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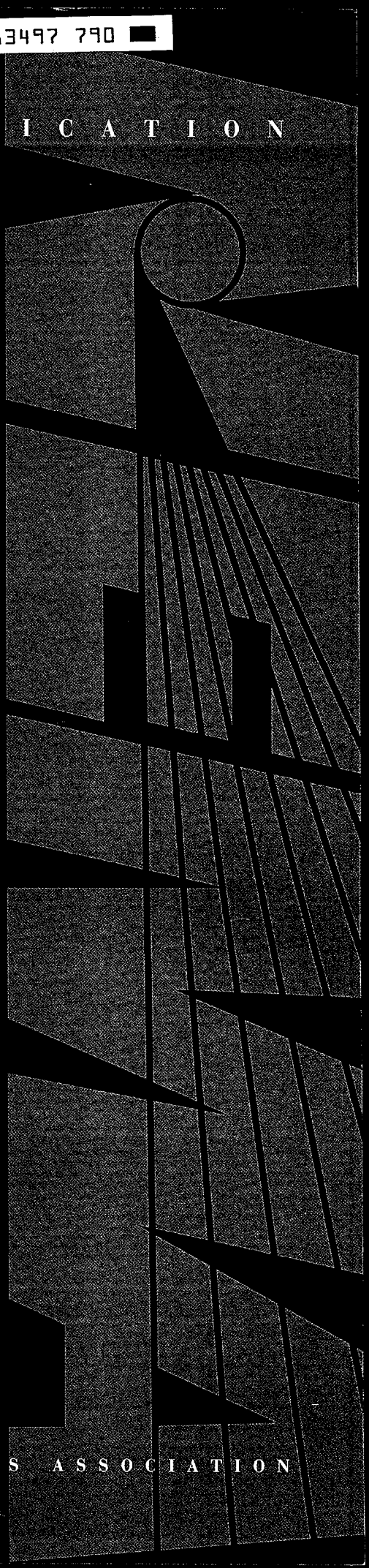
NEMA STANDARDS PUBLICATION

NEMA WC 67

STANDARD FOR UNINSULATED CONDUCTORS USED IN ELECTRICAL AND ELECTRONIC APPLICATIONS



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NEMA Standards Publication No. WC 67-1997

Standard For Uninsulated Conductors Used In Electrical And Electronic Applications

Published by

National Electrical Manufacturers Association
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Rosslyn, Virginia 22209

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FORWARD

This Standard Publication was developed by the NEMA High Performance Wire and Cable Section as an alternative non-government standard to MIL-W-29606. It assures that all included conductors, both Metric and English (inch/pound) sizes, will meet the current requirements associated with high-reliability aerospace, electrical and electronic equipment. This standard was adapted from, and harmonizes, the following specifications: MIL-W-29606, ISO 2635, prEN 2083, and BSI 231. In addition, it also utilizes many of the ASTM conductor standards for reference purposes.

Compliance with provisions of this Standards Publication is strictly voluntary and any certification of compliance is left to the discretion of the buyer and seller.

In the preparation of this Standard Publication, input of users and other interested parties has been considered. Inquiries, comments, and proposed or recommended revisions should be submitted to the concerned NEMA product Subdivision by contacting the:

Vice-President, Engineering
National Electrical Manufacturers Association
1300 N. 17th Street
Rosslyn, Virginia 22209

This Standards Publication was developed by the NEMA High Performance Wire and Cable Section. Section approval of the standard does not necessarily imply that all section members voted for its approval or participated in its development. At the time it was approved, the Section was composed of the following members:

Barcel Wire and Cable Corporation—Irvine, CA
BICC/Brand-Rex—Willimantic, CT
Cable USA Inc.—Naples, FL
Comm Scope Inc.—Elm City, NC
Furon Company/Dekron Division—Akron, OH
Judd Wire Inc.—Turner Falls, MA
Quirk Wire Company Inc.—West Brookfield, MA
Radix Wire Company—Cleveland, OH
Raychem Corporation—Menlo Park, CA
Rockbestos/Surprenant Cable Corp.—Clinton, MA
Times Microwave Systems—Wallingford, CT
Tensolite Company—St. Augustine, FL

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Section 1
GENERAL

1.1 SCOPE

This standard covers the following uninsulated conductors:

- single end (solid) and stranded
- coated and uncoated copper
- coated copper alloy
- coated copper-clad steel
- aluminum conductors
- thermocouple extension conductors

These conductors are used primarily in insulated wires for aerospace, electrical, electronic and other high performance applications. Both Metric and English (inch/pound) conductors are included in this standard.

1.2 REFERENCED STANDARDS

American National Standards Institute (ANSI)
11 West 42nd Street
New York, NY 10036

ANSI MC 96.1	*Temperature Measurement Thermocouples*
ANSI ASQC Z1.4	*Sampling Procedures and Tables for Inspection by Attributes*
ANSI/J-STD-002-1992	*Solderability Tests for Component Leads Terminations Lugs Terminals and Wires*
ANSI/NCSL Z540-1-1994	*Calibration Laboratories and Measuring and Test Equipment - General Requirements*

American Society for Testing and Materials (ASTM)
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959

B3-95	*Soft or Annealed Copper Wire*
B33-94	*Tinned Soft or Annealed Copper Wire*
B230-89	*Aluminum 1350-H19 Wire for Electrical Purposes*
B230M-89	*Aluminum 1350-H19 Wire for Electrical Purposes (Metric)*
B263-94	*Determination of Cross-Sectional Area of Stranded Conductors*
B286-95	*Copper Conductors for Use in Hook-up Wire for Electronic Equipment*
B298-94	*Silver-Coated Soft or Annealed Copper Wire*
B355-95	*Nickel-Coated Soft or Annealed Copper Wire*
B452-93	*Copper Clad Steel Wire for Electronic Applications*
B501-93	*Silver-Coated Copper-Clad Steel Wire for Electronic Applications*
B559-93	*Nickel-Coated Copper-Clad Steel Wire for Electronic Applications*

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British Standards Institute
2 Park Street
London W1A 2BS
UK

BSI G 231 — *Conductors for General-Purpose Aircraft Electrical Cables and Aerospace Applications*

European Committee for Standardization
rue Brederode 2
B-1000 Brussels
Belgium

prEN 2083 — *Copper or Copper Alloy Conductors in Electrical Cables (Draft)*

Department of Defense
Standardization Document Order Desk
Building 4D
700 Robbins Ave.
Philadelphia, PA 19111-5094

MIL-W-29606 — *General Specification for Wire, Electrical, Stranded, Uninsulated Copper, Copper Alloy, or Aluminum, or Thermocouple Extension*

International Electrotechnical Commission/
International Organization for Standardization (IEC/ISO)
3, re de Varembe
Case postale 131
CH-1211 Geneve 20

ISO 2635:1979 (EN 2583) — *Aircraft—Conductors for General Purpose Aircraft Electrical Cables and Aerospace Applications—Dimensions and Characteristics*

National Electrical Manufacturers Association
1300 N. 17th Street
Rosslyn, Virginia 22209

NEMA WC 65-1995 — *A Reasoned Approach to Solving Solderability Problems with Tin-Coated and Nickel-Coated Stranded Conductors in High Performance Wire and Cable Applications*

National Institute of Standards and Technology
Gaithersburg, Maryland 20899

NBS-HDBK-100 — *Copper Wire Tables*

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Section 2
DEFINITIONS

Bunch Stranding—random array of strands wound or twisted in the same lay direction and same length of lay without a geometric arrangement or pattern.

Circular Mil Area (CMA)—The cross-sectional area of a conductor expressed as circular mils. This standard only references nominal circular mil areas, since minimum CMA is controlled by minimum conductor weight requirements. This parameter provides a guideline for termination compatibility.

Concentric-Lay Stranding—a central strand surrounded by one or more layers of helically wound or twisted strands in a geometric arrangement producing a smooth conductor with a circular cross-section.

Equilay Concentric Stranding—concentric-lay stranding with alternately reversed lay direction and the same length of lay of the strand layers.

True Concentric Stranding—concentric-lay stranding with alternately reversed lay direction and an increasing length of lay of the outer strand layers.

Unidirectional Concentric Stranding—concentric-lay stranding with the same lay direction and an increasing length of lay of the outer strand layers.

Unilay Stranding—concentric-lay stranding with the same lay direction and the same length of lay of the outer strand layers.

Conductor Code—a numeric four-digit code which designates conductor size and properties. Each conductor is listed in two Tables. One table lists properties in Metric units, the other in English units. The conductor code denotes which table applies.

Conductor Tolerances—Conductors are available in either "general purpose" or "tight tolerance."

General purpose conductors have broader dimensional limits usually centered on the nominal circular mil area for a given conductor size.

Tight tolerance conductors have tighter dimensions than general purpose conductors of the same wire size. These are also known as "lightweight" or "small diameter" conductors. Additionally, the center for their limits is toward the minimum dimension for that wire size to provide weight savings without sacrificing DC resistance or ability to be terminated.

English Units of Measurement—Wherever "English Units" are specified, it signifies inch/pounds and American Wire Gauge (AWG) as the applicable systems of units.

Inspection Lot—an inspection lot shall consist of all conductors of the same part number, produced under essentially the same conditions, and presented for inspection and shipment at one time.

Length of Lay (Lay Length)—the axial length for one revolution of a strand or member in any layer of a stranded construction.

Metric Units of Measurement—Wherever "Metric Units" are specified, it signifies meters, grams, and square millimeters as the applicable systems of units.

Single End—an individual strand or solid conductor.

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Unit of Product—the unit of product for determining lot size for sampling shall be the quantity of wire offered for inspection on one coil, one reel, or one spool, as applicable.

Whole Conductor Splice—A joining of the entire stranded conductor at a single point.

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Section 3
PART NUMBERING SYSTEM

The part numbers on individual conductors shall be of the following form:

WC67-	0101-	SCC-	TT
[Standard]	[Conductor Code]	[Conductor Material	[Conductor Diameter
[see 3.1]	[see 3.2]	and Coating]	Tolerance]
		[see 3.3]	[see 3.4]

This example is for 30 AWG (7 strands of 38 gauge), silver-coated copper, tight tolerance conductor defined in Metric units. (Note: WC67-0201-SCC-TT is the same conductor, but defined in English [inch/pound] units.)

3.1 STANDARD

Number for this standard.

3.2 CONDUCTOR CODE

A four digit designator from Tables 1 through 7.

3.3 CONDUCTOR MATERIAL AND COATING

A two to five alphabetical character designator as shown in Paragraph 4.2.

3.4 CONDUCTOR DIAMETER TOLERANCE

The conductor diameter dimensional tolerance shall be designated as follows:

GP	General Purpose Conductors
TT	Tight Tolerance Conductors

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Section 4
REQUIREMENTS

4.1 GENERAL

The individual conductor requirements shall be as specified herein and in accordance with the applicable referenced documents. In the event of any conflict between this standard and referenced documents, this standard shall govern.

4.2 CONDUCTOR MATERIAL AND COATING

All single end (solid) conductors or conductor strands, prior to stranding, shall conform to the following requirements as applicable. The conductor material and coating designator (see Paragraph 3.3) is in parenthesis for each.

4.2.1 Bare (Uncoated) Copper (BC)

This conductor material shall conform to ASTM B3.

4.2.2 Tin Coated Copper (TCC)

The tin coating shall be as specified in ASTM B33.

4.2.3 Silver Coated Copper (SCC)

This type shall have a coating thickness of not less than 40 microinches (1.00 µm) of silver when measured in accordance with ASTM B298.

4.2.4 Nickel Coated Copper (NCC)

This type shall have a coating thickness of not less than 50 microinches (1.25 µm) of nickel when measured in accordance with ASTM B355.

4.2.5 Heavy Nickel Coated Copper (NHC)

This type shall have a coating thickness of not less than 27% by weight of nickel when measured in accordance with ASTM B355.

4.2.6 Silver Coated Copper Alloy (SCA)

The copper alloy strand base material shall conform to the requirements in Tables 2, 3, or 5. The strands shall have a coating thickness of not less than 40 microinches (1.00 µm) of silver when measured in accordance with ASTM B298.

4.2.7 Nickel Coated Copper Alloy (NCA)

The copper alloy strand base material shall conform to the requirements in Tables 2, 3, or 5. The strands shall have a coating thickness of not less than 50 microinches (1.25 µm) of nickel when measured in accordance with ASTM B355.

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4.2.8 Tin Coated Copper Alloy (TCA)

The tin coated alloy strand base material shall conform to the requirements in Tables 2, 3, or 5. The tin coating shall be as specified in ASTM B33.

4.2.9 Heavy Nickel Coated Copper Alloy (NHA)

The copper alloy strand base material shall conform to the requirements in Tables 2 ,3, or 5. The strands shall have a coating thickness of not less than 27% by weight of nickel when measured in accordance with ASTM B355.

4.2.10 Silver Coated Ultra-High Strength Copper Alloy (SCU)

The ultra-high strength copper alloy strands shall be made of a copper alloy material capable of meeting all requirements herein. The strands shall have a coating thickness of not less than 40 microinches (1.00 µm) of silver when measured in accordance with ASTM B298.

4.2.11 Nickel Coated Ultra-High Strength Copper Alloy (NCU)

The ultra-high strength copper alloy strands shall be made of a copper alloy material capable of meeting all requirements herein. The strands shall have a coating thickness of not less than 50 microinches (1.25 µm) of nickel when measured in accordance with ASTM B355.

4.2.12 Aluminum Strands (ALU)

The aluminum strand material shall conform to either ASTM B230 and B230M.

4.2.13 Type K Thermocouple Extension Conductor (KPH, KPS, KNH, and KNS)

Type KPH and KPS strands shall be made from an alloy of 90% nickel – 10% chromium and type KNH and KNS strands shall be made from an alloy of 95% nickel – 2% aluminum – 2% manganese - 1% silicon and minor traces of other materials and shall conform to ANSI MC96.1.

4.2.14 Nickel-Coated Copper-Clad Steel (NCCCS)

The base material shall conform to ASTM B452, Class 40A. The nickel coating shall have a minimum thickness of 50 microinches (1.25 µm) in accordance with ASTM B559.

4.2.15 Silver-Coated Copper-Clad Steel (SCCCS)

The base material shall conform to ASTM B452, Class 40A. The silver coating shall have a minimum thickness of 50 microinches (1.25 µm) in accordance with ASTM B501.

4.3 CONDUCTOR CONSTRUCTION

4.3.1 Single end

Single end (solid) conductors shall conform to paragraph 4.2 for materials. All other requirements shall be as specified in Table 3 and in paragraph 4.4 below as applicable.

4.3.2 Concentric Stranding

The conductors with 7, 19, or 37 strands shall be concentric stranded. The strands shall be assembled in a geometric arrangement of concentric layers, producing a smooth and uniform conductor, circular in cross-section and free of any crossovers of adjacent strands, high strands, or other irregularities. The direction of lay of the individual strands in the outer layer of the concentric stranded conductors of the

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finished wire shall be left hand. The length of lay of the outer layer shall be 8 to 16 times the maximum conductor diameter as specified in Tables 1 through 7. If a specific type of stranding is required, it must be specified in the ordering data. See definitions for descriptions (Section 3) of different types of concentric stranding.

4.3.3 Rope-lay Stranding

Rope-lay stranded conductors shall be laid up concentrically with a central member surrounded by one or more layers of helically wound members. The direction of lay of successive layers shall be alternately reversed (true concentric lay), or in the same direction (unidirectional lay). The length of the lay of the outer layer of rope-lay stranded conductor shall be 8 to 14 times the maximum outside diameter of the completed conductor. The direction of lay of the outer layer shall be left hand unless otherwise specified. The individual members of the rope-lay stranded conductors may be either bunched or concentric stranded, left or right hand lay. The length of the lay of the stranded members shall not be greater than 16 times the outside diameter of the member.

4.3.4 Bunch Stranding

Those constructions that are not concentric nor rope-lay stranded shall be bunch stranded with a left hand lay. The length of lay of the stranded conductor shall not be greater than 16 times the outside diameter of the completed conductor.

4.3.5 Allowable Splices

For conductor types TCC, SCC, NCC, NHC, SCA, NCA, TCA, NHA, SCU, NCU, NCCCS, and SCCCS, splices in individual strands or members shall be butt brazed or welded. There shall not be more than one strand splice in any two lay lengths of a stranded concentric conductor in any single layer, or in any two lay lengths of any member of a rope-lay conductor. Not more than one splice of the entire member shall be permitted in any two lay lengths of a rope-lay conductor. Splices in individual members of a rope-lay construction are permitted and shall be so finished that the conductor diameter is not increased at the point of joining. A 7 strand core of a 19 strand conductor or a 19 strand core of a 37 strand conductor is not considered as a member and shall not be spliced as a whole.

For conductor type ALU, splices in individual strands shall not be closer than two lay lengths of the conductor or rope member. Splices in members of rope-lay constructions shall not be closer than 10 feet.

For conductor types KPH, KPS, KNH, and KNS, splices in individual strands or groups of individual strands shall be butt brazed with silver solder.

4.3.5.1 Whole Conductor Splices

Whole conductor splices may be permitted when requested by the purchaser for use as a manufacturing aid and so specified in the ordering data.

4.4 CONDUCTOR PROPERTIES

4.4.1 Diameter

Diameters shall be as specified In Tables 1 through 7 and measured in accordance with Paragraph 6.2.

4.4.2 Elongation

Elongation values shall be as specified In Tables 1 through 7 and measured in accordance with Paragraph 6.3.

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4.4.3 Tensile or Break Strength

When specified, in Tables 1 through 7, tensile or break strength shall be measured in accordance with Paragraph 6.3.

4.4.4 Conductor DC Resistance

Conductor DC resistance shall be as specified In Tables 1 through 7 and measured in accordance with Paragraph 6.4.

4.4.5 Continuity of Coating

Conductor coatings shall be continuous and shall be tested in accordance with Paragraph 6.5.

4.4.6 Coating Thickness

Where specified in Paragraph 4.2, coating thickness shall be measured in accordance with Paragraph 6.6.

4.4.7 Weight

When specified in Tables 1 through 7, conductor weight shall be measured in accordance with Paragraph 6.7.

4.4.8 Solderability of Tin and Silver Coated Conductors

Tin and silver coated conductors, 10 AWG and smaller, shall have a minimum coverage of 95% when examined in accordance with Paragraph 6.8. Solderability shall not be required for sizes larger than 10 AWG.

(Note: A review of problems and test methods related to solderability is covered in NEMA WC 65. Solderability requirements are not applicable to aluminum, thermocouple extension, nickel coated and bare copper conductors.)

4.4.9 Workmanship

Finished conductors shall be free from lumps, kinks, splits, scraped or corroded surfaces, and other impurities.

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Section 5
QUALITY ASSURANCE

5.1 RESPONSIBILITY FOR INSPECTION

Unless otherwise specified in the buyers contract or purchase order, the manufacturer (seller) is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Inspection shall consist of verification of all requirements specified herein, including all examinations and tests specified in Section 4. The manufacturer may use their own or other facilities suitable for the performance of the inspection requirements specified herein. Manufacturers shall establish and maintain a calibration system in accordance with ANSI/NCSL Z540-1.

5.2 QUALITY CONFORMANCE INSPECTION OF FINISHED PRODUCT

5.2.1 Inspection Lot and Unit of Product

Definitions for inspection lot and unit of product can be found in Section 2.

5.2.2 Sampling for Performance Inspection

Use the sampling plan in accordance with ANSI/ASQC Z1.4 inspection level S-2, acceptance number 0 (single plan).

5.2.3 Quality Conformance Inspection

The following is a list of tests and examinations that shall be performed when applicable:

a. verification of materials and construction (per 6.1)
b. conductor diameter (per 6.2)
c. elongation (per 6.3)
d. break strength (per 6.3)
e. conductor dc resistance (per 6.4)
f. continuity of coating (per 6.5)
g. coating thickness (per 6.6)
h. weight (per 6.7)
i. solderability (per 6.8)
j. workmanship (per 6.1)

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Section 6
TEST METHODS

6.1 VISUAL

The conductor shall be visually inspected with the unaided eye to determine conformance to the conductor strand materials requirement, workmanship, and any other requirements herein not covered by specific test methods.

6.2 CONDUCTOR DIAMETER

The diameter shall be measured at three locations along the length of a 0.3 meter (1 ft.) sample. Each measurement shall be the average of two readings taken 90 degrees apart on the conductor. Each measurement shall be within the specified requirements. The reported diameter shall be the average of these three measurements.

Micrometers, calipers, or optical measurement devices being used shall have the following minimum precision:

English		Metric	
12 AWG and smaller	0.0001 inch	0.5 mm^2 and smaller	0.001 mm
Greater than 12 AWG	0.001 inch	Greater than 0.5 mm^2	0.01 mm

Note: It is recommended that all measurements be made with devices that provide readings in the same system [English or Metric] as the specified requirement.

6.3 CONDUCTOR ELONGATION, TENSILE AND BREAK STRENGTH

Where specified, conductor elongation, tensile or break strength shall be tested as follows:

6.3.1 Test Equipment

a. Power driven tensile test machine with sample grips attached to a force indicator. The machine sample grips shall be capable of separating while applying force to the specimen at a uniform rate of speed. The force indicator shall be accurate to within ± 1 percent of the actual force applied and shall indicate the maximum force applied to break the wire or first strand as applicable.

b. A recording device to accurately measure the length of separation of the benchmarks at break.

6.3.2 Test Samples

When whole conductor testing is required, at least 3 specimens, 20 inches (500 mm) in length shall be tested. When individual strand testing is required, at least 3 specimens removed from the same 20 inch (500 mm) length of conductor shall be tested.

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6.3.3. Test Procedure

6.3.3.1 Spool-Type Grips

For spool-type grips, two parallel bench marks shall be marked at 10 ± 1/32 inches (250 ± 0.8 mm) apart on each specimen without damage to the conductor. A specimen shall be placed in the grips of the calibrated testing machine and adjusted such that the benchmarks are between the grips.

6.3.3.2 Jaw-Type Grips

For jaw-type grips, specimens shall be placed in the grips which are spaced at a distance of 10 ± 1/32 inches (250 ± 0.8 mm) apart.

6.3.3.3 Soft or Annealed Copper and Copper-Clad Steel

For stranded conductor sizes 22 AWG (0.4 mm^2) and smaller, the tests shall be performed upon the whole conductor and the elongation measured when the first strand of the conductor breaks. For stranded conductor sizes larger than 22 AWG, strands shall be carefully removed from the conductor and tested for elongation. The elongation at break of the single end, individual strand or of the first strand of the whole conductor, as applicable, shall be determined by means of a recording device on the testing machine. The speed of separation of the grips shall be 10 ± 2 inches/minute (250 ± 50 mm/minute) under no load.

6.3.3.4 High Strength Copper Alloy and Ultra-High Strength Copper Alloy

Testing shall be performed on the whole conductor. Conductor elongation shall be measured when the first strand of the conductor breaks. The elongation at break of the first strand of the whole conductor shall be determined by means of a recording device on the testing machine. The speed of separation of the grips shall be 10 ± 2 inches/minute (250 ± 50 mm/minute) under no load.

The break strength for the entire conductor shall be considered as the total tensile force indicated by the testing machine at the break of the first strand.

6.3.3.5 Aluminum Conductors

Strands shall be carefully removed from the conductor and tested for tensile strength and elongation. The tensile strength and elongation of the individual strand shall be determined by means of a recording device on the testing machine. The speed of separation of the grips shall be 10 ± 2 inches/minute (250 ± 50 mm/minute) under no load.

6.3.4 Calculations

6.3.4.1 Elongation

The elongation of the specimen shall be calculated as follows:

$$\text{Percent elongation} = \frac{(L - S)}{S} \times 100$$

Where:

L = The distance between the benchmarks on the specimen or the jaw separation immediately after rupture.

S = The distance between the benchmarks or the jaw separation prior to testing.

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6.3.4.2 Tensile Strength

The tensile strength (aluminum only) of the specimen shall be calculated as follows:

$$\text{Tensile Strength} = \frac{F}{A}$$

Where:

F = The breaking force of the individual strand as indicated by the tester.
A = Cross-sectional area of the individual strand prior to testing

6.4 CONDUCTOR DC RESISTANCE

Where specified, conductor dc resistance shall be tested as follows and corrected to a reference temperature of 20°C:

6.4.1 TEST EQUIPMENT

a. A resistance measuring device capable of accuracy to within 0.1 percent of the reading shall be used if the resistance reading is less than 1 ohm. If the resistance is greater than 1 ohm, the device shall be capable of accuracy to within 1 percent of the reading.

b. Temperature measuring device that will determine the conductor temperature to within 0.5°C.

c. A fixture to control or a scale to measure the specimen length to within an accuracy of 0.2 percent.

6.4.2. TEST SPECIMEN

The test specimen length shall be measured in either feet or meters to conform with specified requirements. It shall be free of splices, surface cracks, or other visible defects when viewed with the unaided eye. Test specimen length shall be at least 5 feet (1.5 m) long.

6.4.3 MEASUREMENT

The test specimen shall be allowed to come to the same temperature as the surrounding environment. The resistance, the conductor length, and the conductor temperature shall be measured and recorded. The measured resistance shall be converted to ohms per 1,000 feet or ohms per kilometer as follows:

$$\text{Conductor dc resistance} = \frac{\text{Measured resistance (Ohms) x 1,000}}{\text{Sample length}}$$

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6.4.4 TEMPERATURE CORRECTION

When measurement is made at other than the reference temperature, the measured resistance shall be corrected to the reference temperature of 20°C as follows:

$$R_T = \frac{R_t}{1+\alpha(t-T)}$$

Where:

R_T = Resistance at reference temperature T.
R_t = Resistance as measured at temperature t.
α = Temperature coefficient of resistance (see note below).
T = Reference temperature.
t = Temperature at which measurement is made.

Note: The parameter α varies with the material, the copper conductivity, and the temperature. The value for 100 percent conductivity copper at 20°C is 0.00393. The value for high strength copper alloy at 20°C is 0.00342. Values for temperature coefficients for other materials, conductivities, and temperatures can be found in Table 2 of NBS-HDBK-100.

α Coefficients: (units are per °C)	
Copper	0.00393
High Strength Copper Alloy	0.00342
Ultra High Strength Copper Alloy	0.00198
Copper Alloy C16200	0.00319
Copper Clad Steel	0.00378
Aluminum	0.00407

6.5 CONTINUITY OF COATING

A single end conductor must meet the continuity of coating requirement of Paragraph 6.5.1. A stranded specimen shall be tested in accordance with Paragraph 6.5.2

6.5.1 Single End

Samples of coated single end conductors shall be tested in accordance with the applicable ASTM requirement (ASTM B33, B298, B355, B501, B559)

6.5.2 Stranded Conductors

A visual inspection with the unaided eye shall be performed on the entire outer layer of the conductor on the supplied package with a white card (used as a background) to ascertain if any base metal is exposed through a break in the coating. Detection of any such exposed base metal constitutes rejection.

A visual examination with 10X magnification with a white background shall be performed on a conductor sample taken from the top of the supplied spool. The sample shall be a minimum of 12 inches (30 cm) in length. The outer surface of all stranded constructions shall be examined. For stranded constructions of more than one layer (i.e. 19 and 37 strand, etc.), it is necessary to open up the conductor and perform the 10X visual examination on each inner layer. For rope constructions, two members from each layer of the conductor shall be examined. Detection of excessive exposed base metal due to the stranding process such as indications along one side of the sample due to excessive localized abrasion during stranding constitutes rejection. Continuous lines or patterns of exposed base metal constitutes rejection. Small random point failures shall not be cause for rejection.

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6.6 COATING THICKNESS

Where specified, coating thickness shall be measured in accordance with the applicable ASTM test method (see Paragraph 4.2).

6.7 WEIGHT

A conductor length of at least 2 feet (0.6 meter) shall be measured to within 0.5%. This length of conductor shall be weighed on a scale, or balance, capable of accuracy within 0.1% and will provide a reading of at least three significant figures. The resultant weight per unit length shall then be calculated and expressed in the units stated for the requirement.

6.8 SOLDERABILITY

Where specified, samples shall be tested in accordance with ANSI/J-STD-002, with the exception that steam aging shall not be required.

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Section 7
PACKAGING

7.1 PACKAGING REQUIREMENTS

Spools, reels, and packaging material(s) shall be sufficient to afford adequate protection against physical damage during shipment from the supply source to the customer. Any special packaging requirements must be specified in the ordering data.

7.2 LABELING

Part number (see Section 3)
Net weight
Date (month, day, and year) of manufacture and inspection
Manufacturer's name or identifying mark

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Section 8
NOTES

8.1 ORDERING DATA

Purchasing documents should specify the following information:

a. Part number (see Section 3)
b. Special packaging requirements
c. Total quantity
d. Whole conductor and core member splice allowances (see 4.3.5)
e. Any other special requirements
f. Stranding type (see 4.3)

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SECTION 9
DETAILS OF CONDUCTORS

Note that blanks existing under maximum diameter and/or maximum resistance in the following tables signifies that a particular conductor product does not fall within the scope of this specification.

Examples: Conductor code 0103 - Tight tolerance conductors of BARE, SCC, NCC or TCC in size 0.15 sq. mm. are not available under this specification.
Conductor code 0301 - Nickel coated or tin coated conductors of NCA or TCA in size 32 AWG are not available under this specification.

Blanks existing in other areas of the following tables signify that there are no requirements specified for a particular attribute.

Example: Conductor code 0101 - There are no requirements specified for maximum weight in these size 30 AWG constructions.

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Table 1M
DETAILS OF CONDUCTORS (Metric)
ANNEALED COPPER CONDUCTORS

COND. CODE	SQ. MM	AWG	ROPE CONST	NO. STRANDS	NOMINAL STRAND SIZE (mm)	NOMINAL CONDUC-TOR AREA (CMA) TOR AREA (sq. mm)	MISSING STRANDS MAX.	DIAMETER (mm)					RESIST. (ohms/km)			ELONG. MIN. %	WEIGHT (kg/km) MIN.	WEIGHT (kg/km) MAX.
								MIN.	MAX.									
									TIGHT TOLERANCE		GEN. PURPOSE							
									BARE/ SCC	NCC/ TCC	BARE/ SCC	NCC/ TCC	BARE/ SCC	NCC	TCC			
0101		30		7	0.102	0.0568	0	0.267	0.315	0.340	0.315	0.340	330	363	356	6	0.463	
0102		28		7	0.127	0.0887	0	0.343	0.391	0.417	0.391	0.417	209	223	225	6	0.732	
0103	0.15			19	0.10	0.1492	0	0.46			0.530	0.53	125	134	134	11		1.45
0104		26		19	0.102	0.1540	0	0.445	0.493	0.518	0.518	0.544	126	138	136	6	1.26	
0105	0.25			19	0.12	0.2149	0	0.550			0.620	0.620	86.3	91.1	91.1	11		2.00
0106		24		19	0.127	0.2407	0	0.572	0.620	0.620	0.645	0.671	79.7	85.0	86.0	6	1.98	
0107	0.40			19	0.15	0.3358	0	0.700			0.800	0.800	56.4	60.0	60.0	6		3.43
0108		22		19	0.160	0.3821	0	0.724	0.772	0.798	0.823	0.848	49.5	52.5	53.2	10	3.18	
0109	0.60			19	0.20	0.5969	0	0.940			1.05	1.05	31.3	33.2	33.2	6		5.95
0110		20		19	0.203	0.6162	0	0.927	0.975	1.00	1.03	1.05	30.2	32.1	32.4	10	5.15	
0111	1			19	0.25	0.9327	0	1.18			1.30	1.30	19.9	21.1	21.1	10		9.16
0112		18		19	0.254	0.9627	0	1.16	1.23	1.25	1.28	1.31	19.0	20.0	20.4	10	8.08	
0113		16		19	0.287	1.229	0	1.31	1.38	1.41	1.46	1.48	14.8	15.6	15.8	10	10.3	
0114	1.2			19	0.30	1.343	0	1.39			1.55	1.55	13.7	14.5	14.5	10		13.2
0115	2			37	0.25	1.816	0	1.68			1.82	1.82	10.2	10.9	10.9	10		18.0
0116		14		19	0.361	1.941	0	1.64	1.74	1.76	1.84	1.86	9.45	9.84	10.0	10	16.4	
0117		12		37	0.32	2.976	0	2.12	2.22	2.27	2.27	2.30	6.23	6.50	6.63	10	25.0	
0118	3			37	0.320	2.976	0	2.12			2.28	2.28	6.40	6.80	6.80	10		28.5
0119	5			37	0.400	4.650	0	2.69			2.90	2.90	4.00	4.20	4.20	10		46.0
0120		10		37	0.404	4.743	0	2.69	2.79	2.84	2.84	2.90	3.90	4.07	4.13	10	39.7	

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Table 1M (Continued)
DETAILS OF CONDUCTORS (Metric)
ANNEALED COPPER CONDUCTORS

COND. CODE	SQ. MM	AWG	ROPE CONST	NO. STRANDS	NOMINAL STRAND SIZE (mm)	NOMINAL CONDUCTOR AREA (CMA) (sq. mm)	MISSING STRANDS MAX.	DIAMETER (mm)					RESIST. (ohms/km)			ELONG. MIN. %	WEIGHT (kg/km) MIN.	WEIGHT (kg/km) MAX.
								MIN.	MAX.									
									TIGHT TOLERANCE		GEN. PURPOSE							
									BARE/ SCC	NCC/ TCC	BARE/ SCC	NCC/ TCC	BARE/ SCC	NCC	TCC			
0121	5			61	0.32	4.906	0	2.72			2.94	2.94	3.90	4.10	4.10	10		48.0
0122	9			117			0				4.40	4.40	2.30	2.40		10		86.1
0123	9		17 x 7	119	0.30	8.412	0				4.40	4.40	2.23	2.28	2.28	12		83.0
0124		8	19 x 7	133	0.287	8.605	0	4.01	4.22	4.29	4.29	4.39	2.16	2.28	2.30	10	76.6	
0125	9			127	0.30	8.977	0				4.40	4.40	2.10	2.30	2.30	10		87.0
0126	14		26 x 7	182	0.30	12.86	0				5.45	5.45	1.46	1.49	1.49	12		127
0127	14			127			0				5.50	5.50	1.50	1.55		10		133
0128	14		27 x 7	189	0.30	13.36	0				5.50	5.50	1.44	1.58	1.58	10		133
0129		6	19 x 7	133	0.361	13.59	0	5.03	5.28	5.38	5.41	5.51	1.37	1.43	1.46	10	121	
0130	22		42 x 7	294	0.300	20.78	0				6.94	6.94	0.903	0.921	0.921	12		206
0131		4	19 x 7	133	0.455	21.59	0	6.35	6.68	6.81	6.81	6.96	0.866	0.902	0.919	10	193	
0132	22		37 x 12	444	0.250	21.79	0				6.80	6.80	0.880	0.969	0.969	10		216
0133	22			182			0				6.80	6.80	0.910	0.940		10		214
0134	34			201			0				8.60	8.60	0.585	0.620		10		333
0135	34		29 x 7	203	0.450	32.29	0				8.54	8.54	0.576	0.585	0.585	12		318
0136		2	19 x 35	665	0.254	33.70	2	8.13			8.64	8.64	0.558	0.581	0.600	10	302	
0137	34		37 x 19	703	0.250	34.51	2				8.60	8.60	0.556	0.613	0.613	10		342
0138	42		35 x 7	245	0.450	38.97	0				9.50	9.50	0.480	0.500	0.485	10		402
0139	42		13 x 19	247	0.450	39.28	0				9.48	9.48	0.474	0.481	0.481	12		387
0140		1	19 x 43	817	0.254	41.40	2	9.14			9.65	9.65	0.456	0.472	0.489	10	371	
0141	42		37 x 23	851	0.250	41.77	2				9.50	9.50	0.459	0.505	0.505	10		414

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Table 1M (Continued)
DETAILS OF CONDUCTORS (Metric)
ANNEALED COPPER CONDUCTORS

COND. CODE	SQ. MM	AWG	ROPE CONST	NO. STRANDS	NOMINAL STRAND SIZE (mm)	NOMINAL CONDUCTOR AREA (CMA) (sq. mm)	MISSING STRANDS MAX.	DIAMETER (mm) MAX.					RESIST. (ohms/km)			ELONG. MIN. %	WEIGHT (kg/km) MIN.	WEIGHT (kg/km) MAX.
								MIN.	TIGHT TOLERANCE		GEN. PURPOSE							
									BARE/ SCC	NCC/ TCC	BARE/ SCC	NCC/ TCC	BARE/ SCC	NCC	TCC			
0142	53		17 x 17	289	0.450	45.96	0				10.9	10.9	0.362	0.368	0.368	12		505
0143	53		46 x 7	322	0.450	51.21	0				10.8	10.8	0.375	0.390	0.369	12		504
0144	53		37 x 29	1073	0.250	52.67	3				10.7	10.7	0.364	0.401	0.401	10		522
0145		1/0	19 x 55	1045	0.254	52.95	3	10.0			10.8	10.8	0.354	0.371	0.381	10	475	
0146	68			416			0				12.1	12.1	0.295	0.305		10		685
0147	68		22 x 19	418	0.450	66.48	0				12.4	12.4	0.280	0.284	0.284	12		654
0148	68		60 x 7	420	0.450	66.80	0				12.3	12.3	0.278	0.283	0.283	12		657
0149	68		37 x 37	1369	0.250	67.20	3				12.1	12.1	0.286	0.315	0.315	10		666
0150		2/0	19 x 70	1330	0.254	67.39	3	11.2			12.1	12.1	0.279	0.292	0.299	10	604	
0151	85		27 x 19	513	0.450	81.59	0				13.7	13.7	0.233	0.240	0.232	10		849
0152	85		74 x 7	518	0.450	82.38	0				13.7	13.7	0.226	0.229	0.229	12		810
0153		3/0	37 x 45	1665	0.254	84.37	4	12.7			13.7	13.7	0.223	0.233	0.233	10	756	
0154	85		48 x 36	1728	0.250	84.82	4				13.6	13.6	0.226	0.249	0.249	10		841
0155	107			660			2				15.2	15.2	0.183	0.190		10		1090
0156	107		35 x 19	665	0.450	105.76	2				15.7	15.7	0.176	0.179	0.179	12		1040
0157	107		18 x 37	666	0.450	105.92	2				15.7	15.7	0.176	0.178	0.178	12		1042
0158		4/0	37 x 57	2109	0.254	106.86	5	14.4			15.4	15.4	0.177	0.184	0.184	10	960	
0159	107		61 x 36	2196	0.250	107.80	5				15.2	15.2	0.178	0.195	0.195	10		1069

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Table 1E
DETAILS OF CONDUCTORS (Inch-Pound)
ANNEALED COPPER CONDUCTORS

COND. CODE	SQ. MM.	AWG	ROPE CONST.	NO. STRANDS	NOMINAL STRAND SIZE (in.)	NOMINAL CONDUCTOR AREA (CMA) (sq. in.)	MISSING STRANDS MAX.	MIN.	DIAMETER MAX. TIGHT TOLERANCE BARE/ SCC	DIAMETER MAX. TIGHT TOLERANCE NCC/ TCC	DIAMETER MAX. GEN. PURPOSE BARE/ SCC	DIAMETER MAX. GEN. PURPOSE NCC/ TCC	RESIST. (ohm/mft) MAX. BARE/ SCC	RESIST. (ohm/mft) MAX. NCC	RESIST. (ohm/mft) MAX. TCC	ELONG. MIN. %	WEIGHT (lb/mft) MIN.	WEIGHT (lb/mft) MAX.
0201		30		7	0.0040	112	0	0.0105	0.0124	0.0134	0.0124	0.0134	100.7	110.7	108.4	6	0.311	
0202		28		7	0.0050	175	0	0.0135	0.0154	0.0164	0.0154	0.0164	63.8	67.9	68.6	6	0.492	
0203	0.15			19	0.0039	295	0	0.0181			0.0209	0.0209	38.1	40.8	40.8	11		0.974
0204		26		19	0.0040	304	0	0.0175	0.0194	0.0204	0.0204	0.0214	38.4	42.2	41.3	6	0.844	
0205	0.25			19	0.0047	424	0	0.0217			0.0244	0.0244	26.3	27.8	27.8	11		1.34
0206		24		19	0.0050	475	0	0.0225	0.0244	0.0244	0.0254	0.0264	24.3	25.9	26.2	6	1.33	
0207	0.40			19	0.0059	663	0	0.0276			0.0315	0.0315	17.2	18.3	18.3	6		2.30
0208		22		19	0.0063	754	0	0.0285	0.0304	0.0314	0.0324	0.0334	15.1	16.0	16.2	10	2.14	
0209	0.60			19	0.0079	1178	0	0.0370			0.0413	0.0413	9.54	10.1	10.1	6		4.00
0210		20		19	0.0080	1216	0	0.0365	0.0384	0.0394	0.0404	0.0414	9.19	9.77	9.88	10	3.46	
0211	1			19	0.0098	1841	0	0.0465			0.0512	0.0512	6.07	6.43	6.43	10		6.16
0212		18		19	0.0100	1900	0	0.0455	0.0484	0.0494	0.0504	0.0514	5.79	6.10	6.23	10	5.43	
0213		16		19	0.0113	2426	0	0.0515	0.0544	0.0554	0.0574	0.0584	4.52	4.76	4.81	10	6.93	
0214	1.2			19	0.0118	2651	0	0.0547			0.0610	0.0610	4.18	4.42	4.42	10		8.87
0215	2			37	0.0098	3584	0	0.0661			0.0717	0.0717	3.11	3.32	3.32	10		12.1
0216		14		19	0.0142	3831	0	0.0645	0.0684	0.0694	0.0724	0.0734	2.88	3.00	3.06	10	11.0	
0217		12		37	0.0126	5873	0	0.0835	0.0874	0.0894	0.0894	0.0904	1.90	1.98	2.02	10	16.8	
0218	3			37	0.0126	5873	0	0.0835			0.0898	0.0898	1.95	2.07	2.07	10		19.2
0219	5			37	0.0157	9176	0	0.106			0.114	0.114	1.22	1.28	1.28	10		30.9
0220		10		37	0.0159	9360	0	0.106	0.110	0.112	0.112	0.114	1.19	1.24	1.26	10	26.7	
0221	5			61	0.0126	9682	0	0.107			0.116	0.116	1.19	1.25	1.25	10		32.3
0222	9			117			0				0.173	0.173	0.701	0.731		10		57.9
0223	9		17 x 7	119	0.0118	16601	0				0.173	0.173	0.680	0.695	0.695	12		55.8
0224		8	19 x 7	133	0.0113	16983	0	0.158	0.166	0.169	0.169	0.173	0.658	0.694	0.701	10	51.5	

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Table 1E (Continued)
DETAILS OF CONDUCTORS (Inch-Pound)
ANNEALED COPPER CONDUCTORS

COND. CODE	SQ. MM.	AWG	ROPE CONST.	NO. STRANDS	NOMINAL STRAND SIZE (in.)	NOMINAL CONDUC-TOR AREA (CMA) (sq. in.)	MISSING STRANDS MAX.	MIN.	DIAMETER MAX. TIGHT TOLERANCE BARE/ SCC	DIAMETER MAX. TIGHT TOLERANCE NCC/ TCC	DIAMETER MAX. GEN. PURPOSE BARE/ SCC	DIAMETER MAX. GEN. PURPOSE NCC/ TCC	RESIST. (ohm/mft) MAX. BARE/ SCC	RESIST. (ohm/mft) MAX. NCC	RESIST. (ohm/mft) MAX. TCC	ELONG. MIN. %	WEIGHT (lb/mft) MIN.	WEIGHT (lb/mft) MAX.
0225	9			127	0.0118	17717	0				0.173	0.173	0.640	0.701	0.701	10		58.5
0226	14		26 x 7	182	0.0118	25389	0				0.215	0.215	0.445	0.454	0.454	12		85.3
0227	14			127			0				0.217	0.217	0.457	0.472		10		89.4
0228	14		27 x 7	189	0.0118	26366	0				0.217	0.217	0.438	0.482	0.482	10		89.4
0229		6	19 x 7	133	0.0142	26818	0	0.198	0.208	0.212	0.213	0.217	0.418	0.436	0.445	10	81.4	
0230	22		42 x 7	294	0.0118	41013	0				0.273	0.273	0.275	0.281	0.281	12		138
0231		4	19 x 7	133	0.0179	42615	0	0.250	0.263	0.268	0.268	0.274	0.264	0.275	0.280	10	130	
0232	22		37 x 12	444	0.0098	43013	0				0.268	0.268	0.268	0.295	0.295	10		145
0233	22			182			0				0.268	0.268	0.277	0.286		10		144
0234	34			201			0				0.339	0.339	0.178	0.189		10		224
0235	34		29 x 7	203	0.0177	63717	0				0.336	0.336	0.176	0.178	0.178	12		214
0236		2	19 x 35	665	0.0100	66500	2	0.320			0.340	0.340	0.170	0.177	0.183	10	203	
0237	34		37 x 19	703	0.0098	68103	2				0.339	0.339	0.169	0.187	0.187	10		230
0238	42		35 x 7	245	0.0177	76900	0				0.374	0.374	0.146	0.152	0.148	10		270
0239	42		13 x 19	247	0.0177	77527	0				0.373	0.373	0.144	0.147	0.147	12		260
0240		1	19 x 43	817	0.0100	81700	2	0.360			0.380	0.380	0.139	0.144	0.149	10	249	
0241	42		37 x 23	851	0.0098	82441	2				0.374	0.374	0.140	0.154	0.154	10		278
0242	53		17 x 17	289	0.0177	90710	0				0.428	0.428	0.110	0.112	0.112	12		339
0243	53		46 x 7	322	0.0177	101068	0				0.424	0.424	0.114	0.119	0.112	12		339
0244	53		37 x 29	1073	0.0098	103947	3				0.421	0.421	0.111	0.122	0.122	10		351
0245		1/0	19 x 55	1045	0.0100	104500	3	0.395			0.425	0.425	0.108	0.113	0.116	10	319	
0246	68			416			0				0.476	0.476	0.090	0.093		10		460
0247	68		22 x 19	418	0.0177	131200	0				0.488	0.488	0.085	0.087	0.087	12		439

STD·NEMA WC 67-ENGL 1997 ■ 6470247 0513532 615 ■

Table 1E (Continued)
DETAILS OF CONDUCTORS (Inch-Pound)
ANNEALED COPPER CONDUCTORS

COND. CODE	SQ. MM.	AWG	ROPE CONST.	NO. STRANDS	NOMINAL STRAND SIZE (In.)	NOMINAL CONDUCTOR AREA (CMA) (sq. In.)	MISSING STRANDS MAX.	MIN.	DIAMETER MAX.				RESIST. (ohm/mft) MAX.			ELONG. MIN. %	WEIGHT (lb/mft) MIN.	WEIGHT (lb/mft) MAX.
									TIGHT TOLERANCE		GEN. PURPOSE							
									BARE/ SCC	NCC/ TCC	BARE/ SCC	NCC/ TCC	BARE/ SCC	NCC	TCC			
0248	68		60 x 7	420	0.0177	131828	0				0.485	0.485	0.085	0.086	0.086	12		442
0249	68		37 x 37	1369	0.0098	132622	3				0.476	0.476	0.087	0.096	0.096	10		448
0250		2/0	19 x 70	1330	0.0100	133000	3	0.440			0.475	0.475	0.085	0.089	0.091	10	406	
0251	85		27 x 19	513	0.0177	161018	0				0.541	0.541	0.071	0.073	0.071	10		571
0252	85		74 x 7	518	0.0177	162588	0				0.539	0.539	0.069	0.070	0.070	12		544
0253		3/0	37 x 45	1665	0.0100	166500	4	0.500			0.540	0.540	0.068	0.071	0.071	10	508	
0254	85		48 x 36	1728	0.0098	167400	4				0.535	0.535	0.069	0.076	0.076	10		565
0255	107			660			2				0.598	0.598	0.056	0.058		10		732
0256	107		35 x 19	665	0.0177	208727	2				0.617	0.617	0.054	0.055	0.055	12		699
0257	107		18 x 37	666	0.0177	209041	2				0.617	0.617	0.054	0.054	0.054	12		700
0258		4/0	37 x 57	2109	0.0100	210900	5	0.565			0.605	0.605	0.054	0.056	0.056	10	645	
0259	107		61 x 36	2196	0.0098	212738	5				0.598	0.598	0.054	0.059	0.059	10		718

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Table 2M
DETAILS OF CONDUCTORS (Metric) ALLOY CONDUCTORS

							DIAMETER (mm)											
								MAX.										
					NOMINAL	NOMINAL CONDUC-			TIGHT TOLERANCE		GEN. PURPOSE		RESISTANCE (ohm/km)			ELONG.	BREAK STRENGTH	WEIGHT	WEIGHT
				NOMINAL	STRAND	TOR	MISSING			NCA(1)/		NCA(1)/	MAX.			MIN.	(N)	(kg/km)	(kg/km)
	COND.	SQ.		NO.	SIZE	AREA	STRANDS												
	CODE	MM	AWG	STRANDS	(mm)	(sq. in.)	MAX.	MIN.	SCA(1)	TCA	SCA(1)	TCA	SCA(1)	NCA(1)	TCA	%	MIN.	MIN.	MAX
	0301		32	7	0.0787	0.0341	0	0.231	0.244		0.244		620			6	14.2		0.333
	0302		30	7	0.102	0.0568	0	0.267	0.315	0.340	0.315	0.340	385	425		6	23.1	0.463	
	0303		28	7	0.127	0.0887	0	0.343	0.391	0.417	0.391	0.417	244	259		6	36.4	0.732	
	0304	0.10		19	0.080	0.0955	0	0.370			0.430	0.430	233	252	252	6			0.870
	0305	0.15		19	0.100	0.1492	0	0.450			0.530	0.530	149	160	160	6	46.0		1.60
	0306		26	19	0.102	0.1553	0	0.445	0.518	0.518	0.518	0.544	147	162		6	63.0	1.26	
(2)	0307		26	19	0.102	0.1553	0	0.445			0.518	0.544	185	192		6	95.6	1.26	
	0308	0.25		19	0.120	0.2149	0	0.550			0.620	0.620	106	114	114	6	67.0		2.18
	0309		24	19	0.127	0.2407	0	0.572	0.620	0.645	0.645	0.671	93.2	98.8		6	100	1.98	
(2)	0310		24	19	0.127	0.2407	0	0.572			0.645	0.671	118	124		6	151	1.98	
	0311		22	19	0.160	0.3821	0	0.724	0.798	0.798	0.823	0.848	57.4	61.0		6	159	3.18	
	0312		20	19	0.203	0.6162	0	0.927	1.00	1.03	1.03	1.05	35.1	37.4		6	258	5.15	
	0313		18	19	0.254	0.9627	0	1.18	1.19	1.19	1.28	1.31	21.1	22.3		6	401	8.08	
	0314		16	19	0.287	1.229	0	1.31	1.35	1.35	1.46	1.48	16.1	16.9		6	511	10.3	

(1) High Strength Alloy or Ultra High Strength Alloy (as applicable)
(2) Ultra High Strength Alloy

Table 2E
DETAILS OF CONDUCTORS (Inch-Pound) ALLOY CONDUCTORS

								DIAMETER (in)											
								MAX											
						NOMINAL CONDUC-			TIGHT TOLERANCE		GENERAL PURPOSE		RESISTANCE (ohm/km) MAX			ELONG.	BREAK-STRENGTH	WEIGHT	WEIGHT
	COND.	SQ.		NO.	NOMINAL STRAND SIZE	TOR AREA (CMA)	MISSING STRANDS			NCA(1)/		NCA(1)/				MIN.	(N)	(kg/km)	(kg/km)
	CODE	MM	AWG	STRANDS	(In)	(sq. In.)	MAX.	MIN.	SCA(1)	TCA	SCA(1)	TCA	SCA(1)	NCA(1)	TCA	%	MIN	MIN	MAX
	0401		32	7	0.0031	67.3	0	0.0091	0.0096		0.0096		189			6	3.2		0.224
	0402		30	7	0.0040	112	0	0.0105	0.0124	0.0134	0.0124	0.0134	117	130		6	5.2	0.311	
	0403		28	7	0.0050	175	0	0.0135	0.0154	0.0164	0.0154	0.0164	74.4	79.0		6	8.2	0.492	
	0404	0.10		19	0.0031	188	0	0.0146			0.0169	0.0169	71.0	76.8	76.8	6			0.585
	0405	0.15		19	0.0039	295	0	0.0177			0.0209	0.0209	45.4	48.8	48.8	6	10.4		1.08
	0406		26	19	0.0040	304	0	0.0175	0.204	0.0204	0.0214	0.0214	44.8	49.4		6	14.2	0.844	
(2)	0407		26	19	0.0040	304	0	0.0175			0.0214	0.0214	56.4	58.4		6	21.5	0.844	
	0408	0.25		19	0.0047	424	0	0.0217			0.0244	0.0244	32.3	34.7	34.7	6	15.1		1.46
	0409		24	19	0.0050	475	0	0.0225	0.0244	0.0254	0.0264	0.0264	28.4	30.1		6	22.4	1.33	
(2)	0410		24	19	0.0050	475	0	0.0225			0.0264	0.0264	35.9	37.7		6	34.0	1.33	
	0411		22	19	0.0063	754	0	0.0285	0.0314	0.0314	0.0334	0.0334	17.5	18.6		6	35.8	2.14	
	0412		20	19	0.0080	1216	0	0.0365	0.0404	0.0404	0.0414	0.0414	10.7	11.4		6	58.1	3.46	
	0413		18	19	0.0400	1900	0	0.0465	0.0467	0.0467	0.0214	0.0514	6.43	6.79		6	90.3	5.43	
	0414		16		0.0113	2426	0	0.0515	0.0530	0.0530	0.0584	0.0584	4.90	5.16		6	115	6.93	

(1) High Strength Alloy or Ultra High Strength Alloy (as applicable)
(2) Ultra High Strength Alloy

Table 3M
DETAILS OF CONDUCTORS (Metric)
SINGLE END CONDUCTORS

COND. CODE	SQ. MM	AWG	NOMINAL COND. AREA (CMA) (sq. mm)	GENERAL PURPOSE DIAMETER (mm)			RESISTANCE (ohm/km)						BREAK-STRENGTH Min (N)
				NOM	MIN	MAX	BARE/ SCC	NCC/ TCC	SCA	NCA	SCCCS	NCCCS	SCA/ NCA
0501		40	0.00487	0.0787		0.0864	3781	4154	4448	4974	9644	10002	1.87
0502		38	0.00811	0.102		0.109	2237	2458	2632	2943	5707	5918	3.20
0503		36	0.01267	0.127		0.135	1417	1508	1667	1794	3615	3690	5.02
0504		34	0.02011	0.160		0.168	885	942	1041	1120	2258	2305	8.04
0505		32	0.03243	0.203		0.211	545	581	643	689	1391	1421	13.1
0506		30	0.05067	0.254		0.262	348	361	407	430	886	896	20.5
0507		28	0.08044	0.320		0.330	219	228	257	270	558	564	32.6
0508		26	0.1281	0.404		0.417	137	143	161	170	351	354	52.0
0509		24	0.2047	0.511		0.526	86.0	89.6	101	106	219	221	83.1
0510		22	0.3243	0.643		0.663	54.1	56.4	63.6	66.9	138	140	132
0511		20	0.5189	0.813		0.838	33.8	35.4	40.0	42.0	86.6	87.3	210
0512		18	0.8229	1.02		1.05	21.4	22.3	25.2	26.4	54.5	55.1	333
0513		16	1.308	1.29		1.33	13.5	14.0	15.8	16.6	34.4	34.8	529

Table 3E
DETAILS OF CONDUCTORS (Inch-Pound)
SINGLE END CONDUCTORS

COND. CODE	SQ. MM	AWG	NOMINAL COND. AREA (CMA) (sq. in.)	GENERAL PURPOSE DIAMETER (in)			RESISTANCE (ohm/mft)						BREAK STRENGTH Min (lb)
				NOM	MIN	MAX	BARE/ SCC	NCC/ TCC	SCA	NCA	SCCCS	NCCCS	SCA/ NCA
0601		40	9.61	0.0031		0.0034	1152	1266	1356	1516	2940	3049	0.42
0602		38	16.0	0.0040		0.0043	682	749	802	897	1739	1804	0.72
0603		36	25.0	0.0050		0.0053	432	460	508	547	1102	1125	1.13
0604		34	39.7	0.0063		0.0066	270	287	317	342	688	703	1.81
0605		32	64.0	0.0080		0.0083	166	177	196	210	424	433	2.94
0606		30	100	0.0100		0.0103	106	110	124	131	270	273	4.62
0607		28	159	0.0126		0.0130	66.7	69.6	78.4	82.3	170	172	7.33
0608		26	253	0.0159		0.0164	41.9	43.6	49.2	51.7	107	108	11.7
0609		24	404	0.0201		0.0207	26.2	27.3	30.8	32.3	66.8	67.5	18.7
0610		22	640	0.0253		0.0261	16.5	17.2	19.4	20.4	42.2	42.6	29.6
0611		20	1024	0.0320		0.0330	10.3	10.8	12.2	12.8	26.4	26.6	47.3
0612		18	1624	0.0403		0.0415	6.52	6.79	7.67	8.04	16.6	16.8	75.0
0613		16	2581	0.0508		0.0523	4.10	4.27	4.82	5.06	10.5	10.6	119

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Table 4M
DETAILS OF CONDUCTORS (Metric)
ALUMINUM CONDUCTORS

COND. CODE	AWG	NO. STRANDS	NOMINAL STRAND SIZE (mm)	NOMINAL COND. AREA (CMA) (sq.mm)	MISSING STRANDS	GENERAL PURPOSE DIAMETER (mm)		RESIST (ohm/ km)	ELONG. (%)	TENSILE STRENGTH (N/sq.mm)	WEIGHT (kg/km)
					MAX	MIN	MAX	MAX	MIN		MIN
0701	8	41	0.511	8.3933	0	3.81	4.06	3.59	1	158-241	TBD
0702	6	70	0.511	14.330	0	5.11	5.36	2.10	1	158-241	TBD
0703	4	107	0.511	21.904	0	6.30	6.65	1.40	1	158-241	TBD
0704	2	168	0.511	34.392	2	8.00	8.38	0.879	1	158-241	TBD
0705	1	219	0.511	44.833	2	8.97	9.35	0.702	1	158-241	TBD
0706	0	259	0.511	53.021	3	10.2	10.6	0.554	1	158-241	TBD
0707	2/0	334	0.511	68.375	3	11.5	12.1	0.436	1	158-241	TBD
0708	3/0	427	0.511	87.413	4	13.0	13.6	0.358	1	158-241	TBD
0709	4/0	523	0.511	107.07	5	14.3	14.9	0.279	1	158-241	TBD

Table 4E
DETAILS OF CONDUCTORS (Inch-Pound)
ALUMINUM CONDUCTORS

COND. CODE	AWG	NO. STRANDS	NOMINAL STRAND SIZE (in.)	NOMINAL COND. AREA (CMA) (sq. in.)	MISSING STRANDS	GENERAL PURPOSE DIAMETER (in)		RESIST. (ohm/mft)	ELONG (%)	TENSILE STRENGTH (ksi)	WEIGHT (lb/mft)
					MAX	MIN	MAX	MAX	MIN		MIN
0801	8	41	0.0201	16564	0	0.150	0.160	1.093	1	23-35	TBD
0802	6	70	0.0201	28281	0	0.201	0.211	0.641	1	23-35	TBD
0803	4	107	0.0201	43229	0	0.248	0.262	0.427	1	23-35	TBD
0804	2	168	0.0201	67874	2	0.315	0.330	0.268	1	23-35	TBD
0805	1	219	0.0201	88478	2	0.353	0.368	0.214	1	23-35	TBD
0806	0	259	0.0201	104639	3	0.400	0.418	0.169	1	23-35	TBD
0807	2/0	334	0.0201	134939	3	0.454	0.478	0.133	1	23-35	TBD
0808	3/0	427	0.0201	172512	4	0.511	0.535	0.109	1	23-35	TBD
0809	4/0	523	0.0201	211297	5	0.563	0.587	0.085	1	23-35	TBD

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Table 5M
DETAILS OF CONDUCTORS (Metric)
27% NICKEL COATED COPPER AND COPPER ALLOY CONDUCTORS

COND. CODE	SQ. MM.	AWG	ROPE CONST.	NO. STRANDS	NOMINAL STRAND SIZE (mm)	NOMINAL COND. AREA (CMA) (sq.mm)	MISSING STRANDS	GEN. PURPOSE DIAMETER (mm)		RESIST. (ohm/km) MAX		ELONG MIN		WEIGHT (kg/km)
							MAX	MIN	MAX	NHC	NHA	NHC	NHA	MIN
0901		22		19	0.160	0.3821	0	0.737	0.838	77.8	84.0	10	6	3.18
0902		20		19	0.203	0.6162	0	0.927	1.054	47.9	50.2	10	6	5.15
0903		18		19	0.254	0.9627	0	1.16	1.32	30.0	31.5	10	6	8.08
0904		16		19	0.287	1.229	0	1.32	1.55	22.5	24.0	10	6	10.3
0905		14		19	0.361	1.941	0	1.65	1.88	14.2		10		16.4
0906		12		19	0.455	3.085	0	2.08	2.39	9.12		10		25.0
0907		10	7 x 7	49	0.361	5.006	0	3.12	3.28	5.51		10		39.7
0908		8	19 x 7	133	0.287	8.605	0	4.01	4.55	3.07		10		76.6
0909		6	19 x 7	133	0.361	13.589	0	5.03	5.54	1.94		10		121
0910		4	19 x 7	133	0.455	21.593	0	6.35	6.91	1.23		10		193
0911		2	19 x 35	665	0.254	33.696	2	8.13	8.76	0.791		10		302
0912		1	19 x 43	817	0.254	41.398	2	9.02	9.75	0.643		10		371
0913		0	19 x 55	1045	0.254	52.951	3	10.0	11.0	0.502		10		475
0914		2/0	19 x 70	1330	0.254	67.392	3	11.2	12.4	0.394		10		604
0915		3/0	37 x 45	1665	0.254	84.367	4	12.7	13.9	0.315		10		756
0916		4/0	37 x 57	2109	0.254	106.86	5	14.4	15.6	0.253		10		960

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Table 5E
DETAILS OF CONDUCTORS (Inch-Pound)
27% NICKEL COATED COPPER AND COPPER ALLOY CONDUCTORS

COND. CODE	sq. mm.	AWG	ROPE CONST.	NO. STRANDS	NOMINAL STRAND SIZE (in.)	NOMINAL CONDUCTOR AREA (CMA) (sq. in.)	MISSING STRANDS	GENERAL PURPOSE DIAMETER (in)		RESIST. (ohm/mft) MAX		ELONG (%) MIN		WEIGHT (lb/mft)
							MAX	MIN	MAX	NHC	NHA	NHC	NHA	MIN
1001		22		19	0.0063	754	0	0.0290	0.0330	23.7	25.6	10	6	2.14
1002		20		19	0.0080	1216	0	0.0365	0.0415	14.6	15.3	10	6	3.46
1003		18		19	0.0100	1900	0	0.0455	0.0520	9.14	9.59	10	6	5.43
1004		16		19	0.0113	2426	0	0.0520	0.0610	6.85	7.30	10	6	6.93
1005		14		19	0.0142	3831	0	0.0650	0.0740	4.32		10		11.0
1006		12		19	0.0179	6088	0	0.0820	0.0940	2.78		10		16.8
1007		10	7 x 7	49	0.0142	9880	0	0.123	0.129	1.68		10		26.7
1008		8	19 x 7	133	0.0113	16983	0	0.158	0.179	0.936		10		51.5
1009		6	19 x 7	133	0.0142	26818	0	0.198	0.218	0.591		10		81.4
1010		4	19 x 7	133	0.0179	42615	0	0.250	0.272	0.375		10		130
1011		2	19 x 35	665	0.0100	66500	2	0.320	0.345	0.241		10		203
1012		1	19 x 43	817	0.0100	81700	2	0.355	0.384	0.196		10		249
1013		0	19 x 55	1045	0.0100	104500	3	0.395	0.432	0.153		10		319
1014		2/0	19 x 70	1330	0.0100	133000	3	0.440	0.490	0.120		10		406
1015		3/0	37 x 45	1665	0.0100	166500	4	0.500	0.548	0.096		10		508
1016		4/0	37 x 57	2109	0.0100	210900	5	0.565	0.615	0.077		10		645

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Table 6M
DETAILS OF CONDUCTORS (Metric)
COPPER CLAD STEEL CONDUCTORS

COND CODE	SQ MM	AWG	NO. STRANDS	NOMINAL STRAND SIZE (mm)	NOMINAL COND. AREA (CMA) (sq. mm.)	MISSING STRANDS	GENERAL PURPOSE DIAMETER (mm)		RESIST. (ohm/km) MAX		ELONG (%) MIN	
						MAX	NOM	MAX	SCCCS	NCCCS	SCCCS	NCCCS
1101		32	7	0.079	0.0341	0	0.236	0.259	1421	1473	6	6
1102		32	19	0.051	0.0385	0	0.239	0.292	1316	1388	8	8
1104		30	7	0.102	0.0568	0	0.305	0.328	840	869	8	8
1105		30	19	0.064	0.0602	0	0.300	0.356	824	869	8	8
1107		28	7	0.127	0.0887	0	0.381	0.404	532	545	8	8
1108		28	19	0.079	0.0925	0	0.371	0.432	528	548	8	8
1110		26	7	0.160	0.1408	0	0.480	0.503	331	338	8	8
1111		26	19	0.102	0.1540	0	0.478	0.546	312	324	8	8
1113		24	7	0.203	0.2270	0	0.610	0.632	205	209	8	8
1114		24	19	0.127	0.2407	0	0.597	0.673	198	202	8	8
1116		22	7	0.254	0.3547	0	0.762	0.785	130	132	8	8
1117		22	19	0.160	0.3821	0	0.752	0.838	124	126	8	8
1119		20	7	0.320	0.5631	0	0.960	0.988	82.0	83.0	8	8
1120		20	19	0.203	0.6162	0	0.955	1.05	76.1	77.8	8	8
1122		18	7	0.404	0.8967	0	1.21	1.25	51.5	52.2	8	8
1123		18	19	0.254	0.9627	0	1.19	1.31	48.6	48.9	8	8
1125		16	19	0.287	1.229	0	1.35	1.48	38.1	38.4	8	8

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Table 6E
DETAILS OF CONDUCTORS (Inch-Pound)
COPPER CLAD STEEL CONDUCTORS

COND CODE	SQ MM	AWG	NO. STRANDS	NOMINAL STRAND SIZE (in)	NOMINAL COND. AREA (CMA) (sq. in.)	MISSING STRANDS	GENERAL PURPOSE DIAMETER (in)		RESIST. (ohm/mft) MAX		ELONG (%) MIN	
						MAX	NOM	MAX	SCCCS	NCCCS	SCCCS	NCCCS
1201		32	7	0.0031	67.3	0	0.0093	0.0102	433	449	6	6
1202		32	19	0.0020	76.0	0	0.0094	0.0115	401	423	8	8
1204		30	7	0.0040	112	0	0.0120	0.0129	256	265	8	8
1205		30	19	0.0025	119	0	0.0118	0.0140	251	265	8	8
1207		28	7	0.0050	175	0	0.0150	0.0159	162	166	8	8
1208		28	19	0.0031	183	0	0.0146	0.0170	161	167	8	8
1210		26	7	0.0063	278	0	0.0189	0.0198	101	103	8	8
1211		26	19	0.0040	304	0	0.0188	0.0215	95.2	98.7	8	8
1213		24	7	0.0080	448	0	0.0240	0.0249	62.4	63.7	8	8
1214		24	19	0.0050	475	0	0.0235	0.0265	60.3	61.6	8	8
1216		22	7	0.0100	700	0	0.0300	0.0309	39.7	40.1	8	8
1217		22	19	0.0063	754	0	0.0296	0.0330	37.7	38.5	8	8
1219		20	7	0.0126	1111	0	0.0378	0.0389	25.0	25.3	8	8
1220		20	19	0.0080	1216	0	0.0376	0.0415	23.2	23.7	8	8
1222		18	7	0.0159	1770	0	0.0477	0.0491	15.7	15.9	8	8
1223		18	19	0.0100	1900	0	0.0470	0.0515	14.8	14.9	8	8
1225		16	19	0.0113	2426	0	0.0531	0.0582	11.6	11.7	8	8

Table 7M
DETAILS OF CONDUCTORS (Metric)
TYPE KPH, KPS, KNH AND KNS CONDUCTORS

COND CODE	SQ MM	AWG	NO. STRANDS	NOMINAL STRAND SIZE (mm)	CONDUCTOR AREA (CMA) (sq. mm.)		MISSING STRANDS	GENERAL PURPOSE DIAMETER (mm)		RESISTANCE (ohm/km)			
										KP (H or S)		KN (H or S)	
					MIN	NOM	MAX	NOM	MAX	MIN	MAX	MIN	MAX
1301		22	19	0.160	0.3517	0.3821	0	0.737	0.838	1793.7	1982.7	748.7	827.8
1302		20	19	0.203	0.5711	0.6162	0	0.940	1.04	1112.9	1230.4	464.3	513.5
1303		18	19	0.254	0.8969	0.9627	0	1.17	1.30	712.0	787.4	296.9	328.8
1304		16	19	0.287	1.146	1.229	0	1.32	1.47	556.8	615.8	231.6	256.6
1305		14	19	0.361	1.809	1.941	0	1.65	1.85	353.0	390.4	147.3	163.1

Table 7E
DETAILS OF CONDUCTORS (Inch-Pound)
TYPE KPH, KPS, KNH AND KNS CONDUCTORS

COND CODE	SQ MM	AWG	NO. STRANDS	NOMINAL STRAND SIZE (in)	CONDUCTOR AREA (CMA) (sq. in.)		MISSING STRANDS	GENERAL PURPOSE DIAMETER (in)		RESISTANCE (ohm/mft)			
										KP (H or S)		KN (H or S)	
					MIN	NOM	MAX	NOM	MAX	MIN	MAX	MIN	MAX
1401		22	19	0.0063	694	754	0	0.029	0.033	546.7	604.3	228.2	252.3
1402		20	19	0.0080	1127	1216	0	0.037	0.041	339.2	375	141.5	156.5
1403		18	19	0.0100	1770	1900	0	0.046	0.051	217	240	90.5	100.2
1404		16	19	0.0113	2261	2426	0	0.052	0.058	169.7	187.7	70.6	78.2
1405		14	19	0.0142	3570	3831	0	0.065	0.073	107.6	119	44.9	49.7

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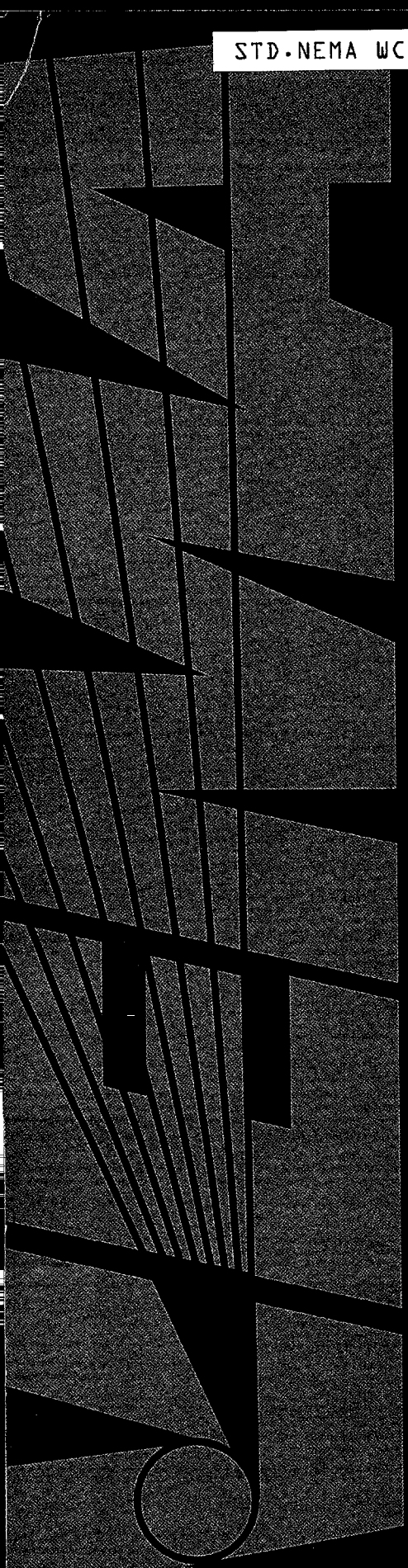

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