SECTION260513

MEDIUM VOLTAGE CABLES (5 kV – 15 kV)

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**NOTE TO SPECIFIER**

*Use this Specification Section for Mail Processing Facilities.*

***This is a Type 1 Specification with completely editable text; therefore, any portion of the text can be modified by the A/E preparing the Solicitation Package to suit the project.***

*For Design/Build projects, do not delete the Notes to Specifier in this Section so that they may be available to Design/Build entity when preparing the Construction Documents.*

*For the Design/Build entity, this specification is intended as a guide for the Architect/Engineer preparing the Construction Documents.*

*The MPF specifications may also be used for Design/Bid/Build projects. In either case, it is the responsibility of the design professional to edit the Specifications Sections as appropriate for the project.*

*Text shown in brackets must be modified as needed for project specific requirements.* *See the “Using the USPS Guide Specifications” document in Folder C for more information.*

*The last date that USPS revised this standard specification section occurs in two places, at the end of this section and in the Table of Contents. If the date in this section matches the date in the Table of Contents, then you are using the latest version. Do not delete or revise the “last revised” date at the end of the section during the development of the Project Manual.*

*The footer in this section should be edited to replace the text, “USPS MPF SPECIFICATION” with the project name, and the blank date in the center should be replaced with the submission date, for interim design reviews, or the issue date of the completed Project Manual.*

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1. GENERAL
	1. Summary
		1. This section includes requirements for medium voltage 5 kV to 15 kV, shielded single and-multiple conductor power cables, cable splices and terminations.
		2. Related Documents: The Contract Documents, as defined in Section 011100 – Summary of Work, apply to the Work of this Section. Additional requirements and information necessary to complete the Work of this Section may be found in other documents.
		3. Related Sections:
			1. Section 019113- General Commissioning Requirements.
			2. Section 260500 - Common Work Results for Electrical.
			3. Section 260800 - Commissioning of Electrical Systems.
			4. Section 261116 - Secondary Unit Substations.
			5. Section 261216 - Dry-Type, Medium-Voltage Transformers.
			6. Section 261313 - Medium Voltage Circuit Breaker Switchgear.
			7. Section 261317 - Medium-Voltage Non-Fusible Interrupter Switchgear.
			8. Section 337173 - Electrical Utility Services.
	2. REFERENCES
		1. The references listed below form a part of this specification to the extent referenced.
			1. AEIC C8: (2000) Extruded Dielectric Shielded Power Cables Rated 5 through 46 kV.
			2. ASTM B 3: (2001; R 2007) Standard Specification for Soft or Annealed Copper Wire.
			3. ASTM D 746: (2007) Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
			4. IEEE 383: (2003; R 2008) Standard for Qualifying Class 1E Electric Cables and, Field Splices for Nuclear Power Generating Stations 2004.
			5. IEEE 400 (2001) Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems
			6. IEEE 400.1: (2007) Guide for Field Testing of Laminated Dielectric, Shielded Power Cable Systems Rated 5kV and Above with High Direct Current Voltage.
			7. NEMA WC 74 / ICEA S-93-639: (2006) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy.
			8. NFPA 70: National Electrical Code.
			9. FED-STD-228: (2000) Cable and Wire, Insulated; Methods of Testing.
	3. GENERAL REQUIREMENTS
		1. Provide Certificates for the following showing that the cable manufacturer has made factory-conducted tests on each shipping length of cable. Provide certified copies of test data that shows conformance with the referenced standards prior to delivery of cable.
	4. SUBMITTALS
		1. Submit the following in accordance with Section 013300 - Procedures for Submittals.
			1. Provide performance data and manufacturer’s catalog data for each cable type.
			2. Provide field test reports for the following in accordance with Section 014000 - Quality Requirements: Field Inspection.
				1. Dielectric Absorption Tests
				2. High Voltage Tests
			3. Provide manufacturer’s instructions showing the recommended sequence and method of installation.
			4. Provide qualifications for cable splicers.
	5. QUALITY ASSURANCE
		1. Manufacturer qualifications: The bidder must have at least 10 years experience in manufacturing medium voltage cable assemblies.
		2. Regulatory requirements:
			1. Conform to requirements of NFPA 70.
			2. Provide products listed and classified by Underwriters Laboratories, Inc.
		3. For the cable specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
	6. qualifications
		1. Cable splicers performing splicing are required to have [10] [\_\_\_] years experience in cable splicing and terminations. Once a termination or splice has been started by a worker, the same person completes that particular splice. Start and complete each termination and splice in one continuous work period.
	7. cable voltage ratings
		1. Provide medium voltage power cables including multiple and single conductor cables rated as follows, phase-to-phase, for grounded and underground neutral systems:
			1. Use cable rated [5,000] [15,000] volts, ungrounded neutral, on [2,400 / 4,160] [13,200 / 13,800] [12,470]-volt, three phase, 60-hertz distribution systems.
			2. Cable insulations shall be rated at 133 percent.
	8. SHIPMENT
		1. Ship cables on reels such that the cable is protected from mechanical injury. Hermetically seal and securely attach each end of each length of cable to the reel.
		2. Make minimum reel drum diameter [14] [\_\_\_] times the overall diameter of the cable. Provide a pulling eye that is installed by the manufacturer fro each length of cable supplied for installation in ducts, manholes, and utility tunnels.
2. PRODUCTS
	1. MANUFACTURERS
		1. Experience: Manufacturer shall provide evidence demonstrating a minimum of ten (10) years U.S. production experience in the type cable specified herein.
		2. Subject to compliance with project requirements, U.S. manufacturer’s offering Products which may be incorporated in the Work include the following:
			1. Okonite Cable, Inc., Ramsey, NJ (201) 825-0300.
			2. Aetna Insulated Wire, LLC, Virginia Beach, VA (800) 423-6505.
			3. Southwire, Inc. Carrollton, GA (800) 444-1700.
			4. Prysmian Group, Lexington, SC (803) 951-4800.
			5. Substitutions permitted; subject to prior approval.
	2. CONDUCTORS
		1. Provide [5 kV] [15 kV] conductors that are MV-105 copper, conforming to ASTM B 3.
	3. CABLE IDENTIFICATION
		1. The overall cable jacket shall be printed in a contrasting color with the following information:
			1. Manufacturer name
			2. Location code of plant
			3. Number and conductor size
			4. Insulation type and thickness
			5. Voltage rating
			6. UL designation
			7. CT use
		2. Closely group information on the tape at 1-foot intervals to permit complete identification.
	4. FLAMMABILITY
		1. Test cables not to be enclosed in metallic conduit for flammability in accordance with [FED-STD-228, Method 5221 [vertical], [spark]] [IEEE 383, 20,000 Watt, 70,000 Btu per hour per hour vertical tray flame test].

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**NOTE TO SPECIFIER**

Utilize multiconductor, interlocked armor cable for interior, cable tray applications and single conductor shielded cables for exterior, in-conduit installations. Edit paragraphs 2.5 and 2.6 below accordingly.

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* 1. MULTIPLE CONDUCTOR SHIELDED CABLES
		1. Multiple conductor ethylene propylene rubber (EPR) insulated with jacketed interlocked armor.
			1. Provide multiple conductor insulated interlocked armor covered [5 kV] [15 kV] cable assemblies that consist of: Class B stranded copper conductors, an extruded semi-conducting shield over the conductors, 5.6 millimeter 220 mils of ethylene propylene rubber (133 percent) insulation, an extruded or other approved semi-conducting shield, a 0.130 millimeter 5 mil minimum copper tape shield wrapped helically with a minimum of 12.5 percent overlap and a Class B, bare copper, grounding conductor with a single strip of interlocked armor of aluminum and a red PVC jacket.
		2. Provide multiple conductor, ethylene propylene rubber insulated with interlocked armor jacketed, shielded cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639, AEIC C8, IEEE Std 532.
		3. Basis of Design:
			1. Okonite #C-L-X, MV-105.
			2. Southwire #AL13ET, type MV-105.
			3. Alternate U.S. manufacturers permitted; subject to prior approval.
	2. single conductor shielded cables
		1. Single conductor, ethylene propylene rubber (EPR) insulated PVC jacketed shielded cable.
			1. Provide single conductor [5 kV] [15 kV] cable assemblies that consist of: Class B stranded copper conductors, an extruded semi-conducting shield over the conductors, 5.6 millimeter 220 mils of ethylene propylene rubber (133 percent) insulation, an extruded semi-conducting shield and 1/3 copper concentric neutral. The concentric neutrals shall be encapsulated with a 50 mils overall linear low density polyethylene (LLDPE) jacket wrapped helically.
		2. Provide single conductor, ethylene propylene insulated, LLDPE-jacketed, concentric neutral cable that conforms to NEMA WC 70, ANSI/NEMA WC 71/ICEA S-96-659, NEMA WC 74/ICEA S-93-639 and AEIC C8.
		3. Basis of Design:
			1. Okonite type URO-J, MV-105.
			2. Aetna #2-81-3, type MV-105.
			3. Southwire #15 kV primary UD EPR, type MV-105.
			4. Alternate U.S. manufacturer permitted; subject to prior approval.
	3. TERMINATIONS
		1. Terminations
			1. Provide cable terminations with grounding terminals rated [5 kV] [15 kV], to withstand [25 kV] [45 kV] for 10 seconds, minimum.
	4. CABLE SUPPORTS AND FITTINGS
		1. Provide cable racks, cable tray supports and related fittings that are UL listed heavy-duty nonmetallic [glass-reinforced nylon] [polycarbonate].
1. EXECUTION
	1. EXAMINATION
		1. Section 017300 - Execution: Verification of existing conditions before starting work.
		2. Verification of Conditions: Verify that field measurements, surfaces, substrates and conditions are as required, and ready to receive Work.
		3. Report in writing to USPS Project Manager prevailing conditions that will adversely affect satisfactory execution of the Work of this Section. Do not proceed with Work until unsatisfactory conditions have been corrected.
		4. By beginning Work, Contractor accepts conditions and assumes responsibility for correcting unsuitable conditions encountered at no additional cost to the United States Postal Service.
	2. installation
		1. Install medium-voltage cables in accordance with NFPA 70.
		2. Install cable inside buildings, by open wire method and ceiling mounted cable trays.
		3. Secure cables with heavy duty cable ties in trays mounted horizontally, where cable rests on tray bottom. Install cable ties at minimum of [10] [\_\_\_\_\_] foot intervals.
		4. Secure cables with [PVC coated] [non-metallic] cable clamps, straps, hangers, or other approved supporting devices in cable trays mounted vertically, where tray bottom is in a vertical plane.
		5. When field cuts or other damage occurs to the PVC coating, apply a liquid PVC patch to maintain the integrity of the coating. After the installation is complete, perform an inspection to ensure the absence of voids, pinholes, or cuts.
		6. Ensure that all cable tray is properly secured and supported prior to installing armored cable. Add permanent and/or temporary tray support devices as required to preclude cable tray failure during cable pulling or after cable is installed.
		7. Pull medium-voltage cables into cable tray with equipment designed for this purpose, including power-driven winch, cable-feeding flexible tube guide, cable grips, and lubricants. Employ a sufficient number of trained personnel and equipment to ensure the careful and proper installation of the cable.
		8. Unreel cable from the top of the reel. Carefully control payout. Make cable to be pulled be attached through a swivel to the main pulling wire by means of a [pulling eye] [suitable cable grip permitted only on cables less than 60 meter 200-feet long and less than 50 millimeter 2 inches in diameter].
		9. Use woven-wire cable grips to grip the cable end when pulling small cables and short straight lengths of heavier cables.
		10. Attach pulling eyes to the cable conductors to prevent damage to the cable structure. Use pulling eyes and cable grips together for nonmetallic sheathed cables to prevent damage to the cable structure. Provide a minimum bending radius in accordance with the following manufacturer’s recommendations.
		11. Provide cables cut in the field that have the cut ends immediately sealed to prevent entrance of moisture. Seal cables with rubber tape wrapped down to [3] [\_\_\_\_\_] inches from the cable end. Cover-wrap rubber tape with polyvinylchloride tape.
		12. Dry terminations with medium voltage pennants, preformed, and hand wrapped stress cones are allowed for terminating cables.
		13. Installation includes built-up or prefabricated heat or cold shrink stress-relief cones at the terminals of all shielded cables.
		14. Provide bushings that are glazed wet-process electrical porcelain insulators, factory assembled and hermetically sealed.
		15. Provide cable connectors that are high-conductivity copper accurately machined and threaded for internal and external electrical connections. Provide cross-sectional and contact areas that are adequate to carry the full-load current rating of the conductors. Provide solder type cable connectors with gasket seal between the connector and bushing.
		16. Provide bonding and grounding in conformance with NFPA 70.
	3. PACKAGING
		1. Reels
			1. Reels shall be in good condition and serviceable enough to hold the weight of the cable under fairly rugged handling.
			2. Reels should be tagged with a durable metal or paper tag containing at a minimum: “sold to” name, manufacturer’s name, corporation PO number, product description, quantity on reel, shipment reel number and required UL tagging information.
			3. Reels should only be shipped upright and shall be wrapped in such a way as to minimize damage and show evidence of tampering or in shipment damage.
			4. Cables shall be reeled in such a way as to leave both ends available for testing.
		2. Cable End Preparation: Cables shall be cut flush and the ends sealed with heat shrink end caps.
	4. FIELD QUALITY CONTROL - ELECTRICAL TESTING AND INSPECTION
		1. Section 014000 - Quality Requirements: Field testing and inspection.
		2. Section 260800 - Commissioning of Electrical Systems: Requirements related to Division 26 Commissioning.
		3. Instrumentation:
			1. Provide calibration program that assures applicable test instrumentation is maintained within rated accuracy and directly traceable to National Bureau of Standards.
			2. Calibrate instruments in accordance with following frequency schedule:
				1. Field Instruments:

Analog - 6 months maximum.

Digital - 12 months maximum.

* + - * 1. Leased Specialty Equipment: 12 months. (Where accuracy is guaranteed by lessor.)
			1. Dated Calibration Labels: Visible on test equipment.
			2. Keep records current; show date and result of instruments calibrated or tested.
			3. Maintain current instrument calibration instruction and procedure for each test instrument.
			4. Calibrating Standard: Higher accuracy than that of instrument being calibrated.
		1. Regulatory Requirements:
			1. Safety Practices: Include, but not limited to, the following requirements:
				1. Occupational Safety and Health Act of 1970 - OSHA.
				2. Accident Prevention Manual for Industrial Operations, Seventh Edition, National Safety Council, Chapter 4.
				3. Applicable State and Local Safety Operating Procedures.
				4. NETA Safety/Accident Prevention Program.
				5. United States Postal Service Safety Practices.
				6. NFPA 70E - Electrical Safety Requirements for Employee Workplace.
				7. American National Standards for Personnel Protection, ANSI Z244.1.
				8. Recommended Practices for Safety in High-Voltage Testing, IEEE 510 (1983).
			2. Safety Representative: Provide a designated safety representative present at Project Site to supervise safety operations. Do not proceed until safety representative has determined that it is safe to do so.
			3. Testing Laboratory: Provide sufficient protective barriers and warning signs to conduct specified tests safely.
		2. Safety Practices:
			1. When testing, personnel safety and service reliability of the electrical systems are of ultimate importance. All cable and equipment tests shall be performed on isolated and de-energized systems except where otherwise specifically required and authorized. The safety practices must include at least the following requirements:
				1. Applicable user safety operating procedures.
				2. Recommended practices for safety in high-voltage testing (see IEEE Std 510-1983).
				3. Applicable national, state and local government safety operating procedures.
				4. Part 4 of the National Electrical Safety Code® (NESC®)(Accredited Standards Committee C2-2002) where applicable.
				5. Provide protection of utility and customer property by such means as barriers, enclosures with warning signs, and safety watchers at all points. The protection shall provide minimum interference, as much as practicable, with related operations channels, systems and equipment.
				6. Cables must be de-energized and grounded before testing is begun.
				7. While testing, one or more cable ends will be remote from the testing site; therefore cable ends must be cleared and guarded.
				8. At the conclusion of high-voltage testing, cables and cable systems shall be discharged and careful consideration must be given to eliminate the aftereffects of the cables’ dielectric absorption and capacitance characteristics. Those effects shall be reduced by leaving both the conductors and sheath of the cable grounded until it is placed in service.
		3. Testing and Inspection:
			1. Inspect and test in accordance with NETA ATS, where applicable.
			2. Perform inspections and tests listed in NETA ATS, Section 7.13.
			3. Subject each cable assembly to dielectric-absorption tests and high-voltage tests after the installation of medium-voltage power cables and terminations have been completed and before the cable is energized.
			4. Provide test equipment, labor, and technical personnel as necessary to perform the electrical acceptance tests. Make arrangements to have tests witnessed and approved by the USPS Project Manager.
		4. Preliminary Testing Procedure (Megger Testing):
			1. Completely isolate each power-cable installation from extraneous electrical connections at cable terminations.
			2. Initially each power cable shall be subjected to a full dielectric-absorption (megger) test with [2500][5000]-volt insulation-resistance test set. Apply test for a long enough time to fully charge the cable. Record readings every 15 seconds during the first 3 minutes of test and at 1 minute intervals thereafter. Continue test until three equal readings, 1 minute apart, are obtained. Minimum reading is 200 megohms at an ambient temperature of 20 degrees C (68 degrees F). Correct readings taken at other than 20 degrees C 68 degrees F ambient temperatures.
			3. Upon successful completion of the dielectric absorption tests, subject the cable to a direct-current high-potential test in accordance with IEEE 400.1 for ethylene propylene rubber-insulated cable.
		5. Acceptance Testing Procedure (DC High Potential Testing):
			1. Disconnect all equipment not to be included in the test, but leave all ground connections intact. Prepare the cable system for testing in accordance with manufacturer or utility recommendations. Clean insulator surfaces with a dry cloth and, if necessary (in severely polluted areas), apply silicone grease to minimize leakage currents and prevent flashover.
			2. Check the operation of the test equipment in accordance with the manufacturer’s recommendations prior to connecting the test cable.
			3. If the leakage current in the test equipment is a substantial portion of the test value to be measured, this current should be measured and subtracted from the test current readings.
			4. The ground lead for the test equipment shall be connected to a local ground or in the absence of a local ground to the metallic shield of the cable that is grounded. For ungrounded cable terminations, the metallic shield shall be connected to a local ground, during the high direct voltage testing.
			5. Connect the test lead to the first conductor or conductors to be tested. When multiconductor cables are tested, each conductor should be tested separately, with the remaining conductors and shields grounded.
			6. The initially applied voltage shall not exceed 1.8 times the rated ac rms phase-to-phase voltage of the cable. The voltage may be increased continuously or in steps to the maximum test value. Apply voltage slowly enough to prevent overloading and/or tripping of the power supply or overshooting the test level.
				1. If the voltage is increased continuously, the rate of increase shall be uniform and should result in the maximum test voltage being reached in a time period of not less than 10 s and not more than 60 s. In cases where extremely long cable runs are to be tested, the rate of voltage rise may be slower.
				2. If the step method of voltage increase is employed, a minimum of five steps shall be employed. Duration at each step should be long enough for the current to reach a steady value (1 min suggested). Current readings at each voltage step shall be recorded at the end of the step duration.
			7. The maximum test voltage shall be maintained for 15 min. After reaching the maximum test voltage, the current magnitude shall be recorded at least twice: once at approximately 2 min and again at the end of the test period (15 min).
			8. Recommended test voltages for shielded cable systems 5 kV and above shall be as listed in IEEE 40.1 – 2007 Table 1. Recommended field test voltages for the 5kV and 15kV system voltages are listed below:

**Table 1 - Field test voltages for shielded power cables 5 kV to 15 kV system voltage**

|  |  |  |
| --- | --- | --- |
| **System voltage,****kV rms,****phase-to-phase** | **System BIL,****kV crest** | **Acceptance test,****kV dc,****phase-to-ground** |
| 5 | 75 | 28 |
| 8 | 95 | 36 |
| 15 | 110 | 56 |
| NOTES:1. The user shall consult with the suppliers of the cable and any/all accessories before applying the high voltage.
2. If the test voltage exceeds 50% of system BIL, surge protection against excessive overvoltages induced by flashovers at the termination should be provided.
3. The user shall consult with the manufacturer(s) of all components that will be subjected to such testing before performing any tests on cables and cable accessories.
4. If any equipment is included beyond the cable and its terminations, the dielectric strength of such equipment must be taken into consideration when establishing the test voltage.
5. If an external flashover occurs during a high-voltage test of a shielded cable, it is possible to develop fast transients and voltage reversals of high magnitude that may damage the cable or accessories. Precautions should be taken to provide high-voltage connections that are suitable for the testing voltage.
 |

* + - 1. At the completion of the test period, the voltage can be reduced by returning the voltage control of the test equipment to zero. The voltage on the cable will discharge through the internal resistance of the test equipment.
				1. The discharge time for cables longer than 300 ft. will be very long, therefore a separate automatic grounding system with built-in high-voltage discharge resistance shall be utilized to reduce the discharge time. In all cases, discharge mechanisms should be designed to safely handle the test voltage and energy stored in the cable under test.
			2. After the test voltage is reduced to a low level, the high-voltage conductor shall be solidly grounded. The cable shall remain grounded until ready for service or further testing. A retest shall not be started until the cable has been grounded for a period of at least four times the duration of the previous test.
		1. Evaluation of Results:
			1. The test current will momentarily increase for each voltage increment due to the charging of the capacitance and the dielectric absorption characteristics of the cable. Both of these decay, the first in a few seconds, the latter more slowly, ultimately leaving only the conduction current plus any external surface leakage or corona currents.
			2. One criterion of a satisfactory test is a steady current value or a decrease of current with time at a fixed voltage application. The absence of an increase in current with time is a practical criterion for acceptance.
				1. If the current starts to increase without any increase in applied voltage, gradual insulation failure may be in progress. This process will most likely continue until the cable or accessories eventually fail unless the voltage is rapidly reduced. Immediately terminate the testing and take steps to find and correct the fault. Upon completion of the correction, repeat the test procedure.
			3. If the test equipment overload system trips at any time during a test, it may indicate one of the following events:
				1. A very rapid increase in current
				2. A flashover of the test equipment, the leads, or a termination
				3. A failure of the circuit under test, the cable, a splice, or a termination.
				4. The failure can be confirmed by the inability to sustain another application of the test voltage.
			4. In the event of such an apparent cable failure, the source of the failure shall be determined and corrected prior to retesting of the cable assembly.
			5. Upon satisfactory completion of the high-potential test, give the cable a second dielectric-absorption test. Provide results of the second dielectric-absorption test that agree with the first test and that indicate no evidence of permanent injury to the cable caused by the high-potential test.
			6. Final acceptance depends upon the satisfactory performance of the cable under test. Do not energize cable until recorded test data has been approved by the Engineer and the USPS Project Manager.
		2. Recording of Test Results:
			1. The test data shall be recorded for future reference. Such data shall include the date, time of day, location, ambient temperature, relative humidity or weather condition, cable description, phase, and circuit identification, as well as the name of the test operator and the test equipment used.
				1. The test schedule used shall include the time of voltage application as well as the voltage and current readings. The name of the manufacturer of the cable, its terminations, and its date of installation shall be included.
			2. Provide final test reports to the USPS Project Manager. Provide reports with a cover letter/sheet clearly marked with the System name, Date, and the words "Final Test Report - Forward to the Systems Engineer/Condition Monitoring Office/Predictive Testing Group for inclusion in the Maintenance Database."

end of section

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