	Title: YALE OFFICE OF FACILITIES PROCEDURE MANUAL Chapter: 01 - Yale Design Standard Division: Electrical Standards	Section: 26 05 13 Medium Voltage Cables
		Date: 6/15/16
		Author: Office of Facilities
CC: Project Folder		

## Change History


Date	Description of Change	Pages / Sections Modified	Change Approver Initials
6/15/16	Updated division section from 16124 to 26 05 13, removed references to other section	-	mgl44
10/17/14	Add supporting paragraphs 13. And 14.	15 – 16124, K. #13 & #14 (Conductors and Cables; Installation Guidelines)	SO
3/26/13	Amend text to remove 'MV'.	13 - 16124 H. #2 (Medium Voltage Cables; Special Requirements)	SO
3/26/13	Add next item to address alternate power serve in shared Man hole with normal power service.	13 - 16124 H. #3 (Medium Voltage Cables; Special Requirements)	SO
3/26/13	Replace 'THHN/THWN" with 'XHHW-2' to avoid use of thermoplastic insulation compounds.	14 - 16124 K #7 (Medium Voltage Cables; Installation Guidelines)	SO
11/21/14	Add text in section B to add clarity for requirements..	8 - 16124; B. #1. (Medium Voltage Cables)	SO

## A. Summary

This section contains design criteria for cables, terminating devices, and related materials for use in the medium voltage systems.

## B. System Design and Performance Requirements


1. The Medium Voltage (MV) Cables shall be single conductor, shielded power cable for installations in conduits, underground ducts. All MV Cable shall be rated for 15KV, even for 4160 volt systems.
2. Conductor shall be uncoated copper, Type MV-105, Class B compact stranded with minimum of 98% conductivity at 20 degree C.
3. The conductor stress control layer shall be an extruded, black-colored, non- conducting thermoset material in accordance with Part 3 of ANSI/ICEA S-93- 639-2004. The minimum point thickness for the 500 kcmil size is 16 mils. This material shall have a high dielectric constant in order to provide the desired stress control. This stress control layer shall be Kerite Permashield or similar material in order to achieve the same results.
4. The cable insulation shall be a thermosetting Ethylene-Propylene Rubber (EPR) material with a minimum of 30 years successful service. The material shall be discharge resistance as demonstrated by the ASTM D2275 test. Insulation thickness shall be 133% (220 mils) and rated 105 degree C for normal operation and 140 degree C for emergency operation.

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5. The insulation shield shall be a thermoplastic extruded semi-conducting layer. The layer should be easily removable without the use of special tools or solvents.
6. The cable shield shall be a 5 mil copper tape helically applied with a 20% minimum overlap.
7. The overall jacket shall be low smoke, zero-halogen, black, sunlight resistant polyolefin. The jacket shall be free stripping from the insulation screen and shall be printed with the following legends:
  - a. Manufacturer's Name and Cable Type (Trade Name)
  - b. Conductor size
  - c. CU (Conductor Material –copper)
  - d. Voltage Rating- 15 kV
  - e. Insulation level of 133%
  - f. Insulation Thickness
  - g. Sequential Footage Number (as applicable)
  - h. Year of Manufacture

## C. Submittals

1. Submit the following manufacturer's technical product data:
  - a. Cable construction specifications, data and a sample of the exact design cable shall be submitted for approval before cable manufacture commences.
  - b. Warranty – The manufacturer shall warrant that the cable to be furnished is of first class material and workmanship throughout, and that cable is free from defects in design, material or workmanship, for a period of 40 years when installed, terminated and operated within acceptable industry practices. The manufacturer shall agree to replace any defective section of cable free of charge, and extend the same warranty on the replacement cable.
  - c. Installation instructions and recommendations.
  - d. Splicing equipment and kits.
  - e. Termination equipment and kits.
  - f. Manufacturer's factory test data.

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g. Recommended field test procedures

## 2. Field Test Reports

a. After installation perform field acceptance testing and submit certified field test reports. Sections of cable fail the test shall be replaced and retested.


## D. Product Standards

Products shall conform to the following standards:

1. ICEA S-93-639
2. NEMA WC 74
3. AEIC CS-8
4. UL-1072 (For Type MV-105 Cables)
5. ASTM B-496-Compact Strand and ASTM Standard 1000
6. IEEE Standard 383 and Standard 386
7. ANSI Standard C119.1
8. NFPA 70

## E. Manufacturers

1. Subject to compliance with the design requirements, provide medium voltage cables by one of the following manufacturers:
  - a. Kerite (preferred)
  - b. Okonite
2. Subject to compliance with the design requirements, provide medium voltage splicing, terminating kits and connectors by one of the following manufacturers:
  - a. Raychem
  - b. 3M Electrical Products Division
  - c. Thomas & Betts Corporation/Elastimold
  - d. Cooper Power Systems
3. Subject to compliance with the design requirements, provide medium voltage fire proofing tape by one of the following manufacturers:
  - a. 3M Scotch 77 Fire Retardant Arc Proofing Tape with banding of Scotch 69 Glass


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### Cloth Electrical Tape

- b. Plymouth-Bishop 53 Plyarc Arc and Fire Proofing Tape
- c. Industrial Energy Products “Hot-Stop” XLN Tape

## F. Material

1. Splice kits shall be a single in-line per conductor (3 kits per feeder) for splicing medium voltage cable in manholes and where it is required.
2. Splice kits, 3M QS and QS II or approved equal, shall be molded EPDM rubber, waterproof, capable of passing ANSI C119.1-1986 water immersion tests, heat- shrink type, compatible with the cable construction, dimensions, and materials. Taped splices will not be acceptable.
3. Connectors for splicing shall be a compression type, compatible with splicing kits and conductors, applied with oxidation-inhibiting compound where applicable and approved for application, for each conductor.
4. Indoor termination kits shall be one per conductor (3 kits per feeder) at medium voltage switchgear. Outdoor termination kits shall be one per conductor (3 kits per feeder) at customer’s dead-end pole for connection to overhead service or in the underground/manhole installation. Outdoor termination kits shall have multiple skirts to increase surface creepage distance. The termination kits shall be compatible with the cable construction, dimensions, and materials, and shall meet Class 1 requirement per IEEE-48-1996. The termination kits package shall include shield ground strap for shielded cable termination.
5. At the primary side of each padmount transformer or padmount switch shall require six, 15 kV, 600A deadbreak elbow connectors and, if required, six matching deepwell inserts. Elbows shall meet the requirements of ANSI/IEEE Standard 386- 1995 for separable insulated high-voltage connectors, and shall be fully compatible with 15 kV construction, dimensions, and materials, and with the bushing wells and switching modules provided on the transformers.
6. Connectors and lugs for 15 kV terminations shall be a compression type, compatible with the equipment to which being connected and conductors, applied with oxidation-inhibiting compound where applicable and approved for application.
7. Connectors shall be made by Cooper Power Systems or Elastimold or approved equivalent.
8. The fire proofing tape shall be fire-retardant, arc-proofing, and shall consist of a flexible conformable fabric having one side coated with a fire-retardant, flexible polymeric coating and/or an intumescent elastomer. Tape shall conform to ASTM- 1000 standards. The tape

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shall be 1/16” thickness by 3” width, with non-corrosive to the cable jacket, and shall not be fabricated from any hazardous substances.

## G. Accessories or Special Features

- Wherever the design called for, usually at padmount loop-fed feeder cables, fault indicators shall be mounted. Fault indicators shall be automatically current reset type with inrush restraint feature, arranged to clamp to cable sheath and provide a display after a fault has occurred in cable. Fault indicators shall not be affected by heat, moisture, and contusive conditions and shall be installed at other conditions recommended by manufacturer. Current reset rated shall be at minimum 2.4A, trip rating 600A, for 0.25”-2.0” diameter cable such as made by Power Delivery Products indicators Cat # 29-3114-000 with automatic reset time of 4 hours.

## H. Special Requirements


- All MV power cables shall be rated 15 kV including Alternate Power Systems.
- All power cables in the electrical manhole shall be protected with fire proofing tape.
- Where alternate power wiring is in a manhole along with the normal power service, all efforts shall be made to insure that the alternate power cables are separated and run as far apart as possible from the normal power cables.

## I. Quality Control Testing

- Perform factory production tests to insure that conductor resistance, insulation resistance, and high voltage meet all requirements in accordance with above mentioned industrial standards criteria.
- Specifically voltage withstand, tested for 5 minutes minimum, shall be 47 kV AC and 94 kV DC, minimum.


## J. Preparation

- Cable reels shall be shipped in an upright position supported by both outside flanges.
- Water tight seals shall be applied to cable ends to prevent the entrance of moisture during transit, storage and installation.

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## K. Installation Guidelines

1. Installation medium voltage cables, splices, terminations, and other required accessories in strict accordance with manufacturer's written instructions, applicable codes, and recognized industrial practices.
2. Prior to cables pulling all ducts shall be swept.
3. Prior to pulling cables into ducts, the contractor shall verify that manufacturer's cable pulling tension, side wall pressure, and bending radii limits and make sure they will not be exceeded.
4. Neatly train, rack, and strap MV cables at each manhole and termination. Install an 1 1/2" engraved plastic tag on each cable at each manhole and termination for feeder number and conductor phase identifications. The cable labeling tag shall be made by Tech Products see Section: Electrical Identification.
5. Splices and taps shall be installed so that they possess equivalent-or-better mechanical strength, ampacity and insulation ratings than cables being spliced.
6. Install cables of less than 500 foot length without intermediate splices.
7. Install size #4/0, 600V, XHHW-2 insulated copper ground conductor with each primary circuit.
8. Prior to application of termination and splice kits, verify that sufficient space is available in the box, enclosure, or manhole enclosing each such termination or splice.
9. Exposed live portions of medium-voltage cable terminations shall be insulated with a minimum 1/4" thick covering of Kearney Air-Seal, or equivalent.
10. Exposed portions of medium-voltage cables in manholes, handholes and pullboxes shall be individually wrapped with arc and fireproofing tape for entire length, plus one inch (1") into electrical ducts at each entry/exit. Tap shall be wrapped around conductor sets spirally in accordance with manufacturer's instructions. Non-adhesive tapes shall be banded with a layer of glass cloth electrical tape per manufacturer's recommendations.
11. Maintain continuity of concentric neutrals and/or metallic shields across splice points, within the waterproof splice kit jacket.
12. 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.
13. In manholes for new radial runs 600 amp conductor dead break elbows shall be used instead of cable splices.

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14. All high voltage cable terminations shall be by cable splicing certified technicians. Connecticut Cable is the preferred contractor for all high voltage cable terminations on the Yale campus.

## L. Field Quality Control

1. Field Testing: Engage a qualified testing and inspecting agency to perform the following field tests and inspects and prepare test reports:
  - a. Perform each visual and mechanical inspection and electrical test stated in InterNational Electrical Testing Association (NETA) Acceptance Testing Specifications (ATS). Provide a written report and certify compliance with test parameters.
  - b. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
  - c. Remove and replace failed units or sections and retest as specified above.

**End of Section**