UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated July 2025
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DIVISION 26 - ELECTRICAL

SECTION 26 05 13

MEDIUM-VOLTAGE CABLES

08/25

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USACE / NAVFAC / AFCEC **UFGS-26 05 13 (August 2025)**

Preparing Activity: USACE

Superseding
UFGS-26 05 13.00 10 (May 2023)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

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SECTION 26 05 13

MEDIUM-VOLTAGE CABLES
08/25

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NOTE: This guide specification covers the requirements for medium-voltage cables, including shielded and nonshielded single-and multiple-conductor power cables, portable cables, cable splices and terminations, single- and multiple-conductor potheads, and fireproofing cables in manholes and utility tunnels.

Show plan layout of power cable and power-cable terminations on drawings. Show the size, type, electrical characteristics, and raceway system of power cables and type of cable termination on electrical riser diagrams.

Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.

Remove information and requirements not required in respective project, whether or not brackets are present.

Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).

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PART 1 GENERAL

[Provide the project name, contract name, and a brief description of the work covered. Provide references to the Basic or General electrical section and any other technical sections that might or should reference this section.][Section 33 71 01 OVERHEAD TRANSMISSION AND DISTRIBUTION]

[33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION] applies to work specified in this section.

1.1 DEFINITIONS

Medium-voltage power cables include all cables rated above 2,000 volts up to 35,000 volts.

1.2 REFERENCES

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NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

Use the Reference Wizard's Check Reference feature when you add a Reference Identifier (RID) outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text are automatically deleted from this section of the project specification when you choose to reconcile references in the publish print process.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

ASTM INTERNATIONAL (ASTM)

ASTM B3	(2013; R 2024) Standard Specification for Soft or Annealed Copper Wire
ASTM B8	(2023) Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B33	(2010; R 2020) Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM B172	(2017; R 2024) Standard Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors
ASTM B174	(2017; R 2024) Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors
ASTM D746	(2024) Standard Test Method for Brittleness Temperature of Plastics and

	Elastomers by Impact

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE 48	(2020) 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
IEEE 386	(2016) Separable Insulated Connector Systems for Power Distribution Systems Rated 2.5 kV through 35 kV
IEEE 400	(2023) Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems Rated 5 kV and Above
IEEE 400.2	(2024) Guide for Field Testing of Shielded Power Cable Systems Using Very Low Frequency (VLF)
IEEE 404	(2012) Standard for Extruded and Laminated Dielectric Shielded Cable Joints Rated 2500 V to 500,000 V
IEEE 1202	(2006; R 2012; CORR 1 2012) Flame-Propagation Testing of Wire and Cable
IEEE C2	(2023) National Electrical Safety Code

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA T-29-520	(1986) Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input Rate of 210,000 B.T.U./Hour

INTERNATIONAL ELECTRICAL TESTING ASSOCIATION (NETA)

NETA ATS	(2025) Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

ANSI C119.1	(2023) Electric Connectors - Sealed Insulated Underground Connector Systems Rated 600 Volts
ANSI/NEMA WC 71/ICEA S-96-659	(2014; R 2022) Standard for Nonshielded Cables Rated 2001-5000 Volts for use in the Distribution of Electric Energy
NEMA BI 50018	(2024) Cable Cleats
NEMA WC 58/ICEA S-75-381	(2008) Portable and Power Feeder Cables for Use in Mines and Similar Applications

NEMA WC 74/ICEA S-93-639	(2022) 5-46 kV Shielded Power Cable for Use in the Transmission and Distribution of Electric Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2023; ERTA 1 2024; TIA 24-1; TIA 25-2) National Electrical Code
NFPA 70E	(2024) Standard for Electrical Safety in the Workplace

U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

30 CFR 7.407	Test for Flame Resistance of Electric Cables and Cable Splices

UL SOLUTIONS (UL)

UL 4	(2004; Reprint Mar 2021) UL Standard for Safety Armored Cable
UL 1072	(2006; Reprint Oct 2024) Medium-Voltage Power Cables
UL 1581	(2019; Reprint Nov 2023) UL Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords
UL 1685	(2015) UL Standard for Safety Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables

1.3 SUBMITTALS

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NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item, if the submittal is sufficiently important or complex in context of the project.

For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes

following the "G" typically are not used for Navy, and Air Force.

The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.

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Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are for Contractor Quality Control approval. Submittals not having a "G" or "S" classification are for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

List of Splices and Terminations to be Installed by Splicer/Terminator; G, [_____]

SD-02 Shop Drawings

Pulling Plan; G, [_____]

SD-03 Product Data

Multiple-Conductor Shielded Cables; G, [_____]

Multiple-Conductor Nonshielded Cables; G, [_____]

Single-Conductor Shielded Cables; G, [_____]

Single-Conductor Nonshielded Cables; G, [_____]

Ground Conductors; G, [_____]

Cable Cleats; G, [_____]

Flexible and Portable Cable; G, [_____]

Cable Supports and Fittings; G, [_____]

Cable Grips; G, [_____]

Cable Tags; G, [_____]

Fireproof Tape; G, [_____]

Splices; G, [_____]

Terminations; G, [_____]

Metal-Clad and Armored Cable; G, [_____]

Jumper Cables; G, [_____]

Cable Identification; G, [_____]

SD-05 Design Data

Submit within 90 calendar days of Notice to Proceed.

Cable Pulling Calculations; G, [_____]

Cleat Manufacturer's Calculations; G, [_____]

SD-06 Test Reports

Factory Inspection and Tests; G, [_____]

Field Acceptance Testing; G, [_____]

Wire And Cable Test Record Form; G, [_____]

Phase Rotation Test Record Form; G, [_____]

SD-07 Certificates

Splicer/Terminator Certifications; G, [_____]

SD-08 Manufacturer's Instructions

Terminations; G, [_____]

Splices; G, [_____]

1.4 ADMINISTRATIVE REQUIREMENTS

1.4.1 Pre-Installation Meetings

No later than [30][_____] days after Notice to Proceed, coordinate with the Contracting Officer to schedule a pre-installation meeting. Submit the following for review and approval prior to the meeting:

a. Pulling Plan. Do not perform any pull until Government reviews and approves the pulling plan, pulling calculations, and cable factory test certificates.

b. Splicer/Terminator Certifications

c. List of Splices and Terminations to be Installed by Splicer/Terminator

d. Manufacturer's catalog data for all cables, cable supports and fittings, cable tags, fireproof tape, splice kits, terminations, and any other product data required to complete the work.

1.5 QUALITY CONTROL

1.5.1 Regulatory Requirements

In each of the publications referred to herein, consider the advisory provisions to be mandatory. Interpret references in these publications to the "authority having jurisdiction," or words of similar meaning, to mean the Contracting Officer. Ensure equipment, materials, installation, and workmanship are in accordance with the mandatory and advisory provisions

of NFPA 70, IEEE C2 unless more stringent requirements are specified or indicated.

1.5.2 Standard Products

Provide materials and equipment that are products of manufacturers regularly engaged in the production of such products which are of equal material, design and workmanship. Provide products which have been in satisfactory commercial or industrial use for 2 years prior to bid opening. Ensure the 2-year period includes applications of equipment and materials under similar circumstances and of similar size. Ensure the product has been on sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2-year period. Where two or more items of the same class of equipment are required, these items must be products of a single manufacturer.

1.5.3 Qualifications`

Verify personnel performing Medium Voltage (MV) splicing or terminations have [5][ ] years minimum experience in cable splicing and terminations of the type used in this project. Submit splicer/terminator certifications issued by the cable splice and termination manufacturer who has examined and tested a test splice or termination of each type required by this contract for each cable splicer. Ensure the certification identifies which splices and terminations it applies to.[Require each individual, certified or not, with the required medium voltage splicing and terminating experience, who is to perform cable splicing or terminating, to perform a minimum of one splice or termination of each type in the presence of the manufacturer's[and Government's] representative. Supply all materials and tools required for the demonstration splices and terminations.][Submit each splice or termination performed by individuals without manufacturer's certification to the manufacturer for testing and subsequent certification.][Certification is not required for load break elbows and dead break connectors.]

Once a splice or termination has been started by a splicer, ensure the same splicer completes that particular splice, and that each termination and splice is started and completed in one continuous work period.

Maintain and submit a list of splices and terminations to be installed by splicer/terminator. Ensure the list includes the following for each splice or termination completed.

a. Name of splicer/terminator.

b. Date splice or termination was performed.

c. Location of splice or termination. For terminations at equipment indicate equipment number as required to completely define the location.

d. Feeder number, as applicable.

1.6 FACTORY INSPECTION AND TESTS

1.6.1 General

Perform factory inspection and tests of wire and cable by and at the plant

of the manufacturer. Ensure testing complies with Section 7 of ANSI/NEMA WC 71/ICEA S-96-659 and Section 9 of NEMA WC 74/ICEA S-93-639 as applicable. Include specific tests required for particular materials, components, and completed cables as specified in the sections of the above standards applicable to those materials, components, and cable types. Also perform tests in accordance with the additional requirements specified below. In addition to the manufacturer's routine sample testing, for each reel perform an insulation resistance test, and a shield continuity test as applicable. Do not ship cable until after the manufacturer's test reports have been submitted and approved.

1.6.2 Flame Tests

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NOTE: The traditional IEEE 383 Flame Test has been moved to IEEE 1202. Indication that the wire or cable has passed the IEEE 383 Flame Test is still acceptable, and a variance would not be required.

The Canadian FT4 Flame Test is recognized by UL as being equivalent to the IEEE 1202 and UL 1685 Flame Tests and may be accepted as a variance to these specified tests.

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Provide multiple-conductor and single-conductor cable assemblies for cable trays and risers that have passed IEEE 1202 (FT4), UL 1685, or ICEA T-29-520 flame tests. For all other single-conductor cables and individual conductors of multiple-conductor cables, provide cables that have at least passed UL 1581 (VW-1 or FT1) flame tests. If such tests have previously been performed on identical cables of the same design and is indicated in the product data, these tests need not be repeated.

1.7 DELIVERY, STORAGE, AND HANDLING

a. Ship cables on reels in a way that protects the cable from mechanical injury. Hermetically seal end of each cable length using heat-shrinkable molded cable end caps to exclude moisture and securely attached to the reel.

b. Store cables on reels with the axis hole parallel to the horizontal plane. Cables on reels stored laying flat on the side of the reel will not be accepted. Roll reels in the direction indicated by the manufacturer.

c. Make the minimum reel drum diameter a minimum of 14 times the overall diameter of the cable. Ensure that each cable length is installed with a pulling eye installed by the manufacturer, for installation in ducts, manholes, and utility tunnels.

d. Unreel or uncoil cables slowly to prevent damage to the sheath by sudden bending. Stop unreeling or uncoiling if kinks appear and do not proceed until kinks have been removed. Kinked cable will be rejected. Improperly handled cable may be rejected.

PART 2 PRODUCTS

2.1 MEDIUM-VOLTAGE CABLE

2.1.1 Wire and Cable Schedule

Provide cable [in accordance with the requirements of the Conduit and Cable Schedules][, and][as indicated on the drawings]. Estimated quantities [listed in the Conduit and Cable Schedules][shown on the drawings]are approximate for bidding purposes and must be verified by the Contractor.

2.1.2 Governing Standards

Provide materials, construction, and tests, unless otherwise specified, conforming to the applicable requirements of ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639 as applicable, for the following:

[a. Multiple-Conductor Shielded Cables

][b. Multiple-Conductor Nonshielded Cables

][c. Single-Conductor Shielded Cables

][d. Single-Conductor Nonshielded Cables
]

2.2 MATERIALS

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NOTE: Variations from these specifications may be appropriate in some cases. In addition to increasing rated circuit voltage where large overvoltages could occur, material sizes and strengths should be coordinated to withstand any pulling forces which will be applied. The lower strength of EPR, even jacketed, may at times preclude the use of this material for long pulls. If variations are requested by a Contractor, they should only be approved if the safety and integrity of conservatively designed circuits are not compromised.

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2.2.1 Submittal Requirements

Submit catalog data sufficient to demonstrate compliance with the specifications requirements for all cable types provided.

2.2.2 Rated Circuit Voltages

Provide cables with minimum rated circuit voltages in accordance with ANSI/NEMA WC 71/ICEA S-96-659, and NEMA WC 74/ICEA S-93-639 as applicable.

2.2.3 Conductors

2.2.3.1 Material for Conductors

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NOTE: If aluminum is to be specified for any of the

wire purchased, revise the paragraphs accordingly.

Conductors for wire and cable may be aluminum or copper. Aluminum conductors may be considered for use in accordance with NFPA 70, Article 310.106. When used, aluminum conductor material must be AA-8000 series electrical grade aluminum alloy. The designer must consider several factors when deciding to use aluminum instead of copper including comparisons of electrical properties, mechanical properties, environmental properties specific to the intended installation, reliability, and cost. Specifications for wire and cable may be written to permit either aluminum or copper conductors where aluminum is suitable for the application, suitably reliable, and is determined to be more economical than copper.

Aluminum conductors should be permitted only where cost comparisons show an overall savings and after a careful evaluation of the corrosion problems associated with their use. They should only be allowed where installers are qualified to make reliable connections with them. Proper wire and cable connectors must be suitably rated for installation with the conductor material to which they are applied. Wire and cable connectors used with aluminum conductors must be suitably rated, termination must be prepared correctly, and an antioxidant must be applied when the connector is installed. Costs should be compared to between all pertinent items such as installation, conduit, tray, tunnel and duct banks, lifetime costs of energy losses if significant, and differences in ventilation needs if losses are evaluated. Conductors should have the required current-carrying capacities, the required short circuit capacities, and should be satisfactory with respect to voltage drop. Aluminum conductors should be sized to have equal or less resistance than the alternate copper conductors unless the total cost comparison, including losses, shows a net advantage otherwise. In such cases where the engineering costs to properly compare the use of the two materials will exceed any possible savings to be achieved by aluminum, the arbitrary choice of copper may be the best policy.

****

Provide conductors that in accordance with Section 2 of ANSI/NEMA WC 71/ICEA S-96-659, and NEMA WC 74/ICEA S-93-639, annealed copper conforming to ASTM B3 or ASTM B8 unless specified otherwise. Copper conductors must be bare, or tin- or lead-alloy-coated, if required by the type of insulation used. Tin-coated copper conductors must conform to ASTM B33.[Ensure that aluminum conductors, if permitted, are Type AA-8000 aluminum conductors. Do not use Type 1350 aluminum conductors.]

2.2.3.2 Conductor Size

Minimum wire sizes are No. 6 AWG for 5kV cable and and No. 2 AWG for 15kV cable.

2.2.3.3 Stranding

Provide class B stranding as defined in Table G-2 of ANSI/NEMA WC 71/ICEA S-96-659, and Table H-2 of NEMA WC 74/ICEA S-93-639, as applicable.

2.2.4 Insulation

****

NOTE: The previously-used AEIC CS1 for Paper Insulated Lead-Shethed Cable (PILC) is no longer applicable to modern construction, as most manufacturers have abandoned that market in favor of improvements in Cross-Linked Polyethyene (XLPE) cable. The only modern application for PILC is to replace a section of an existing run of PILC, which is not economicaly feasible. Transitions to XLPE for replacement segments in PILC has become the norm.

****

2.2.4.1 Insulation Material

Except as otherwise specified, provide cross-linked thermosetting type (XLPE or XLPO) or an ethylene-propylene rubber (EPR) type insulation meeting the requirements of Section 4 of ANSI/NEMA WC 71/ICEA S-96-659 and NEMA WC 74/ICEA S-93-639 as applicable. Polyvinyl Chloride (PVC) insulation will not be accepted.

2.2.4.2 Insulation Thickness

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NOTE: The NEC Article 315.10(C) allows a 100 percent insulation level where protection is provided by instantaneous trip relaying at any voltage. But for ungrounded systems operating at 4160 volts or higher that could experience a ground fault of up to one hour, a 133 percent insulation level is required. For longer than one hour, a 173 percent level is required.

****

Provide minimum insulation thickness for each conductor based on its rated voltage and insulation material for [100][133][172] percent insulation levels. For both single-conductor cables and individual conductors of multiconductor cables, provide insulation thickness per Table 4-2 of ANSI/NEMA WC 71/ICEA S-96-659 and per Table 4-4 of NEMA WC 74/ICEA S-93-639 as applicable. Thicknesses shown below are nominal, ranging from -5 mils below nominal to +30 mils above nominal. Acceptable nominal thicknesses are:

Voltage Rating (kV)	Insulation Level (percent)	Typical Insulation Thickness	
		mm	mils
2.4	100	Depends on conductor size, see Table 4-2, NEMA WC 71	
	133	Depends on conductor size, see Table 4-2, NEMA WC 71	
5	100	2.29	90
	133	2.92	115
	173	3.56	140
8	100	2.92	115
	133	3.56	140
	173	4.45	175
15	100	4.45	175
	133	5.59	220
	173	6.6	260
25	100	6.6	260
	133	8.13	320
	173	10.67	420
35	100	8.76	345
	133	10.67	420
	173	14.73	580

2.2.4.3 Insulation Shielding

Provide shielding that complies with Sections 5 and 6 of NEMA WC 74/ICEA S-93-639 for all cables rated 5kV and higher.

[2.2.4.4 Concentric Neutral Shield

Provide [copper][aluminum] wires helically applied over the insulation shield, where the minimum total cross sectional area, of the shield wires, is [1/3 of the core][full core] conductor for the cable. Minimum size of an individual shield wire is 1.6 millimeter No. 14 AWG.

]2.2.5 Jackets

Provide jackets meeting the requirements of Section 5.1 of ANSI/NEMA WC 71/ICEA S-96-659 and Section 7.1 of NEMA WC 74/ICEA S-93-639 as applicable for all cables. Individual conductors of multiple-conductor

cables are required to have jackets only if they are necessary for the conductor to meet other specifications herein. For single-conductor cables and individual conductors of multiple-conductor cables, except for shielded cables, provide jackets in direct contact and adhered or vulcanized to the conductor insulation. For multiple-conductor cables and shielded single-conductor cables, provide a common overall jacket, tightly and concentrically formed around the core. Repaired jacket defects found and corrected during manufacturing are permitted if the cable, including jacket, afterward fully meets these specifications and the requirements of the applicable standards.

2.2.5.1 Jacket Material

Provide jackets of one of the materials listed below, in accordance with Section 5 of ANSI/NEMA WC 71/ICEA S-96-659 and Section 7 of NEMA WC 74/ICEA S-93-639 as applicable. Polyvinyl chloride compounds will not be permitted.

a. Black neoprene (CR).

b. Chlorosulfonated polyethylene (CSPE)

c. Chlorinated polyethylene (CPE)

d. Low smoke zero halogen (LSZH)

e. Crosslinked polyolefin (XLPO)

f. Medium-density polyethylene (MDPE)

2.2.5.2 Jacket Thickness

Ensure the minimum thickness of the jackets at any point is not less than 80 percent of the nominal thicknesses specified in Tables 5-2 and 5-3 of ANSI/NEMA WC 71/ICEA S-96-659 and Table 7-4 of NEMA WC 74/ICEA S-93-639 as applicable.

2.2.6 Cabling

Assemble individual conductors of multiple-conductor cables with flame-and moisture-resistant fillers, binders, and a lay in accordance with Section 8 of NEMA WC 74/ICEA S-93-639 as applicable. Provide non-hygroscopic fillers compatible with the cable insulation, jacket, and other components of the cable in the interstices of multiple-conductor round cables, with a common covering where necessary to give the completed cable a substantially circular cross section. Provide rubber-filled or other approved type of binding tape that is compatible with the other components of the cable and lapped at least 10 percent of its width.

2.2.7 Dimensional Tolerance

Ensure outside diameters of single-conductor cables and of multiple-conductor cables do not vary more than 5 percent and 10 percent, respectively, from the manufacturer's published catalog data.

2.2.8 Cable Identification

Provide cables with printing on the outer jacket showing the name of the manufacturer, conductor size and material, type of insulation and nominal

thickness, and the year in which the cable was manufactured. Closely group the information on the tape at 1.8 meters 3.3-foot (1 meter) maximum intervals to permit complete identification.

2.3 SPECIAL WIRE AND CABLE

2.3.1 Ground Conductors

Provide ground conductors that are bare, soft-drawn, Class A or B stranded copper cables sized in accordance with NFPA 70, or NEMA WC 74/ICEA S-93-639 Section 8 as applicable. The ground conductor may be integral to a 3-conductor cable assembly where applicable.

[2.3.2 Metal-Clad and Armored Cable

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NOTE: Metal-clad/Armored Cables, and Jumper Cables are optional and should be deleted if not being specified.

****

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NOTE: Metal-clad and armored cable may used wherever physical protection is required for an exposed cable. It is also often used in cable tray where different voltage ratings must occupy the same cable tray, to avoid violating the NEC Article 300.3(C) requirement that all cables in a cable tray have insulation rated to the highest voltage in the tray, unless the cables are separated by a barrier. The metal cladding or armor serves as such a barrier.

Metal-clad cables are designated as Type MC. Cables designated as Type AC are armored cables built to other less stringent requirements under other sections of ICEA/NEMA standards or under UL 4 Armored Cable than for Type MC. Type AC is not listed for wet locations and is limited by the standards for wire size and number of conductors. Type MC does not have these restrictions.

****

Provide [metal-clad Type MC][armored Type AC] cables where indicated to be armored or metal-clad. Ensure the metallic covering is a continuous sheath of interlocked steel strip, interlocked aluminum alloy strip, or a corrugated aluminum-base alloy tube conforming to the requirements NEMA WC 74/ICEA S-93-639 Section 7.2, or [UL 1072, Section 28 for Type MC][UL 4 Section 7 for Type AC]. Galvanized steel wire armor will not be accepted. Unless indicated otherwise, ensure [metal-clad Type MC][armored Type AC] cables have insulation as described in paragraph INSULATION, and outer jackets as described in paragraph JACKETS. Provide individual conductors and cable assemblies that also have passed the flame tests described in paragraph FLAME TESTS.

][2.3.3 Flexible and Portable Cable

****

NOTE: Flexible cables have much finer stranding and are designed under different standards for

installations where above-average flexibility is required, or for temporary installations where the cable is subject to occasional disturbance or movement.

Cables listed only as "welding cable" are only recognized by the NEC in Article 630 as being suitable for connections to portable welders and should not be used for any other purpose. Welding cable cannot be accepted as a substitute for the specified flexible cable.

****

Provide type SH or type SHD cables rated for 5000 volts minimum, conforming to the requirements of NEMA WC 58/ICEA S-75-381, for cables indicated to be flexible or portable. Ensure stranding complies with ASTM B172 or ASTM B174. Provide individual conductors and cables that also have passed the flame tests described in paragraph FLAME TESTS or the MSHA flame test of 30 CFR 7.407. Cables listed as Welding Cable will not be accepted.

][2.3.4 Jumper Cables

****

NOTE: Jumper cables are only required where connections are being made to surge equipment internal to switchgear.

Cables listed only as "welding cable" are only recognized by the NEC in Article 630 as being suitable only for connections to portable welders and should not be used for any other purpose.

****

Unshielded jumper cables may be used only for internal direct connection of bus to surge protection devices within a circuit breaker enclosure or transformer enclosure. Cables listed as Jumper Cable with the appropriate voltage rating may be used. Cables listed as Welding Cable will not be accepted.

]2.4 SPLICES, CONNECTIONS, AND TERMINATIONS

****

NOTE: Pad-mounted equipment may require plug-in type terminations for connection and disconnection in the field. Such terminations are called load break and nonload break depending on their ratings. Use this option if these connections are anticipated.

****

[2.4.1 Load Break and Nonload Break Connectors

Provide [load-break][and][nonload-break] terminations that comply with IEEE 386 requirements where the drawings indicate plug-type field connections to equipment terminals, or where otherwise specified. Provide connector with a steel reinforced hook-stick eye, grounding eye, test point, and arc-quenching contact material. Ensure connections are compatible with equipment bushings.

]2.4.2 Splices

****

NOTE: Heat shrink splices are slighly less expensive and provide better protection against water, dust, oil, and other contaminants. But they require skill in applying the proper amount of heat for proper installation without damaging equipment, and they do not expand and contract with environmental temperature the same as most insulation and jacket materials, which may eventually create voids. They are also less flexible than cold shrink splices. Cold shrink splices are slightly more expensive but are faster and easier to install without risk of damage to equipment. They exhibit expansion and contraction similar to most insulation and jacket materials and are more flexible than heat shrink. Select cold shrink splices indoors, in confined spaces, and outdoors where protected from weather. Select heat shrink splices outdoors where exposed to weather, or in dusty or oily environments.

****

Provide [heat][cold] shrink splice kits which are the product of a single manufacturer. Ensure the power cable splice meets the requirements of IEEE 404 for a [5][15][_____] kV rating, and are rated by the manufacturer for use on [5][15][_____] kV class cable systems. Ensure splices are rated for continuous operation at 105 degrees C 221 degrees F, with an emergency overload temperature rating of 140 degrees C 284 degrees F. Ensure the kit is capable of splicing cables with copper[or aluminum] conductors sized as indicated in the contract drawings or accommodate a conductor size transition. Provide splices specifically designed for the cable and grounding provisions.

[Provide heat shrink splices which include but are not limited to the following:

a. Inner heat shrink stress control tube with external end sealant, additional heat shrink tube over inner tube and inner tube end sealant.

b. Heat shrink outer wraparound sleeve with heat sensitive indications on both the tube and rail/channel area to indicate proper torch heating, stress relief material, mastic, sealant, shielding mesh, and silicone grease.

][Provide splices of a cold shrink design which does not require any additional heat source for installation. The cold shrink splice body must be of a molded design made of silicone rubber with splice jacketing made of EPDM rubber.]

2.4.3 Terminations

****

NOTE: IEEE 48 identifies three classes of MV cable terminations: Class 1, Class 2, and Class 3. Class 1 is further broken down into Class 1A, Class 1B, and Class 1C.

All classes providing electric stress control for the cable insulation shield terminus. Additionally:

Class 1 terminations also essentially seal the cable materials from the outside world preventing even air from coming into contact with the conductor or insulating medium. In general, Class 1 is an outdoor termination for wet location, or wet locations indoors.

Class 1A is for solid dielectric insulation
Class 1B is for laminated paper insulation
Class 1C is exclusively for pressurized cable systems, which immerse laminated paper-insulated cables in an oil or gas medium.

Class 2 can be for indoor use, being less stringent on controlling the environment's access to the conductor and insulating medium at the shield terminus, but also continues to insulate each conductor from ground up to the point of actual mechanical connection.

Class 3 terminations only provide electric stress control for the shield terminus, but are suitable for single-conductor cable being terminated directly to a bus inside a grounded enclosure.

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Provide Class [1A][2][3] terminations per IEEE 48.

[2.4.4 Cable Cleats

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NOTE: Cleats are required only where cables are running in open cable tray.

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NOTE: Use this option for three-phase medium-voltage feeder cables installed in open cable tray.

Cables under load expand with heat, and will flex within the cable tray during load cycles. Large cables that are cleated to cable tray have been know to buckle the cable tray, because the cleat spacing did not accommodate thermal expansion between cleat points where all cleats were affixed to the cable tray. Intermediate restraints not affixed to the cable tray (unattached cleats) are typically located between cleats that are affixed to the cable tray. The intermediate restraints keep the cables from flailing away from each other and causing physical damage under fault conditions, as do the fixed cleats, but still allow the cable bundle more opportunity to flex within the cable tray. Cleat and intermediate support spacing is a function of the electromagnetic forces exerted between the three

phases during a fault, expressed as Newtons per meter. Cleat type and spacing is best detrmined by the cleat manufacturer based on cable size, arrangement of cables in the cable tray, and the peak value of short circuit current available. Cleat spacing calculations are thus required to be submitted for approval.

****

Provide cable cleats meeting the requirements of NEMA BI 50018, designed specifically to secure cables from the electromagnetic forces of a short circuit. The peak short circuit current available is [_____]kA. Submit cleat manufacturer's calculations showing cleat or grip spacing for short circuit restraint in horizontal runs, and install cleats or grips at spacing no further than the calculated value. Include provision for intermediate supports or unattached cleats for short circuit forces that will allow thermal flexing of the cable bundle.

]2.5 SUPPORTS, TAGS, AND ACCESSORIES

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NOTE: Coordinate the following paragraph with Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION if Section 33 71 02 UNDERGROUND ELECTRICAL DISTRIBUTION is used in this project.

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2.5.1 Cable Supports and Fittings

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Provide cable supports, related fittings, and accessories for use in corrosive underground locations, such as manholes and utility tunnels, with a factory-applied coating of PVC of at least [0.51][_____] millimeter [20][_____] mils thick. Provide PVC coated items that have a uniform thickness and are free of blisters, breaks, and holidays. Provide PVC compound that conforms to ASTM D746.]

[

Provide cable racks, cable tray supports and related fittings that are UL-listed [standard][heavy]-duty nonmetallic [glass-reinforced nylon] [polycarbonate].]

2.5.2 Cable Tags

Provide cable identification tags of polyethylene or polypropylene that are non-corrosive. Ensure tags are resistive to acids, alkalis, organic solvents, salt water, and are distortion resistant to 149 degrees C. Tags must be suitable for contact with the type of insulation or jacket material used, and be composed of block letters, numbers, and symbols 1 inch high on a yellow background. Ensure letters, numbers, and symbols do not fall off or change positions regardless of the cable tags orientation. Markings must have been tested by an independent testing laboratory or by the manufacturer to indicate that the markings will not stain or discolor when subjected to an accelerated aging test while in contact with the cable materials and ultraviolet light exposure. Provide a one-piece nylon, self-locking tie at each end of the cable tag. Ensure ties have a minimum loop tensile strength of 175 pounds.

2.5.3 Fireproof Tape

Provide fireproof tape approximately 0.8 millimeter 30 mils thick by 76

millimeters 3 inches wide, consisting of a flexible, unsupported elastomer that expands in fire to provide a thick char buildup between the flame and the cable. Ensure the tape does not give off a smoke when subjected to flames or support combustion. Also, ensure tape does not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Install medium-voltage cables in accordance with NFPA 70, NFPA 70E; and IEEE C2. Refer to contract provisions for safety submittals and requirements associated with working in the vicinity of energized cables and equipment. The use of arc-flash and shock prevention equipment and personal protective equipment is mandatory. Prior to starting work on a medium-voltage cable system, the Contractor must identify and tag the phasing of equipment with a phase rotation meter, and submitting a Phase Rotation Test Record Form. The Contractor is responsible for maintaining the phasing, and matching the existing phase rotation and phasing when installing conductors in existing electrical systems. Install the cables in the following locations:

Exterior:

a. In underground duct banks

b. In conduit above and below grade

c. In manholes

d. By direct burial

Inside Buildings:

a. In conduits, exposed or embedded/concealed

b. On insulator hooks

c. On racks

d. In wall-mounted and ceiling-mounted mounted cable trays

Secure cables with heavy-duty cable ties [and][or cleats] in existing or new trays mounted horizontally, where the cable rests on the tray bottom. Install cable ties at a minimum of [3000][_____] millimeter [10][_____] foot intervals.[Install cleats at intervals as recommended by the cable cleat manufacturer's force calculations.] Secure cables with [PVC-coated][metallic][non-metallic] cable clamps, straps, hangers, or other approved supporting devices to tunnel walls and ceilings, where not installed in cable trays. Immediately seal cut ends of cables cut in the field to prevent entrance of moisture with heat-shrinkable molded cable end caps.

3.1.2 Cable Pulling Calculations

Cable pulling calculations must be performed by the cable manufacturer's Field Engineer or by another qualified engineer and approved by the cable

manufacturer's Field Engineer. Provide calculations that show the cable manufacturer's maximum allowed pulling force and maximum allowed sidewall pressure are not exceeded, and that cables do not require splices. If the calculations show that a splice is required at any point to avoid damage to the cable, immediately bring to the attention of the Government.

3.1.3 Pulling Cables in Conduits, Ducts, Manholes and Utility Tunnels

Thoroughly clean ducts before installation of power cables. Pull a standard flexible mandrel through each duct to loosen particles of earth, sand, or foreign material in the line. Use a mandrel that is not less than [300][_____] millimeter [12][_____] inches long with a diameter 13 millimeter 1/2 inch less than the inside diameter of the duct. Then pull a brush with stiff bristles through each duct to remove the loosened particles. Use a brush with a diameter that is the same as or slightly larger than the diameter of the duct. Cable pulling using a vehicle is not be permitted.

Submit a Pulling Plan including staging provisions, known splice [and][or] termination points, calculations of pulling tension and side wall pressure anticipated, the maximum allowable pulling tension for each pull, and the method of measuring pulling tension throughout the pull. Do not perform any pull until Government reviews and approves the pulling plan and the cable pulling calculations. Cables may only be pulled manually, or by use of a tugger designed for cable pulling. Either method must employ a dynamometer to measure pulling tension throughout the pull.

3.1.3.1 Staging

Pull medium-voltage cables into ducts and utility tunnels with equipment designed for this purpose, including a power-driven winch, cable-feeding flexible tube guide, cable grips, and lubricants. Employ a sufficient number of trained personnel and equipment to ensure correct installation of the cable.

Set up the cable reel at the side of the manhole or tunnel hatch opening and above the duct or hatch level, allowing the cable to enter through the opening without reverse bending. Install a flexible tube guide through the opening in a manner that prevents the cable from rubbing against the edges of structural members.

3.1.3.2 Allowable Sidewall Pressure

The allowable sidewall pressure is the smaller of 7300 newtons per meter 500 pounds per foot of bend radius for 5-15kV shielded cable, 300 pounds per foot for interlocked armored cable and cable rated above 15kV, or the cable manufacturer's recommended maximum value. Show in the pulling plan submittal the calculations for allowable tension and sidewall pressure as well as the anticipated tension and sidewall pressure for each pull in the project.

Unreel cable from the top of the reel, carefully controlling payout. Attach cable to be pulled through a swivel to the main pulling wire by means of a [pulling eye installed by the factory or approved cable splicer] [suitable cable grip permitted only on cables less than 60 meter 200 feet long and less than 50 millimeter2 inches in diameter]. Attach pulling eyes to the cable conductors of the 3-1/c circuit to prevent damage to the cable structure. Pull the entire 3-1/c circuit simultaneously.

3.1.3.3 Minimum Bending Radius

Minimum bending radius during cable pulling operations is 760 millimeter 30 inches. For permanent cable [bending][racking] the minimum bending radius is 12 times cable diameter.

3.1.3.4 Coating of Cables

Liberally coat cables with a suitable cable-pulling lubricant as it enters the tube guide or duct. Do not use greaser and oil lubricants. Cover nonmetallic sheathed cables with wire-pulling compounds, when required, which have no deleterious effects on the cable. Use rollers, sheaves or tube guides, around which the cable is pulled, conforming to the 760 millimeter 30 inches minimum bending radius of the cable during the pulling operations.

3.1.3.5 Pulling Speed

Pull cables into ducts at a speed not to exceed [15][_____] meters per minute 50 feet per minute and not in excess of maximum permissible pulling tension specified by the cable manufacturer. Stop pulling operations immediately with any indication of binding or obstruction and do not resume until such difficulty is corrected. Provide sufficient slack for free movement of cable due to expansion or contraction.

3.1.4 Ventilation

Provide a blower to force fresh air into manholes or confined areas where free movement or circulation of air is obstructed.

3.1.4.1 Moisture Control and Water Intrusion

Have waterproof protective coverings available on the work site to protect against moisture while a splice is being made. Use pumps to keep manholes dry during splicing operations. Never make a splice or termination with the interior of a cable exposed to moisture. Use a manhole ring at least [150][_____] millimeter [6][_____] inches above ground around the manhole entrance to keep surface water from entering the manhole. Before starting the splice, plug unused ducts and stop water seepage through ducts in use.

3.1.5 Installation in Cable Trays

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NOTE: Cables may be configured in a flat cofiguration with one cable diameter spacing between them, or in trefoil (triangular) configuration. NEC Art. 392 provides guidance on cable ampacity depending on the configuration. A flat spaced configuration allows slightly higher ampacity than a trefoil configuration, but may require a wider tray than a trefoil configuration.

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3.1.5.1 General

Use cable pulling sheaves of adequate size where necessary to prevent damage to the cable. Place cables straight and parallel in the trays in a [flat spaced][trefoil] arrangement with a minimum crossing of cables.

Secure cables to the tray as specified. Install identification markers at intervals not to exceed [_____] 18 feet. After all work in the area containing new cables is complete, clean the trays of all dirt and trash generated by the new cable installation. If cable is moved in the cleaning process, reposition to the correct final cable positions in the trays.

3.1.5.2 Bends

The minimum radius to which an insulated conductor or a multiconductor cable may be bent, without specific approval, whether permanently or temporarily during installation, is 12 times the overall diameter of the completed cable for tape shielded cables and 10 times the overall diameter for other cables, or as otherwise recommended by the manufacturer. For multiconductor cable, follow manufacturer's recommendation for type of cable involved.

[3.1.5.3 Cable Grips

For cables installed in vertical wireways, provide supports or grips that provide adequate support of the weight of cables as described in NFPA 70 Table 300.19(A). Determine the size of each support or grip in accordance with the manufacturer's recommendations for each diameter and weight of cable to be secured or supported.

][3.1.5.4 Cable Cleats

Install fixed cleats and unattached cleats at spacing no further than the calculated values as provided by the manufacturer.

]3.1.6 Splices

Make splices in manholes or tunnels except where cable terminations are specifically indicated. Expedite splicing and terminating of cables in order to minimize exposure and cable deterioration. If cable splices in the tunnel are not installed in cable trays, install the cable splices on cable racks or by other approved methods that minimize physical stress on the splice connections. Support splices at approximately the same elevation as the installed cable except where space limitations or existing cable length limitations make this method impractical or impossible.

3.1.6.1 Materials

Use only equipment and materials recommended by the splice manufacturer including calibrated cutting equipment to ensure consistent cut depths when preparing cable ends for the application of the splice kit. Use the cable manufacturer's recommended splice kit. Alternatively, if a kit is not available, connect the cable concentric neutral/shield wires across one side of the splice by split bundling the splice neutral wiring and connecting each bundle set to a continuous No. 4 AWG solid bare copper conductor via two compression conductors. Ensure the No. 4 AWG conductor extrudes from the cable splice jacket and connects to the manholes grounding system. Make all connections within the splice utilizing long barrel-type compression connectors and appropriate compression tools with proper size dies to ensure a satisfactory mechanical and electrical joint. Ensure bare connections of concentric neutral/shield wires are either contained within the splice kit or sealed via an additional outer covering,consisting of a heavy wall, heat-shrinkable tubing containing

adhesive material (mastic) that melts as heat is applied and the outer tubing shrinks to form a moisture proof environmental seal. Provide outer tubing conforming to ANSI C119.1. Ensure splice meets the requirements of IEEE 404 matching the voltage rating of the cable, and is rated by the manufacturer for use on the same voltage rating as the cable. Take extra precautions to seal around the exit area of the bare copper jumpers with an additional mastic per the splice manufacturer's recommendations.

3.1.6.2 Splice Support

Firmly support cable splices made up in manholes on cable racks as indicated. Do not pull cable splices in ducts. Overlap cable ends at the ends of a section to provide sufficient undamaged cable for splicing. Overlap cables to be spliced in manholes to the centerline of the proposed joint by not less than [600][_____] millimeters 2 feet.

Locate cable splices in manholes midway between the cable racks on the walls of the manholes and supported with cable arms at approximately the same elevation as the enclosing duct. Support each cable end termination using a pair of saddle supports under the cable end termination or cable with a minimum [300][_____] millimeter [12][_____] inches and a maximum [750][_____] millimeter [30][_____] inches separation between the supports. Secure the cable end termination and cable to the supports in a manner that prevents movement of termination or cable at the support. Install saddle supports on a galvanized steel framing channel that is anchored to the wall, securely fastened to the cable tray, or installed by other approved methods.

3.1.7 Terminations

Terminate cables in approved cable termination kits. Provide terminations with adequate means for making external connections to the cable conductors of single-conductor cables (phase and concentric neutral if applicable), as well as the single cables of multi-conductor cables. Protect the cable insulation against moisture, oil, or other contaminants. Take extra precautions in physically protecting and supporting cables, and maintaining the insulation level of the cable.

3.1.8 Cable Identification

Provide identification of all cables on both ends using the designations shown on the Contract drawings or as otherwise shown on approved shop drawings. Display the designation by tags conforming to Paragraph 2.5.2 Cable Tags. Install markers in uniform positions on the cables, and where the legends are visible where conductors are terminated at the equipment. Fasten the tags or band markers at each termination, junction or pull box, where cables enter or leave cable trays, manholes, and at other points of access. Install cable tags over the fireproofing as needed. Position the tags so that they are clearly visible without disturbing any cabling or wiring.

3.1.9 Fireproofing

Provide fireproofing (Arc Proofing) for individual cable conductor in manholes, handholes and vaults which carry current at 2200 volts or more. Tightly wrap strips of fireproofing tape around each cable spirally in half-lapped wrapping. Extend the tape 25 millimeter 1 inch into the ducts. To prevent unraveling, random wrap the fireproofing tape the entire length of the fireproofing with pressure-sensitive glass cloth tape.

3.1.10 Grounding

Include a separate ground conductor in all circuits unless the drawings indicate equipment grounding at both ends to the embedded grounding grid of the facility if available, or unless the ground conductor is an integral part of a multiple conductor cable. Support exposed ground cable runs to follow conduit, equipment or concrete wall contours using corrosion resistant clamps or clips. Drilling of equipment housings or frames will be permitted only when approved. Use concrete anchors for fastening to concrete surfaces.

[3.2 DEMOLITION OR CABLE CUTTING

Notify the Contracting Officer 14 working days prior to an outage for demolition or cable cutting of medium voltage electrical system. The Government has established a mandatory inspection point prior to Contractor performing any medium voltage cable cuts or demolition. Notify the Contracting Officer 48 hours in advance of this mandatory inspection point.

As part of the mandatory inspection point, positively identify and label the medium voltage cable to be worked utilizing an electronic cable identifier. Ensure the process of identifying and labeling the cable to be worked is witnessed by the Government. Cable cutting and demolition of any medium voltage cable can occur only after approval by the Contracting Officer. Cut medium voltage cables and conductors by indirect means using cable cutters specifically designed to be operated remotely only. Cutting of medium voltage cables and conductors by direct means is not permitted.

]3.3 FIELD ACCEPTANCE TESTING

3.3.1 Testing

Test per IEEE 400 and NETA ATS recommended procedures.

a. Submit Test Reports in accordance with referenced standards in this section.

b. After completion of the installation and prior to energizing the conductors, perform wire and cable continuity and insulation tests as herein specified.

c. Provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified.

d. Perform all Field Acceptance Testing and submittals as described herein.

e. Isolate completely all wire and cable from all extraneous electrical connections at cable terminations and joints. Use substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices to isolate the circuits under test.

f. Retain suitable and complete records indicating the insulation-resistance tests, high voltage tests, continuity tests, phase rotation tests, high potential tests, and conductor identification markings. Provide a duplicate record of all tests to

the Contracting Officer. Prior to testing, submit the wire and cable test record form for approval. Provide room for the Contracting Officer's signature on the test report.

3.3.2 Tests to be Performed

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NOTE: The Insulation Resistance test is also known as the Megger test.

The High Potential test is also known as the hipot test, withstand test, or high voltage test measures leakage through the cable's insulation with the conductor energized and the metallic shield grounded. It is not used on 2.4kV rated cables because they are not shielded. AC testing is recommended over DC testing due to the possibility if insulation damage, especially for XLP insulated cables.

These are field tests for the specifed conductors, to be performed after their installation and before the finished system "commissioning" as usually described in section 26 08 01.00 26. The tests specified here should not be considered part of the "commissioning".

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After installation, but just prior to terminal connection, perform as a minimum the following tests:

a. Perform a Conductor Continuity Test on each wire and each individual conductor of a multiconductor cable to insure correct connections end-to-end.

b. Perform a Shield Continuity Test on each cable shield.

c. Perform a Shield Resistance Test on each cable shield. Shield resistance must be less than 10 ohms per 1000 feet of cable.

d. Perform an Insulation Resistance Test on each field-installed conductor with respect to ground and adjacent conductors in a cable assembly. Perform applied potential test at 2500 volts DC for 5kV and 15kV rated cable. Minimum insulation resistance values must not be less than 1500 Megohms for 5kV rated cable, and 5000 Megohms for 15kV rated cable.

e. Perform a VLF AC High Potential Test on each shielded cable in accordance with IEEE 400.2. Test each field-installed conductor with respect to ground and adjacent conductors. If the Contractor believes that VLF AC testing is not feasible or not recommended for any given situation, the Contractor may instead perform DC testing with the explicit approval of both the cable manufacturer and the Contracting Officer on an individual case basis. If approved, perform the DC test at the voltage recommended by the cable manufacturer. In lieu of the cable manufacturer's recommendation for a voltage level, perform the test in accordance with NETA ATS Table 100.6.1.

f. Perform a Phase Rotation Test on all three-phase circuits using a

phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment to verify matching the phasing at connections to new or existing equipment, and to existing systems.

g. Tests must be witnessed by the Contracting Officer, and the wire and cable installation test reports submitted in accordance with Section 01 33 00, SUBMITTAL PROCEDURES.

3.3.3 Acceptance

Final acceptance will depend upon the successful performance of wire and cable under test. Do not energize any conductors until the final test reports are reviewed and approved by the Contracting Officer.

-- End of Section --