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MILITARY SPECIFICATION

CABLES, POWER, ELECTRICAL, HIGH VOLTAGE

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers insulated, shielded, high voltage power cables with stranded copper or aluminum conductors. The cable is insulated with crosslinked polyethylene (XLP), ethylene propylene rubber (EPR), or high molecular weight polyethylene (HMWP). The cable is rated at 5,000 to 35,000 volts alternating or direct current.

1.2 Classification. Cables shall be of the following types, classes, composition, and size as specified (see 6.2).

Type I - 5,000 volts.
Type II - 8,000 volts.
Type III - 15,000 volts.
Type IV - 25,000 volts.
Type V - 28,000 volts.
Type VI - 35,000 volts.

Class 1 - one conductor.
Class 2 - two conductors.
Class 3 - three conductors.
Class 4 - four conductors.

Composition A - Aluminum.
Composition B - Copper.

Size 8 - No. 8 American Wire Gage (AWG) through 500 thousand circular mils (kcmil).

* 1.2.1 Definitive part number. Items furnished in accordance with this specification shall be identified by a definitive part number (DPN). This number is intended for cataloging and ordering purposes; it is not intended for surface printing on items in accordance with this specification. The DPN

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer (Code 156), Naval Construction Battalion Center, Port Hueneme, CA 93043, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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shall consist of the Federal Specification symbol, the specification part number (SPN) (see 1.2.2), and the specification part designation (SPD) (see 1.2.3). The DPN shall be written as indicated below (see 6.4):

DPN _____	MC28661	XX	XX
Federal Specification symbol _____			
SPN (see 1.2.2) _____			
SPD (see 1.2.3) _____			

* 1.2.2 Specification part number. The SPN shall be a two position numeric code which identifies items in accordance with this specification (see table I).

TABLE I. Specification part number identification.

Composition A - Aluminum Type (Volts)						
Class						
# of conductors	5,000	8,000	15,000	25,000	28,000	35,000
One	A	E	I	M	Q	U
Two	B	F	J	N	R	V
Three	C	G	K	O	S	W
Four	D	H	L	P	T	X

Composition B - Copper Type (Volts)						
Class						
# of conductors	5,000	8,000	15,000	25,000	28,000	35,000
One	1	5	9	13	17	21
Two	2	6	10	14	18	22
Three	3	7	11	15	19	23
Four	4	8	12	16	20	23

* 1.2.3 Specification part designation. The SPN shall be a two position numeric code which identifies items in accordance with this specification (see table II).

TABLE II. Specification part designation.

Size of wire			
AWG 8-30	2-34	000-38	350-42
6-31	1-35	0000-39	400-43
4-32	0-36	250-40	500-44
3-33	00-37	300-41	

2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

SPECIFICATION

MILITARY

MIL-C-12000 - Cable, Cord, and Wire, Electric; Packaging of.

STANDARDS

MILITARY

- MIL-STD-130 - Identification Marking of U.S. Military Property.
- MIL-STD-143 - Standards and Specifications, Order of Precedence for the Selection of.

(Copies of specification, standards, and publications required by contractors in connection with specific acquisition functions should be obtained from the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

- No. 5 - Specifications for Polyethylene and Cross-Linked-Polyethylene Insulated Shielded Power Cables Rated 5,000 to 69,000 Volts.

(Application for copies should be addressed to the Association of Edison Illuminating Companies, 51 East 42nd Street, New York, NY 10017.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- WC5 - Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. (IPCEA Pub. No. S-61-402).
- WC7 - Cross-linked-thermosetting-polyethylene-insulated Wire and Cable for the Transmission and Distribution of Electrical Energy. (IPCEA Pub. No. S-66-524).
- WC8 - Ethylene-propylene-rubber-insulated, Wire and Cable for the Transmission and Distribution of Electrical Energy. (IPCEA Pub. No. S-68-516).
- WC21 - Nonreturnable Reels for Wire and Cables.

(Application for copies should be addressed to the National Electrical Manufacturers Association, 2101 L Street, N.W., Washington, D.C. 20037.)

Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.

3. REQUIREMENTS

3.1 Selection of specifications and standards. Specifications and standards for necessary commodities and services not specified herein shall be selected in accordance with MIL-STD-143.

3.2 First article. When specified (see 6.2), the contractor shall furnish a reel of cable for first article inspection and approval (see 4.3 and 6.3).

* 3.3 Standard commercial product. The cable shall, as a minimum, be in accordance with the requirements of this specification and shall be the manufacturer's standard commercial product. Additional or better features which are not specifically prohibited by this specification but which are a part of the manufacturer's standard commercial product, shall be included in the unit being furnished. A standard commercial product is a product which, has been sold or is being currently offered for sale, on the commercial market through advertisements or manufacturer's catalogs, or brochures, and represents the latest production model.

* 3.4 Materials. Materials used shall be free from defects which would adversely affect the performance or maintainability of individual components or of the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. Unless otherwise specified herein, all equipment, material, and articles incorporated in the work covered by this specification are to be new and fabricated using materials produced from recovered materials to the maximum extent possible without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products are allowed under this specification unless otherwise specified.

3.5 Design and construction. The cable shall be designed and constructed for use in continuous outdoor service under all weather conditions and while either aurally supported, on the surface of the ground, buried directly in the ground, installed in conduit or duct, or submerged in fresh or salt water. Characteristics of the power distribution on which the cable is to be used shall be specified (see 6.2), in accordance with NEMA WC5 of WC7, part 1 "Information to be supplied by Purchaser".

3.5.1 Conductor. The material, direct current resistance, stranding and dimensions of the conductor shall be in accordance with NEMA WC5 or WC7, part 2.

3.5.1.1 Shield. The conductor shield shall be in accordance with NEMA WC5 or WC7, part 2. The extruded semiconducting shield in thermoplastic or thermosetting material shall conform to the requirements of paragraph D.1.1 or AEIC, No. 5.

3.5.2 Insulation. XLP insulation shall meet the requirements of NEMA WC7 and AEIC No. 5, with the AEIC No. 5 requirements to govern in the event of conflict. EPR insulation shall satisfy the requirements of NEMA WC8, Nos. 1 through 4, as appropriate. HMWP insulation shall meet the requirements of NEMA WC5 and AEIC No. 5, with the requirements of AEIC no. 5 to govern in the event of conflict.

3.5.2.1 Shield. Metallic shielding of the insulation shall be extruded in accordance with NEMA WC5 or WC7, part 4. The semiconducting shielding shall meet the requirements of AEIC No. 5, including the stripping test described therein.

3.5.3 Coverings. Cable jackets and metallic coverings shall satisfy the applicable requirements set forth in NEMA WC5 or WC7, part 4.

3.6 Performance.

3.6.1 High temperature. The cable shall be resistant to high temperatures encountered while in storage and under service conditions. When in an ambient temperature of 75° centigrade (C), a full reel of cable shall not suffer permanent set to any portion of the cable or show evidence of insulation deterioration.

3.7 Cable lengths. When special lengths of cable are required, each cable length shall be furnished with a nominal length, -0 +3 percent, as specified (see 6.2). Normally except as specified in 3.5.1, cable shall be of one continuous reel-capacity nominal length +10 percent.

3.7.1 Allowable short lengths. Unless otherwise specified by the procuring activity (see 6.2), short lengths may be supplied in accordance with the following schedule on orders of 100,000 feet and over:

- (a) 85 percent or more of the order - reel capacity nominal lengths, -3 +10 percent.
- (b) 10 percent or less of the order - one-half of reel-capacity nominal lengths, minimum.
- (c) 5 percent or less of the order - one-third of reel-capacity nominal lengths, minimum.

3.8 Reels. Unless otherwise specified (see 6.2), the cable reels shall be nonreturnable type conforming to NEMA WC21.

3.8.1 Identification of products. Each reel of cable shall be marked for identification in accordance with MIL-STD-130.

3.8.2 Marking of reels. Each reel shall be plainly marked on the outside of both flanges with the identifying information. Paper labels shall not be used. Each reel shall have a permanent type of label, tag, or plate marked with the identifying information attached to the inside of a flange so that it will be visible when the reel is unlagged. The label, tag, or plate shall remain in place when all or part of the cable is removed. The following information shall be applied to each reel of cable:

Voltage rating _____
 Size of conductor _____
 Number of conductors _____
 Length (in feet and in meters) _____
 Serial No. _____ (reel)

The voltage rating of the cable shall be shown in kilovolts. The cable conductor size shall be shown in AWG for sizes up to 4/0 and in kcmil for larger sizes.

3.8.3 Surface marking of cable. The manufacturer's name, date of manufacture, voltage rating, size of conductor, and number of conductors shall be legibly marked on the surface of all cable. The marking shall be of paint

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or ink applied at intervals not exceeding 10 feet. The markings shall be durable and not readily smeared during handling of the cable. This paragraph applies only to cable furnished directly to the Government, under a Government contract with the cable vendor as the prime contractor.

3.9 Workmanship. Workmanship shall be of the quality necessary to produce cable free from all defects which effect proper functioning in service. The exterior surface of the cable shall be smooth, uniform and free from splinters, ridges, grooves, indentations, and protuberances visible to the naked eye.

4. QUALITY ASSURANCE PROVISIONS

* 4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

* 4.2 Classification of inspection. The inspection requirements specified herein shall be classified as follows:

- (a) First article inspection (see 4.3).
- (b) Quality conformance inspection (see 4.4).
- (c) Packaging inspection (see 4.8).

* 4.3 First article inspection. First article inspection shall be performed on one reel of cable when a first article is required (see 3.2 and 6.3). This inspection shall include the examination of 4.5 and the tests of 4.6. The first article may be a standard production item from the contractor's current inventory provided the reel and cable meets the requirements of the specification and is representative of the design, construction, and manufacturing technique applicable to the remaining reels and cable to be furnished under the contract.

* 4.4 Quality conformance inspection. Quality conformance inspection shall be performed on the cable. This inspection shall include the examination of 4.5 and the test of 4.6.

4.5 Examination. A sample from each reel shall be examined for compliance with the requirements specified in Section 3 of this specification. Noncompliance with any specified requirements or presence of one or more defects preventing or lessening maximum efficiency shall constitute cause for rejection.

* 4.5.1 NEMA certification. Prior to approval of the first article, if one is submitted, or prior to approval of the first shipment, the contractor shall submit to the contracting officer or his authorized representative, satisfactory evidence that the cable he proposes to furnish under this specification meets the requirements of the applicable NEMA standards. This data shall be furnished as specified in the contract (see 6.2.2).

4.6 Tests. Every reel of cable shall be tested in accordance with 4.6.3. The first article shall be tested in accordance with 4.6.4.

4.6.1 Test conditions. Unless otherwise specified (see 6.2), tests shall be conducted at room temperature ($25 \pm 0^{\circ}\text{C}$).

4.6.2 Electrical and physical test. The electrical and physical tests specified in 4.6.3 and 4.6.4 shall be accomplished in accordance with the methods described in the following publications. In the event of conflicting requirements, this specification shall govern.

- (a) XLP insulated cable - part 6 of IPCEA S-66-524 - NEMA WC7, and paragraphs E through L of AEIC No. 5, with AEIC No. 5 to govern in the event of a conflict with a IPCEA - NEMA publication.
- (b) EPR insulated cable - part 6 of IPCEA S-68-516 - NEMA WC8 Interim Standards No. 1 through 4, as appropriate.
- (c) HMWP insulated cable - part 6 of IPCEA S-61-402 - NEMA WC5, and AEIC No. 5, for polyethylene insulation.

4.6.3 Acceptance tests.

4.6.3.1 Individual tests. A sample from each reel of finished cable shall be subjected to the following tests.

- (a) Alternating - current voltage test.
- (b) Insulation resistance test.
- (c) Corona level test.
- (d) Continuity test.

4.6.3.2 Sampling plan and tests. Unless otherwise specified (see 6.2), the following tests shall be conducted at least once in every 30-day period, in accordance with the methods called for in the referenced industry specifications, starting at the beginning of production and continuing until completion of the order:

- (a) Moisture absorption test.
- (b) Ozone resistance test.
- (c) Cold bend test.
- (d) Insulation electrical properties test.
- (e) Insulation thickness test.
- (f) Conductor wire size test.
- (g) Wire resistance test.
- (h) Physical properties test.
- (i) Aging test.
- (j) Heat distortion test.

4.6.4 First article tests. The first article, when provided, shall be subjected to all of the tests specified in 4.6.3.

4.6.4.1 Test sample. The test sample shall consist of a reel of cable or a 50 foot or longer coil. The sample shall be appropriately identified with the manufacturer's part number and such other information as required by the procuring activity.

4.7 Rejection and retest. When cable selected from a production run fails to meet the specification, no cable still on hand or produced later shall be accepted until the extent and cause of failure has been determined and appropriately corrected. The contractor shall explain to the Government representative the cause of failure and the action taken to preclude recurrence. After correction, all tests shall be repeated.

4.7.1 Continuance of individual tests. For production reasons, the individual and sampling tests may be continued pending the investigation of a sampling test failure. Final acceptance of all cable on hand or produced later shall not be made until it is determined that all cable meets all the requirements of the specification.

4.7.2 Defects in cable already accepted. When investigation of a test failure indicates that defects may exist in cable already accepted, the contractor shall fully advise the procuring activity of all defects likely to be found and the method of correcting them.

4.8 Packaging inspection. The inspection of the preservation, packaging, packing, and marking of the cable shall be in accordance with the requirements of Section 4 of MIL-C-12000. The inspection shall consist of the examination, and when specified (see 6.2), the tests of MIL-C-12000.

5. PACKAGING

5.1 Preservation, packaging, packing, and marking. The cable shall be preserved, packaged, packed, and marked on reels as specified (see 3.8 and 6.2) in accordance with MIL-C-12000 with the level of preservation and the level of packing as specified (see 6.2).

6. NOTES

6.1 Intended use. The cable covered by this specification is intended for electrical power distribution systems complying aerial, wet or dry ground surface, direct burial, trench or conduit enclosure, fresh or salt water submersion deployment of the system cable.

6.2 Ordering data. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type, class, composition, and size cable required (see 1.2).
- (c) When a first article is required for inspection and approval (see 3.2, 4.3, and 6.3).
- (d) Characteristics of power distribution system on which cable is to be used (see 3.5).
- (e) Length of cable required (see 3.7).
- (f) When short lengths are not acceptable (see 3.7.1).
- (g) When other than nonreturnable reels are required (see 3.8).
- (h) When test temperature shall be other than specified (see 4.6.1).
- (i) When sampling plan is to be other than specified (see 4.5.3.2).
- (j) When the packaging tests are required (see 4.3).
- (k) Level of preservation and level of packing required (see 5.1).

* 6.2.1 Contract data requirements. When this specification is used in an acquisition which incorporates a DD Form 1423 and invokes the provisions of paragraph 7-104.9(n) of the Defense Acquisition Regulations (DAR), the data requirements will be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the Contract Data Requirements List (DD Form 1423) incorporated into the contract. When the provisions of DAR 7-104.9(n) are not invoked, the data shall be delivered in accordance with the contract requirements.

* 6.3 First article. When a first article is required, it shall be tested and approved under the appropriate provisions of paragraph 7-104.55 of the DAR. The first article should be a first production item consisting of one complete cable unit or it may be a standard production item from the contractor's current inventory as specified in 4.2.1. The contracting officer should include specific instructions in all acquisition instruments regarding arrangement for examinations, tests, and approval of the first article.

6.4 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodians:

Army - CR
Navy - YD
Air Force - 85

Preparing activity:

Navy - YD
Project No. 6145-0685

Review activities:

Army - MI

User activities:

Army - AT, AV