall be in accordance with ANSI/NETA ATS.
				4. 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.
			2. Manufacturers Qualifications:
				1. Manufacture under a Quality Assurance System such as Appendix B of Federal Register 10 CFR 50, ANSI N45.2, ISO 9001:2008, or equivalent.
			3. Installer Qualifications:
				1. Engage experienced installer of medium-voltage electrical cable to perform installation specified in this section. In addition, for specific work of cable splicing and termination, engage installers who are experienced in cable splices for specific types of cable and cable accessories specified in this section.
		2. Regulatory Requirements:
			1. Tests by Independent Agencies: Cable shall bear label of Underwriters Laboratories, Inc.
			2. Utilities:

NTS: Insert at No. 1 the name of the power company. Delete if not applicable.

* + - * 1. Perform Work in connection with utility service in conformance with requirements of (--1--).
		1. Source Limitations: Obtain cables through one source from a single manufacturer.
		2. Source Limitations: Obtain cable accessories through one source from a single manufacturer.
		3. 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.
		4. Comply with IEEE C2 and NFPA 70.
	1. DELIVERY STORAGE AND HANDLING
		1. Deliver medium voltage cable on factory reels conforming to NEMA Standard WC 26.
		2. Store cables on reels on elevated platforms in clean, dry location.
		3. Do not lay reels’ flat
		4. Keep ends of cable sealed if stored to deter moisture penetration.
1. PRODUCTS
	1. MATERIALS
		1. General:

NTS: Edit paragraph “1” as required and select voltages that suit the Project.

* + - 1. Cable provided under this Section shall be rated for insulation level of 133 percent at five, or 15, or 35 KV.
			2. Cable insulation shall be suitable for normal installation indoors or outdoors, in conduit, in air, and intermittent or continuous submergence in water.
			3. Conductor Insulation: Crosslinked Polyethylene or Ethylene Propylene Rubber.

NTS: Select one version of “4” below and delete other. MV 105 is typically used for most projects. When PVC-type raceways are used, limit the MV 105 cable design ampacity to the current rating associated with 90 degrees C.

* + - 1. Cable shall be single conductor bearing UL label “MV 90” and comply with or exceed applicable ICEA and AEIC standards.
				1. Cable Temperature Rating:

90 degrees Celsius

* + - 1. Cable shall be single conductor bearing UL label “MV 105” and comply with or exceed applicable ICEA and AEIC standards.
				1. Cable Temperature Rating:

105 degrees Celsius

* + - 1. Comply with UL 1072, AEIC CS 8
		1. Cable Manufacturers: Provide products of one of the following:
			1. Kerite Company.
			2. The Okonite Company.
			3. General Cable Technologies Corporation.
			4. Southwire Company.
			5. Rome Cable Corporation.
			6. Prysmian
		2. Cable Materials:
			1. Conductor: Conductors shall be soft or annealed uncoated or tinned coated copper with concentric‑lay Class B round stranding in accordance with ASTM B8, and ASTM B3 or ASTM B33.
			2. Insulation System: Cable insulation system shall include two separate screen layers, primary insulation and shield.
			3. Cable Jacket: Chlorosulfonated polyethylene, CPE.
			4. Strand Filling: Conductor interstices are filled with impermeable compound
		3. Cable Connectors:
			1. Connectors shall be copper, tin-plated, long-barrel compression type. Suitable for voltage applications up to 35 kv.
			2. For sizes 1/0 AWG and larger, connectors shall be two-hole mount type with provisions for two bolts for joining to apparatus terminal.
			3. Use carbon steel bolt with Belleville Washer Nut (or approved equal) and torque to manufacturer’s recommended specs.
			4. Manufacturers: Provide products of one of the following:
				1. FCI-Burndy.
				2. T&B Connectors.
				3. Panduit
		4. Cable Terminations:
			1. Cable terminations shall comply with Class 1 requirements of IEEE 48.
			2. Terminations shall be molded elastomer, wet-process porcelain or heat-shrinkable types with grounding provisions for cable shielding.
			3. Manufacturers: Provide products of one of the following:
				1. Elastimold.
				2. G&W Electric Company.
				3. Raychem Corporation.
				4. 3M Company.
				5. RTE Components; Cooper Power Systems, Inc.
		5. Cable Splices:
			1. Splice Kits: Comply with IEEE 404; type as recommended by cable or splicing kit manufacturer for the application.
			2. Make cable splices using standard splice kits that reinstate cable’s insulation and jacket and continue metallic shielding through entire cable joint.
			3. Splices shall be premolded, conventional tape or heat-shrinkable type.
			4. Manufacturers: Provide products of one of the following:
				1. Elastimold.
				2. G&W Electric Company.
				3. Raychem Corporation.
				4. 3M Company.
				5. RTE Components; Cooper Power Systems, Inc.
		6. Solid Terminations
			1. Shielded-Cable Terminations: Based on specified material type and installation, comply with the following applicable class of IEEE 48. Insulation class is equivalent to that of cable. Include shield ground strap for shielded cable terminations.
				1. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief tube; multiple, molded-silicone rubber, insulator modules; shield ground strap; and compression-type connector.
				2. Class 1 Terminations: Heat-shrink type with heat-shrink inner stress control and outer nontracking tubes; multiple, molded, nontracking skirt modules; and compression-type connector.
				3. Class 1 Terminations: Modular type, furnished as a kit, with stress-relief shield terminator; multiple-wet-process, porcelain, insulator modules; shield ground strap; and compression-type connector.
				4. Class 1 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, compression-type connector, and end seal.
				5. Class 2 Terminations, Indoors: Kit with stress-relief tube, nontracking insulator tube, shield ground strap, and compression-type connector. Include silicone-rubber tape, cold-shrink-rubber sleeve, or heat-shrink plastic-sleeve moisture seal for end of insulation whether or not supplied with kits.
				6. Class 3 Terminations: Kit with stress cone and compression-type connector.
			2. Nonshielded-Cable Terminations: Kit with compression-type connector. Include silicone-rubber tape, cold-shrink-rubber sleeve, or heat-shrink plastic-sleeve moisture seal for end of insulation whether or not supplied with kits.
		7. Pulling Compound:
			1. Provide pulling compound to facilitate wiring pulling. Compound shall be UL-listed, waxed or water based type. Compound shall be compatible with all jacket types.
			2. Pulling tension coefficient of friction shall not exceed 0.35.
			3. Use winter-grade compound for outdoor, low-temperature installations.
			4. Manufacturers: Provide products of one of the following:
				1. Ideal Industries.
				2. Greenlee.
				3. 3M Clear
		8. Fireproofing Tape for Cables in Manholes, Handholes, Switchgear, Transformers, and Boxes:
			1. Tape for First Course on Metal Objects: 10-mil- (250-micrometer-) thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.
			2. Arc-Proofing Tape: 3M Fireproof tape or approved equal, flexible, conformable, intumescent to 0.3 inch (8 mm) thick, compatible with cable jacket.
			3. Glass-Cloth Tape: 3M Pressure-sensitive adhesive type or approved equal, 1- inch (25 mm) wide.

NTS: Confirm with Owner that color coding in paragraph “3” conforms with Owner’s standard and edit accordingly.

* + 1. Color code cables by applying general purpose, flame-retardant tape, wrapped in overlapping turns covering an area of at least two inches. Colors shall be as follows:
			1. Grounded Neutral: Gray
			2. Phase A: Brown.
			3. Phase B: Orange.
			4. Phase C: Yellow.
		2. Separable Insulated Connectors
			1. 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.
			2. Terminations at Distribution Points: Modular type, consisting of terminators installed on cables and modular, dead-front, terminal junctions for interconnecting cables.
			3. Load-Break Cable Terminators: Elbow-type units with 200-A load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
			4. Dead-Break Cable Terminators: Elbow-type unit with 600-A continuous-current rating; designed for de-energized disconnecting and connecting; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled.
			5. 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.
			6. Protective Cap: Insulating, electrostatic-shielding, water-sealing cap with drain wire.
			7. Portable Feed-Through Accessory: Two-terminal, dead-front junction arranged for removable mounting on accessory stand of stationary terminal junction.
			8. Grounding Kit: Jumpered elbows, portable feed-through accessory units, protective caps, test rods suitable for concurrently grounding three phases of feeders, and carrying case.
			9. 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.
			10. Test-Point Fault Indicators: Applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.
	1. SOURCE QUALITY CONTROL
		1. Factory Testing:
			1. Cables shall be factory tested in accordance with testing standards of ICEA and UL.
			2. Conductors shall comply with electrical resistance requirements of ICEA.
1. EXECUTION
	1. INSTALLATION
		1. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
			1. Notify Construction Manager no fewer than fourteen days in advance of proposed interruption of electric service.
			2. Contractor shall not proceed with interruption of any electric service without approval of Construction Manager.
		2. Install cables complete with proper terminations at both ends. Check for proper phase sequence and proper motor rotation.
		3. Splice and terminate medium voltage cables in accordance with cable manufac­turer’s recommendations.
			1. Use experienced personnel familiar with materials and procedures to be employed.
			2. Make splices watertight for below-grade installations, and submersible in manholes and handholes.
			3. Seal cable ends after pulling until termination kits are ready to be installed.
		4. Pulling:
			1. Use insulating types of pulling compounds containing no mineral oil.
			2. Pulling tension shall be within limits recommended by cable manufacturer.
			3. Use dynamometer when mechanical means are used.
			4. Cut off section subject to mechanical means.
		5. Bending Radius: Per manufacturers’ recommendations.
		6. Slack: Provide maximum slack at terminal points and in manholes.
		7. Wrap cables located within manholes, handholes, switchgear, transformers, and boxes with fireproofing/arc-proofing tape for cable’s entire length for each individual cable. Fireproof cables in accordance with cable manufacturer’s recommendations, and cover cables with tape extending at least one inch into each duct.
			1. Clean cable sheath.
			2. Wrap metallic cable components with 10-mil (250-micrometer) pipe-wrapping tape.
			3. Smooth surface contours with electrical insulation putty.
			4. Apply fireproofing/arc-proofing tape in one half-lapped layer with coated side toward cable.
			5. Band fireproofing/arc-proofing tape with 1-inch- (25-mm-) wide bands of half-lapped, adhesive, glass-cloth tape 2 inches (50 mm) o.c.
		8. Seal around cables passing through fire-rated elements and preserve fire-rating.
		9. Identification: Identify conductors by circuit number and phase at each terminal or splice location.
		10. Install cables according to IEEE 576.
		11. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
		12. Warning Tape and Tracer Wire
			1. Underground conduits
				1. Warning tape shall be a continuous strip of red polyethylene and shall have the words “CAUTION ELECTRIC LINE BELOW” printed on 2'-6" centers.
				2. Tracer wire shall be a red, #12 AWG stranded copper wire with polyethylene or (HDPE), 45 mil thick insulation, approved for direct buried applications.
			2. Underground duct banks
				1. Install the continuous marking tape 18" below grade along the centerline of all underground duct banks and conduit runs.
				2. Install the tracer wire directly on the center of each duct bank or centered between conduits. Where a duct spurs, splice the tracer wire with a manufacturer approved direct burial splice kit. Terminate the tracer wire at each end inside a short section of rigid PVC conduit. If the duct terminates inside a building or structure cap the conduit inside the building. If the duct terminates at an enclosure, extend the section of conduit into the enclosure. Permanently identify the tracer wire as a “Duct Bank Tracer” on each end.
		13. 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.
		14. Install cable splices at pull points and elsewhere as indicated; use standard kits.
		15. Install terminations at ends of conductors and seal multi-conductor cable ends with standard kits.
		16. Install separable insulated-connector components as follows:
			1. Protective Cap: At each terminal junction, with one on each terminal to which no feeder is indicated to be connected.
			2. Portable Feed-Through Accessory: Three.
			3. Standoff Insulator: Three.
		17. 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.
	2. FIELD QUALITY CONTROL

NTS: The testing specified is not intended for preventative maintenance cable testing and will require editing when preventative maintenance testing is required.

Testing specified in paragraph “A” addresses acceptance testing requirements suitable for new cable installations. DC testing shall be used.

* + 1. Tests and Inspections:
			1. Perform acceptance testing of medium voltage cable system. Each cable circuit shall be inspected and tested on an individual, per-phase basis. Testing and inspection shall be performed by independent testing agency.
			2. Visual and Mechanical Inspection: Inspect each power cable installation in accordance with ANSI/NETA ATS. Inspect each splice and termination.
			3. Electrical Tests: Perform electrical testing of each power cable in accordance with ANSI/NETA ATS and manufacturer’s recommended testing procedures. Testing shall include:
				1. Shield continuity test.
				2. VLF (Very Low Frequency) testing per manufacturer’s recommendations or DC high potential test. Comply with IEEE 400.2-2013 for VLF testing.
				3. Adhere to following procedures before performing over-potential tests:

Disconnect all equipment, including but not limited to: transformers, switches, motors, circuit breakers, and surge arrestors from cable circuit to prevent test interruptions due to flashovers or trip-outs resulting from excessive leakage current.

Establish adequate clearance between circuit test ends and grounded objects and to other equipment not under test.

Ground all circuit conductors not being tested, all cables shields, and nearby equipment.

Clean insulation surfaces.

Keep cable ends dry.

* + - * 1. Apply high-potential slowly in eight to ten equal steps to 80 percent of manufacturer’s test value. Record leakage current at each test voltage.
				2. Stop the test if leakage current increases excessively or if a “knee” appears in the curve before reaching maximum test voltage.
				3. Upon reaching specified maximum test voltage, maintain voltage for 15 minutes, record leakage current at 30 seconds, one minute, and at one-minute intervals thereafter.
				4. Reduce conductor test potential to zero and measure residual voltage at discrete intervals.
				5. Apply grounds for a time period adequate to drain all insulation stored charge.
				6. Repair or replace and retest new cable that fails tests.
				7. Tests shall be signed by the individual performing tests and submitted to Engineer.

NTS: Retain paragraph “4” where existing cables are spliced to new cables. The age and type of existing cable should be considered when splicing to existing cable is desired. DC high-potential testing should be avoided in cases when cable is older than five years.

* + - 1. Where existing cables are spliced to cables provided under this Contract, new cable shall be high-potential tested prior to splicing. After acceptance of test of new cable, make the splice and insulation-resistance test entire cable. Perform shield continuity test. When tests are positive, perform high-potential test. Test voltage and procedures shall be in accordance with ANSI/NETA ATS and manufacturer’s recommendations. Cable failures shall be brought to attention of Engineer in writing.
			2. Existing cables: perform a maintenance test per cable manufacturer’s recommendations.
		1. Cable Tension Field Quality Control:
			1. As per manufacturers recommendation for pulling tension and as witnessed by Engineer in the field.
		2. Training
			1. Conduit training in fault analysis, testing, troubleshooting, servicing, and preventative maintenance.
			2. Include both class room training in system orientation and hands-on problem solving and equipment operation.
			3. Training shall be submitted and completed in accordance with Section 01 79 23 Instruction of Operations and Maintenance Personnel.

+ + END OF SECTION + +