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National Electrical Manufacturers Association (NEMA) Standard NEMA HP 4, "Electrical and Electronic FEP (Fluorinated Ethylene Propylene) Insulated High Temperature Hook-up Wire; Types KT (250 Volt), K (600 Volt) and KK (1000 Volt)", was adopted on 22 September 1999 for use by the Department of Defense (DoD). Proposed changes by DoD activities must be submitted to the DoD Adopting Activity: Defense Logistics Agency, Defense Supply Center, Columbus, ATTN: DSCC-VAI, P.O. Box 3990, Columbus, OH 43216-5000. DoD activities may obtain copies of this standard from the Defense Automated Printing Service, DODSSP, 700 Robbins Avenue, Building 4, Section D, Philadelphia, PA 19111-5094. The private sector and other Government agencies may purchase the document from the National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209.

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STD.NEMA HP 4-ENGL 1997 ■ 6470247 0513403 933 ■

NEMA STANDARDS PUBLICATION

NEMA HP 4

ELECTRICAL AND ELECTRONIC FEP (FLUORINATED ETHYLENE PROPYLENE) INSULATED HIGH TEMPERATURE HOOK-UP WIRE, TYPES KT (250 VOLT), K (600 VOLT), AND KK (1000 VOLT)

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NEMA Standards Publication No. HP 4-1997

Electrical And Electronic FEP (Fluorinated Ethylene Propylene) Insulated High Temperature Hook-Up Wire, Types KT (250 Volt), K (600 Volt), And KK (1000 Volt)

Published by:

National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847
Rosslyn, VA 22209

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FOREWORD

The Standard Publication was developed by the NEMA High Performance Wire and Cable Section. This standard was developed to assure that these types of hook-up wire can be procured and that they will meet requirements associated with high reliability commercial electrical and electronic equipment in which it is used. 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.

This Standard Publication was designed as a non-government standard for replacement of MIL-W-16878 FEP insulated wire specification sheets (/11, /12, and /13).

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 Standards Publication covers specific requirements for FEP (Fluorinated Ethylene Propylene) insulated solid and stranded wire, designed for the internal wiring of high reliability electrical and electronic equipment. This Standards Publication addresses 250 volt (Type KT), 600 volt (Type K), and 1000 volt (Type KK) wire and permits continuous conductor temperature ratings of -65°C to +200°C with silver-coated or nickel-coated conductors and -65°C to +150°C with tin-coated conductors. These types of hook-up wire are used when the following requirements are called for:

- High temperature resistance
- Low temperature resistance
- Low dielectric constant
- Resistance to cleaning solutions or a variety of chemicals that may come in contact with either the wire or the equipment
- Good flexibility and flex life when stranded conductors are used

1.2 REFERENCED STANDARDS AND SPECIFICATIONS

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

B3-95	Soft or Annealed Copper Wire
B33-93	Tinned Soft or Annealed Copper Wire
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
B624-92	High-Strength, High Conductivity Copper-Alloy Wire for Electronic Application
D2116-96	FEP Fluorocarbon Molding and Extrusion Materials
D3032-93	Methods of Testing Hook-Up Wire Insulation

American Society for Quality Control
611 E. Wisconsin Ave.
Milwaukee, WI 53202

ANSI/ASQC Z1.4	Sampling Procedures and Tables for Inspection by Attributes

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Electronic Industries Association
2500 Wilson Blvd.
Arlington, VA 22201

EIA-359-A-85 EIA Standard Colors for Color Identification and Coding

DODSSP-Customer Service
Bldg. 4D
700 Robbins Ave.
Philadelphia, PA 19111-5094

MIL-STD-2223 Test Methods for Insulated Electric Wire

National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847
Rosslyn, VA 22209

WC 52-1985 (R1991) High Temperature and Electronic Insulated Wire-Impulse Dielectric Testing

WC 56-1993 3.0 kHz Insulation Continuity Proof Testing of Hook-Up Wire

1.3 RECOMMENDED USES OF WIRE TYPES

1.3.1 Type KT

Type KT wire is intended for use in low voltage, high temperature applications. It is suitable for use up to a maximum of 250 volts rms (root mean square) and/or for high frequency circuitry.

Wires having KT thin wall insulation are relatively fragile and can be damaged. They should not be used where a mechanical stress or an abrasive environment may exist.

1.3.2 Type K

Type K is intended for high temperature applications and is considered suitable for use at a maximum of 600 volts rms and/or for high frequency circuitry.

1.3.3 Type KK

Type KK is intended for high temperature applications and is considered suitable for use at a maximum of 1000 volts rms and/or for high frequency circuitry.

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1.4 PART IDENTIFICATION NUMBER (PIN)

The part numbers shall be of the following form:

HP4-(TYPE)-(AWG)(NUMBER OF STRANDS)(CONDUCTOR MATERIAL)(COLOR)

NEMA STANDARD

for FEP insulated wire

TYPE KT,K,KK
as described above

Example:
HP4-K-GAB9

FEP ,Type K, 20 AWG, Solid, Silver Coated Copper, White

AWG NOMINAL CONDUCTOR SIZE

AWG	LETTER	AWG	LETTER	AWG	LETTER	AWG	LETTER
32	A	20	G	8	N	00	W
30	B	18	H	6	P	000	Y
28	C	16	J	4	R	0000	Z
26	D	14	K	2	S		
24	E	12	L	1	T		
22	F	10	M	0	U		

NUMBER OF STRANDS

LETTER	NUMBER OF STRANDS	LETTER	NUMBER OF STRANDS
A	1	R	817
B	7	S	1045
E	19	T	1330
G	37	V	1665
L	133	W	2109
P	665		

CONDUCTOR MATERIAL AND COATING

LETTER	CONDUCTOR MATERIAL & COATING	LETTER	CONDUCTOR COATING & MATERIAL
B	Silver-coated Copper (SCC)	E	Nickel-coated high-strength copper alloy (NCA)
C	Nickel-coated Copper (NCC)	F	Silver-coated copper clad steel (SCCCS)
D	Silver-coated high-strength copper alloy (SCA)	G	Nickel-coated copper clad steel (NCCCS)
		H	Tin-coated copper (TCC)

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COLOR (SEE PARA. 4.1)

COLOR	NUMBER DESIGNATOR	COLOR	NUMBER DESIGNATOR
Black	0	Green	5
Brown	1	Blue	6
Red	2	Violet (Purple)	7
Orange	3	Gray (Slate)	8
Yellow	4	White	9

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SECTION 2
CONDUCTORS

2.1 CONDUCTOR MATERIALS

The base conductor material shall be composed of soft or annealed copper conforming to ASTM B3, copper-clad steel conforming to ASTM B452 Class 40A, or a copper alloy conforming to ASTM B624. Conductor strands shall be individually coated. The addition of the coating material after stranding shall not be permitted.

2.2 CONDUCTOR COATINGS

2.2.1 Silver-Coated Conductors

Silver-coated conductors may be employed for applications up to conductor temperatures of 200°C. The silver coating shall be commercially pure silver and not less than 40 microinches (1 μm) in thickness for copper and copper alloys and not less than 50 microinches (1.25 μm) for copper-clad steel. The conductor shall be tested prior to stranding for continuity of coating and coating thickness in accordance with ASTM B298 or ASTM B501 for silver-coated copper-clad steel.

2.2.2 Nickel-Coated Conductors

Nickel-coated conductors may be employed for applications up to conductor temperatures of 200°C. The nickel coating shall be commercially pure nickel and not less than 50 microinches (1.25 μm) in thickness for all conductor materials. The conductor shall be tested prior to stranding for continuity of coating and coating thickness in accordance with ASTM B355 or ASTM B559 for nickel-coated copper-clad steel.

2.2.3 Tin-Coated Conductors

Tin-coated conductors may be employed for applications up to conductor temperatures of 150°C. The conductor shall be tested prior to stranding for continuity of coating in accordance with ASTM B33.

2.3 STRANDING

Stranding shall be in accordance with Table 2. The lay length of the outer layer shall be 8 to 16 times the maximum conductor diameter. All requirements for stranded conductors, not specified in Table 2, shall be in accordance with the applicable requirements of ASTM B286.

2.4 MINIMUM WIRE AND STRAND DIAMETER

Minimum wire and strand diameter shall be controlled by maximum dc resistance.

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Table 2
DETAILS OF CONDUCTORS*

Size (AWG)	Stranding	Single End Strand Dia. Nominal (inches)	Nominal CMA	Conductor Diameter Nominal (inches)	Conductor Diameter Maximum (inches)	Maximum DC Resistance of Finished Wire (Ohms/1000 Ft. at 20 °C) TCC	SCC	NCC	SCA	NCA	SCCCS	NCCCS	Alloy Breaking Strength Minimum (Lbs.)
32	1 x 32	0.0080	64	0.0080	0.0083	178	166	177	196	210	424	433	2.94
	7 x 40	0.0031	67	0.0093	0.0102	182	170	186	199	223	433	449	2.97
	19 x 44	0.0020	76	0.0094	0.0115	169	157	179	185	215	401	423	3.23
30	1 x 30	0.0100	100	0.0100	0.0103	114	106	110	124	131	270	273	4.62
	7 x 38	0.0040	112	0.0120	0.0129	108	100	110	118	132	256	265	5.02
	19 x 42	0.0025	119	0.0118	0.0140	106	98.6	112	116	135	251	265	5.16
28	1 x 28	0.0126	159	0.0126	0.0130	70.8	66.7	69.4	78.4	82.3	170	172	7.33
	7 x 36	0.0050	175	0.0150	0.0159	68.2	63.6	67.6	74.8	80.5	162	166	7.92
	19 x 40	0.0031	183	0.0146	0.0170	67.7	63.1	69.3	74.2	83.0	161	167	8.06
26	1 x 26	0.0159	253	0.0159	0.0164	44.5	41.9	43.6	49.2	51.7	107	108	11.7
	7 x 34	0.0063	278	0.0189	0.0198	42.6	39.7	42.2	46.7	50.3	101	103	12.7
	19 x 38	0.0040	304	0.0188	0.0215	40.1	37.3	41.0	43.9	49.1	95.2	98.7	13.6
24	1 x 24	0.0201	404	0.0201	0.0207	27.2	26.2	27.3	30.8	32.3	66.8	67.5	18.7
	7 x 32	0.0080	448	0.0240	0.0249	26.2	24.5	26.0	28.8	31.0	62.4	63.7	20.6
	19 x 36	0.0050	475	0.0235	0.0265	25.4	23.6	25.2	27.8	29.9	60.3	61.6	21.5
22	1 x 22	0.0253	640	0.0253	0.0261	17.2	16.5	17.2	19.4	20.4	42.2	42.6	29.6
	7 x 30	0.0100	700	0.0300	0.0309	16.7	15.6	16.2	18.3	19.2	39.7	40.1	32.3
	19 x 34	0.0063	754	0.0296	0.0330	15.9	14.8	15.7	17.4	18.7	37.7	38.5	34.4
20	1 x 20	0.0320	1024	0.0320	0.0330	10.7	10.3	10.8	12.2	12.8	26.4	26.6	47.3
	7 x 28	0.0126	1111	0.0378	0.0389	10.4	9.81	10.2	11.5	12.1	25.0	25.3	51.3
	19 x 32	0.0080	1216	0.0376	0.0415	9.76	9.10	9.68	10.7	11.5	23.2	23.7	55.9
18	1 x 18	0.0403	1624	0.0403	0.0415	6.78	6.52	6.79	7.67	8.04	16.6	16.8	75.0
	7 x 26	0.0159	1770	0.0477	0.0491	6.54	6.16	6.42	7.25	7.60	15.7	15.9	81.7
	19 x 30	0.0100	1900	0.0470	0.0515	6.22	5.79	6.03	6.81	7.15	14.8	14.9	87.8
16	1 x 16	0.0508	2581	0.0508	0.0523	4.26	4.10	4.27	4.82	5.06	10.5	10.6	119
	19 x 29	0.0113	2426	0.0531	0.0582	4.82	4.54	4.73	5.34	5.60	11.6	11.7	112
14	19 x 27	0.0142	3831	0.0667	0.0731	3.05	2.87	2.99					
12	19 x 25	0.0179	6088	0.0841	0.0922	1.92	1.81	1.88					
	37 x 28	0.0126	5874	0.0858	0.0908	2.01	1.89	1.97					
10	37 x 26	0.0159	9354	0.108	0.115	1.26	1.19	1.24					
8	133 x 29	0.0113	16983	0.161	0.175	0.701	0.661	0.688					
6	133 x 27	0.0142	26818	0.202	0.219	0.444	0.418	0.436					
4	133 x 25	0.0179	42615	0.266	0.277	0.280	0.263	0.274					
2	665 x 30	0.0100	66500	0.335	0.342	0.183	0.170	0.177					
1	817 x 30	0.0100	81700	0.378	0.382	0.149	0.139	0.144					
1/0	1045 x 30	0.0100	104500	0.410	0.431	0.116	0.108	0.113					
2/0	1330 x 30	0.0100	133000	0.477	0.486	0.0914	0.0851	0.0887					
3/0	1665 x 30	0.0100	166500	0.535	0.545	0.0727	0.0677	0.0705					
4/0	2109 x 30	0.0100	210900	0.601	0.635	0.0602	0.0537	0.0559					

*See Appendix A for Measurement and Calculation Data.

CMA - Circular Mil Area
TCC - Tin- coated copper
SCC - Silver- coated copper
NCC - Nickel- coated copper
SCA - Silver-coated high-strength copper alloy
NCA - Nickel-coated high-strength copper alloy
SCCCS - Silver-coated copper-clad steel
NCCCS - Nickel-coated copper-clad steel

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Section 3
INSULATION

3.1 GENERAL

The FEP insulating material shall conform to ASTM D2116.

3.2 FEP INSULATION

The insulation shall be extruded concentrically about the conductor. The diameter of the insulated conductor shall be in accordance with Table 3 (see paragraph 6.1.5).

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Table 3-1
DIMENSIONS-TYPE WIRES
(All Dimensions in Inches)

AWG	Wires	Stranding	Conductor Diameter (Nominal)	Insulated Conductor Diameter (Minimum)	Insulated Conductor Diameter (Maximum)
32	KT	1 x 32	.0080	.018	.022
	KT	7 x 40	.0093	.020	.024
	KT	19 x 44	.0099	.020	.024
	K	1 x 32	.0080	.024	.032
	K	7 x 40	.0093	.026	.034
	K	19 x 44	.0099	.026	.034
	KK	1 x 32	.0080	.033	.041
	KK	7 x 40	.0093	.035	.043
	KK	19 x 44	.0099	.035	.043
30	KT	1 x 30	.0100	.020	.024
	KT	7 x 38	.0120	.022	.026
	KT	19 x 42	.0124	.022	.026
	K	1 x 30	.0100	.026	.034
	K	7 x 38	.0120	.028	.036
	K	19 x 42	.0124	.028	.036
	KK	1 x 30	.0100	.036	.044
	KK	7 x 38	.0120	.038	.046
	KK	19 x 42	.0124	.038	.046
28	KT	1 x 28	.0126	.023	.027
	KT	7 x 36	.0150	.025	.029
	KT	19 x 40	.0140	.025	.029
	K	1 x 28	.0126	.029	.037
	K	7 x 36	.0150	.031	.039
	K	19 x 40	.0146	.031	.039
	KK	1 x 28	.0126	.039	.047
	KK	7 x 36	.0150	.041	.049
	KK	19 x 40	.0146	.041	.049
26	KT	1 x 26	.0159	.026	.030
	KT	7 x 34	.0189	.029	.033
	KT	19 x 38	.0188	.029	.033
	K	1 x 26	.0159	.032	.040
	K	7 x 34	.0189	.035	.043
	K	19 x 38	.0188	.035	.043
	KK	1 x 26	.0159	.042	.050
	KK	7 x 34	.0189	.045	.053
	KK	19 x 38	.0188	.045	.053
24	KT	1 x 24	.0201	.030	.034
	KT	7 x 32	.0240	.034	.038
	KT	19 x 36	.0235	.034	.038
	K	1 x 24	.0201	.026	.044
	K	7 x 32	.0240	.040	.048
	K	19 x 36	.0235	.040	.048
	KK	1 x 24	.0201	.046	.054
	KK	7 x 32	.0240	.050	.058
	KK	19 x 36	.0235	.050	.058
22	KT	1 x 22	.0253	.035	.040

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Table 3-1 (Continued)
DIMENSIONS-TYPE WIRES
(All Dimensions in Inches)

AWG	Wires	Stranding	Conductor Diameter (Nominal)	Insulated Conductor Diameter (Minimum)	Insulated Conductor Diameter (Maximum)
	KT	7 x 30	.0300	.040	.044
	KT	19 x 34	.0296	.040	.044
	K	1 x 22	.0253	.041	.050
	K	7 x 30	.0300	.046	.054
	K	19 x 34	.0296	.046	.054
	KK	1 x 22	.0253	.051	.060
	KK	7 x 30	.0300	.056	.064
	KK	19 x 34	.0296	.056	.064
20	KT	1 x 20	.0320	.042	.046
	KT	7 x 28	.0378	.048	.052
	KT	19 x 32	.0376	.048	.052
	K	1 x 20	.0320	.048	.056
	K	7 x 28	.0378	.054	.062
	K	19 x 32	.0376	.054	.062
	KK	1 x 20	.0320	.058	.066
	KK	7 x 28	.0378	.064	.072
	KK	19 x 32	.0376	.064	.072
18	K	1 x 18	.0403	.056	.066
	K	7 x 26	.0477	.064	.074
	K	19 x 30	.0470	.064	.074
	KK	1 x 18	.0403	.066	.076
	KK	7 x 26	.0477	.074	.084
	KK	19 x 30	.0470	.074	.084
16	K	1 x 16	.0508	.067	.081
	K	19 x 29	.0531	.073	.087
	KK	1 x 16	.0508	.077	.089
	KK	19 x 29	.0531	.083	.095
14	K	19 x 27	.0667	.088	.102
	KK	19 x 27	.0667	.098	.114
12	K	19 x 25	.0841	.107	.121
	K	37 x 28	.0858	.105	.119
	KK	19 x 25	.0841	.117	.133
	KK	37 x 28	.0858	.115	.131
10	K	37 x 26	.108	.127	.141
	KK	37 x 26	.108	.137	.153
8	K	133 x 29	.161	.185	.199
	KK	133 x 29	.161	.199	.219
6	KK	133 x 27	.202	.286	.301
4	KK	133 x 25	.266	.349	.369
2	KK	665 x 30	.335	.395	.415
1	KK	817 x 30	.378	.475	.495
1/0	KK	1045 x 30	.410	.504	.524
2/0	KK	1330 x 30	.477	.553	.577
3/0	KK	1665 x 30	.535	.633	.657
4/0	KK	2109 x 30	.601	.703	.727

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SECTION 4
WIRE IDENTIFICATION

4.1 CIRCUIT IDENTIFICATION

Circuit identification if required shall be accomplished by use of an insulation color in accordance with EIA-359-A-85 (R 1985). Colored stripe or band tracers on the insulation, and/or printed numbers or letters shall be permitted, in addition to the colored insulation.

4.2 IDENTIFICATION BY PRINTING

Identification by printing on the wire is available for Types K and KK wire for conductor sizes 22 AWG and larger. Print should be clear and legible. Printing on Type KT wire is not recommended due to the thin wall construction. PIN printed on wire shall not include color designation. Identification marks shall not be applied by hot stamp marking or other methods which significantly penetrate the insulation.

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Section 5
PHYSICAL AND ELECTRICAL REQUIREMENTS

5.1 GENERAL

The physical and electrical requirements for Types KT, K, and KK wire shall be in accordance with this Section and Tables 2, 3, and 5. Testing shall be conducted in accordance with Section 6.

5.2 QUALITY CONFORMANCE INSPECTION OF FINISHED PRODUCT

5.2.1 Definitions

5.2.1.1 Inspection Lot

An inspection lot shall consist of all wire of the same part number, produced under essentially the same conditions, and presented for inspection at one time.

5.2.1.2 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.

5.2.2 Sampling Inspection

Unless otherwise specified, the sampling plan shall be in accordance with special inspection level S-2 in ANSI/ASQC Z1.4.

5.3 WORKMANSHIP

The insulated wire shall be free of kinks, abrasions, and cracked or peeled surfaces. The wire should be a uniform and consistent product and should be free from defects which will adversely affect the serviceability of the product for the intended use, as described in Section 1.2.

5.4 MATERIALS CERTIFICATION

Suppliers shall maintain certifications that all materials used conform to the requirements in Section 2 and Section 3.

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Table 5-1
PHYSICAL AND ELECTRICAL REQUIREMENTS FOR TYPE KT, K, AND KK WIRES

Test	Requirements		
	KT	K	KK
Dimensional Inspection (See 6.1.4)	See Tables 2 and 3	See Tables 2 and 3	See Tables 2 and 3
Conductor Resistance (See 6.2.1)	See Table 2	See Table 2	See Table 2
Spark Test Voltage or Impulse Test Voltage (See 6.2.2)	2.9 kV 4.0 kV	4.6kV 6.5 kV	5.7 kV 8.0 kV
Heat Resistance & Dielectric Strength Peak Voltage (See 6.1.2 and 6.2.3)	1.5 kVrms	2.0 kV rms	3.0 kVrms
Insulation Tensile Strength (Minimum) (See 6.1.3)	2500 psi	2500 psi	2500 psi
Insulation Elongation (Minimum) (See 6.1.3)	200 percent	200 percent	200 percent

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Section 6
TEST PROCEDURES

6.1 PHYSICAL TESTS

Physical test on the conductor and insulated wire shall be made in accordance with the following procedures:

6.1.1 Test Temperature

Unless otherwise specified, physical tests shall be performed at a room temperature of 23 ± 2°C. The test specimens shall be kept at room temperature for not less than 30 minutes prior to the tests.

6.1.2 Heat Resistance

Specimens of insulated wire, each having a length of 12 inches plus the length required for winding on the mandrel, shall be placed in an air-circulating oven at 230 ± 2°C for silver or nickel-coated conductor wire and 180 ± 2°C for tin-coated conductor wires for 96 hours. They shall then be removed from the conditioning chamber and allowed to return to room temperature. The specimen shall be examined for cracks. The length of exposed conductor, if any, at each end of the specimen shall be considered as shrinkage of the insulation. In no case shall the shrinkage at either end exceed a maximum value of 1/8 inch.

Following the oven aging, specimens shall be wound tightly around a mandrel approximately but not less than, three times the overall diameter of the wire for five close turns and removed as a helical coil. Slight discoloration shall be considered normal and acceptable. The coiled sections shall than be subjected to the dielectric strength test, as specified in 6.2.3.

6.1.3 Insulation Tensile Strength and Elongation

The insulation tensile strength and elongation test shall be conducted in accordance with, ASTM D3032, Section 17, except that the rate of travel of the crosshead shall be 2 inches minimum and 20 inches maximum per minute.

6.1.4 Dimensional Inspection

Using a micrometer or equivalent device capable of measuring to the nearest 0.0001 inch, determine the diameters of the conductor and insulation as described below.

6.1.4.1 Conductor Diameter

Remove the insulation for the specimen without damaging or distorting the conductor. Measure the outer diameter in at least three locations along the length of the stripped conductor. Each measurement shall consist of two micrometer readings taken 90 degrees form each other. For sizes 8 and larger, a circumferential measuring tape may be used. Report the average of the readings.

6.1.4.2 Insulation Diameter

Measure the outer diameter of the insulated wire in at least three locations along a 12 inch length of the specimen. Each measurement shall consist of two readings taken 90 degrees from each other. For sizes 8 and larger, a circumferential measuring tape may be used. Report the average of the readings.

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6.2 ELECTRICAL TESTS

Electrical tests on the insulated conductors shall be made in accordance with the following procedures:

6.2.1. Conductor Resistance

The dc resistance of the finished insulated wire shall be measured in accordance with MIL-STD-2223 Method 5003.

6.2.2 Spark or Impulse Test

Spark testing shall be conducted on 100 percent of all lengths of insulated wire per NEMA WC 52 or NEMA WC 56 at the voltages specified in the requirements of Table 5.

6.2.3 Dielectric Strength

One inch of insulation shall be removed from each end of the specimen and the conductor shall be attached to an electric lead. The specimen shall be immersed in tap water at 23 ± 5°C, except for the uninsulated ends. After immersion for 1 hour, the voltage specified in Table 5 at 60 Hz shall be applied between the conductor and an electrode in contact with liquid. The applied voltage shall be uniformly increased from zero to the specified peak voltage in 30 seconds, maintained at that voltage for a period of 1 minute, and uniformly reduced to zero in 30 seconds.

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Section 7
NOTES

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 Identification Number (see 1.4)
Date (month, day, and year) of manufacture
Manufacturer's name or identifying mark

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Section 8
ORDERING DATA

8.1 ORDERING INFORMATION

Purchasing documents should specify the following information:

1. Part Identification Number (see 1.4)
2. Packaging Requirements
3 Length Requirements
4. Quantity
5. Optional Identification (stripes, bands, tracers, printing)

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APPENDIX A
Measurement and Calculation Data for Table 2

Minimum alloy breaking strength calculated based on the minimum diameter and tensile strength per ASTM B624

Nominal CMA based on the square of the nominal single end diameter in mils times the number of ends.

Nominal conductor diameter based on nominal single end diameter per ASTM B3, B298, B355, B501, and B559 which are all the same.

Three times the nominal single end diameter for 7 strand and 4.7 times for 19 strand was used. The OD for 19 strand was based on the unilay construction which is the most commonly used.

Maximum conductor diameter based on maximum single end diameters for nickel coated copper per ASTM B355. Three times which represents the largest possible 19 and 37 strand diameter was used. A 19 X 7 true concentric rope which represents the largest diameter was used. Rope Stranding using bunched members maximum diameter is per ASTM B286.

Maximum DC Resistance

SCC and NCC

- DC resistance based on formula in ASTM B286 Note 2.

SCA

- DC resistance based on formula in ASTM B286 Note 2 using a conductivity of 85% IACS minimum per ASTM B624

NCA

- DC resistance based on formula in ASTM B286 Note 2 using a base conductivity of 85% IACS minimum per ASTM B624 minus the effect of nickel per ASTM B286.

Class 2: .0100" diameter and larger	81% IACS
Class 4: .0099" to .0050"	79% IACS
Class 7: .0049" to .0031"	76% IACS
Class 10: .0030" to .0020"	73% IACS

SCCCA

- DC resistance based on formula in ASTM B286 Note 2 using a minimum conductivity of 39.2% IACS for type 40A per ASTM B501

NCCCS

- DC resistance based on formula in ASTM B286 Note 2 using the minimum conductivity for type 40A per ASTM B559

Class 2: .0100" diameter and larger	38.2% IACS
Class 4: .0099" to .0050"	38.4% IACS
Class 7: .0049" to .0031"	37.8% IACS
Class 10: .0030" to .0020"	37.2% IACS

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