1. CONDUCTOR:

1.1 Size and Material: 22 7/30 AWG silver-plated copper wire.
1.2 O.D.: .030" nom.

2. INSULATION:

2.1 Extruded silicone rubber.
2.2 O.D.: .061" ± .003"
2.3 Color: as per order (replace X in the part number and the description by 0-9 color code).

3. PERFORMANCE:

3.1 Voltage rating: 600 VAC R.M.S.
3.2 Temperature rating: 200°C

4. REFERENCE:

4.1 NEMA Standards Publication No. HP 6.

CUSTOMER APPROVAL

Sign: _____

Date: _____

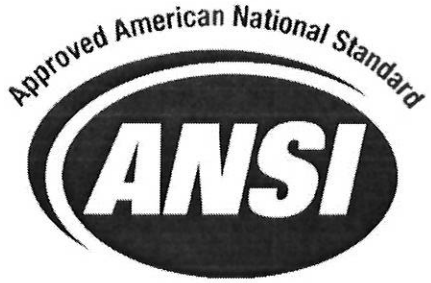
Engineering Change Notice No.							

UNCONTROLLED DOCUMENT
A later revision of this specification may exist.

Done:	Pierre Garand				
Date:	December 9, 2008				
Verified:	Claude Côté				
Date:	December 9, 2008				
Size: A	Scale: ---	Page: 1 of 1	Code Ident. No: 57104	Specification No.: Q02535-X	Rev. ---

Harbour INDUSTRIES
1365, boul. Industriel, Farnham, Quebec, Canada, J2N 2X3
Phone: (450) 293-5304 Fax: (450) 293-2421 Web site: www.harbourind.com

Description: **HP 6-S-BFBX**



ANSI/NEMA HP 6-2013

American National Standard

Electrical and Electronic Silicone and Silicone Braided Insulated, Hook-Up Wire, Types S (600 V), ZHS (600 V), SS (1000 V), ZHSS (1000 V), and SSB Braided (1000 V)

ANSI/NEMA HP 6-2013

American National Standard

Electrical and Electronic Silicone and Silicone Braided Insulated, Hook-Up Wire, Types S (600 V), ZHS (600 V), SS (1000 V), ZHSS (1000 V), and SSB Braided (1000 V)

Secretariat:

National Electrical Manufacturers Association

Approved: March 3, 2013
Published: September 2013

American National Standards Institute, Inc.

NOTICE AND DISCLAIMER

The information in this publication was considered technically sound by a consensus among persons engaged in its development at the time it was approved. Consensus does not necessarily mean there was unanimous agreement among every person participating in the development process.

The National Electrical Manufacturers Association (NEMA) standards and guideline publications, of which the document herein is one, are developed through a voluntary standards development process. This process brings together volunteers and/or seeks out the views of persons who have an interest in the topic covered by this publication. Although NEMA administers the process and establishes rules to promote fairness in the development of consensus, it does not write the documents, nor does it independently test, evaluate, or verify the accuracy or completeness of any information or the soundness of any judgments contained in its standards and guideline publications.

NEMA disclaims liability for any personal injury, property, or other damages of any nature, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, application, or reliance on this document. NEMA disclaims and makes no guaranty or warranty, express or implied, as to the accuracy or completeness of any information published herein, and disclaims and makes no warranty that the information in this document will fulfill any particular purpose(s) or need(s). NEMA does not undertake to guarantee the performance of any individual manufacturer's or seller's products or services by virtue of this standard or guide.

In publishing and making this document available, NEMA is not undertaking to render professional or other services for or on behalf of any person or entity, nor is NEMA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstance. Information and other standards on the topic covered by this publication may be available from other sources, which the user may wish to consult for additional views or information not covered by this publication.

NEMA has no power, nor does it undertake to police or enforce compliance with the contents of this document. NEMA does not certify, test, or inspect products, designs, or installations for safety or health purposes. Any certification or other statement of compliance with any health- or safety-related information in this document shall not be attributable to NEMA and is solely the responsibility of the certifier or maker of the statement.

TABLE OF CONTENTS

Foreword iii

Section 1 GENERAL 1
1.1 Scope 1
1.2 Referenced Standards and Specifications 1
1.3 Recommended Uses of Wire Types 2
1.3.1 Type S 2
1.3.2 Type SS 2
1.3.3 Type SSB 2
1.3.4 Type ZHS 2
1.3.5 Type ZHSS 3
1.4 Part Identification Number (PIN) 3

Section 2 CONDUCTORS 6
2.1 Conductor Materials 6
2.2 Conductor Coatings 6
2.2.1 Tin-Coated Conductors 6
2.2.2 Silver-Coated Conductors 6
2.3 Stranding 6
2.4 Minimum Wire Diameter 6
2.5 Conductor Splices 6

Section 3 INSULATION 7
3.1 General 7
3.2 Silicone Rubber Insulation 7
3.3 Braid Material 7

Section 4 **WIRE IDENTIFICATION** 11
4.1 Circuit Identification 11
4.1.1 Lay of Stripes 11
4.2 Identification by Printing 11
4.2.1 Identification of Product 11

Section 5 PHYSICAL AND ELECTRICAL REQUIREMENTS 12
5.1 General 12
5.2 Quality Conformance Inspection of Finished Product 12
5.2.1 Definitions 12
5.2.2 Sampling Inspection 12
5.3 Workmanship 12
5.4 Materials Certification 12

Section 6 **TEST PROCEDURES** 15
6.1 Physical Tests 15
6.1.1 Test Temperature 15
6.1.2 Heat Resistance 15
6.1.3 Insulation Tensile Strength and Elongation 15
6.1.4 Dimensional Inspection 16
6.1.5 Flammability 16
6.1.6 Cold Bend 16
6.1.7 Halogen Content 18
6.1.8 Smoke Index 18
6.1.9 Toxicity Index 18
6.1.10 Acid Gas 18
6.2 Electrical Tests 18
6.2.1 Conductor Resistance 18
6.2.2 Spark or Impulse Test 18
6.2.3 Dielectric Strength 19
6.2.4 Insulation Resistance 19
6.2.5 Surface Resistance (for wires with outer braid only) 19

Section 7 NOTES 20
7.1 Packaging Requirements 20
7.2 Labeling 20
7.3 Lengths 20

Section 8 ORDERING DATA 22
8.1 Ordering Information 22

Tables

1-1 Conductor Material and Coating 3
1-2 AWG Nominal Conductor Size 3
1-3 Number of Strands 4
1-4 Color 5
3-1 Dimensions–Type Wires 7
3-2 Outside Diameter Increase Due to Braid 10
4-1 Length of Lay of Stripes 11
5-1 Physical and Electrical Requirements for Type S, SS, and SSB Wires 13
6-1 Cold Bend Mandrel, Sizes Type S and ZHS 17
6-2 Cold Bend Mandrel, Sizes Type SS, ZHSS and SSB 17
7-1 Minimum Lengths 20

FOREWORD

This standard publication was developed by the NEMA High Performance Wire and Cable Section. It 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.

In the preparation of this standards publication, input of users and other interested parties has been sought and evaluated. Inquiries, comments, and proposed or recommended revisions should be submitted to the High Performance Wire and Cable Product Section by contacting the:

Senior Technical Director, Operations
National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, Virginia 22209

This standards publication was designed as a non-government standard for replacement of MIL-W-16878 Silicone Rubber Insulated Wire Slash Sheets (/7, /8, /29 through /32).

This standards publication was developed by the High Performance Wire and Cable Section of NEMA. 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:

AFC Cable Systems	New Bedford, MA
Apical Division, Kaneka North America	Pasadena, TX
Belden Inc.	St. Louis, MO
Berk-Tek a Nexans Company	Elm City, NC
Cable USA LLC.	Naples, FL
Champlain Cable Corporation	Colchester, VT
Coleman Cable Inc.	Waukegan, IL
Comtran Cable LLC	Attleboro, MA
Electrolock, Inc.	Hiram, OH
Freeport McMoRan Copper & Gold	Phoenix, AZ
General Cable	Highland Heights, KY

Harbour Industries LLC.	Shelburne, VT
IWG High Performance Conductors	Inman, SC
Lockheed Martin MS2	Morestown, NJ
Marine Tech Wire and Cable, Inc.	York, PA
Nexans AmerCable	El Dorado, AR
Quirk Wire Company, Inc.	West Brookfield, MA
Radix Wire Company	Euclid, OH
RSCC Aerospace and Defense	East Granby, CT
SEA Wire and Cable, Inc.	Madison, AL
Southwire Company	Carrollton, GA
The Monroe Cable Company, Inc.	Middletown, NY
The Okonite Company	Ramsey, NJ
TE Connectivity	Menlo Park, CA
Wiremasters, Inc.	Columbia, TN

Section 1
GENERAL

1.1 SCOPE

This standard publication covers specific requirements for silicone rubber insulated stranded wire, designed for the internal wiring of high reliability electrical and electronic equipment. This standards publication addresses 600 V (Type S, ZHS) and 1000 V (Type SS, ZHSS and SSB) wire and permits continuous conductor temperature ratings of -55ºC to +150ºC with tin-coated copper or -55 ºC to + 200 ºC with silver-coated copper. These types of hook-up wire are used when the following requirements are called for:

- High temperature resistance
- Low temperature resistance
- Good flexibility and flex life
- Solder iron resistance for easier solder terminations without potential damage
- Type ZHS, and ZHSS are used for applications requiring low smoke and zero halogen requirements

1.2 REFERENCED STANDARDS AND SPECIFICATIONS

The following normative documents contain provisions, which through reference in this text constitute provisions of this standards publication. By reference herein these publications are adopted, in whole or in part as indicated, in this standards publication.

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

B 286 *Copper Conductors for Use in Hook-up Wire for Electronics*

B 298 *Silver Coated Soft or Annealed Copper Wire*

D 3032 *Methods of Testing Hook-Up Wire Insulation*

B 3 *Soft or Annealed Copper Wire*

B 33 *Tinned Soft or Annealed Copper Wire*

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

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

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

Fed Std 228	*Methods of Testing Cable and Wire, Insulated*
Mil-STD-2223	*Test Methods for Insulated Electronic Wire*
Mil-C-572	*Cord, Yarns and Monofilaments Organic Synthetic Fiber*
Mil-Y-1140	*Yarn, Cord, Sleeving, Cloth and Tape-Glass*
MIL-DTL-24643	*Cables, Electric Low Smoke, For Shipboard Use General Specification For*

Underwriters Laboratories Inc. (UL)
333 Pfingsten Road
Northbrook, IL 60062

UL 2556	*Reference Standard for Electrical Wires, Cables, and Flexible Cords*

National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, VA 22209

WC 52 *High-Temperature and Electronic Insulated Wire – Impulse Dielectric Testing*
WC-563.0 *kHz Insulation Continuity Proof Testing of Hook-up Wire*

1.3 RECOMMENDED USES OF WIRE TYPES

1.3.1 Type S

Type S wire is intended for use in 600 V high temperature applications.

1.3.2 Type SS

Type SS wire is intended for use in 1000 V high temperature applications.

1.3.3 Type SSB

Type SSB wire is intended for use in 1000 V high temperature applications where enhanced abrasion resistance is required.

1.3.4 Type ZHS

Type ZHS wire is intended for use in 600 V Low Smoke and Zero Halogen applications.

1.3.5 Type ZHSS

Type ZHSS wire is intended for use in 1000 V Low Smoke and Zero Halogen applications.

1.4 PART IDENTIFICATION NUMBER (PIN)

The part numbers shall be of the following form:

HP 6–(Type) (Conductor Material)(AWG Size)(Conductor Stranding)(Color Code)

NEMA STANDARD

Example: For Silicone Rubber insulated wire
HP 6–S-HGB9

TYPE S, ZHS, SS, ZHSS, SSB, Silicone Rubber, Type S, Tin-Coated Copper, 20 AWG, 7 Strands, White
As described above

Table 1-1
CONDUCTOR MATERIAL AND COATING

Letter	Conductor Material and Coating
H	Tin-Coated Copper
B	Silver-Coated Copper

Table 1-2
AWG NOMINAL CONDUCTOR SIZE

AWG	Letter	AWG	Letter
32	A	8	N
30	B	6	P
28	C	4	R
26	D	2	S
24	E	1	T
22	F	0	U
20	G	00	W
18	H	000	Y
16	J	0000	Z
14	K	250 MCM	V
12	L	350 MCM	X

10	M	400 MCM	Q

Table 1-3
NUMBER OF STRANDS

Letter	Number Of Strands
A	1
B	7
C	10
D	16
E	19
F	26
G	37
H	41
J	65
K	105
L	133
M	168
N	259
O	420
P	665
R	817
S	1045
T	1330
V	1672
W	2109
X	2449
Y	3458
Z	3990

Table 1-4
COLOR
(See Clause 4.1)

Color	Number Designator	Color	Number Designator
Black	0	Green	5
Brown	1	Blue	6
Red	2	Violet	7
Orange	3	Gray	8
Yellow	4	White	9

Section 2
CONDUCTORS

2.1 CONDUCTOR MATERIALS

All silver-coated and tin-coated conductor strands shall meet the material requirements of WC-67. The material and coating designators are as follows:

Type SCC: Silver-coated copper
Type TCC: Tin-coated copper

2.2 CONDUCTOR COATINGS

2.2.1 Tin-Coated Conductors

Tin-coated conductors may be employed for applications up to conductor temperatures of 150°C. The stranded conductor shall be tested in accordance with WC-67.

2.2.2 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 µin. in thickness. The stranded conductor shall be tested in accordance with WC-67.

2.3 STRANDING

Stranding shall be in accordance with Table 3-1. The lay length of the outer layer shall be 8 to 16 times the maximum conductor diameter.

2.4 MINIMUM WIRE DIAMETER

Minimum wire diameter shall be controlled by maximum dc resistance per WC-67.

2.5 CONDUCTOR SPLICES

Splices shall not be made in a stranded conductor as a whole; however, individual strands may be spliced. Splices shall be made by cold welding, electro welding or brazing with silver composition solder.

Section 3
INSULATION

3.1 GENERAL

The silicone rubber material shall be formulated and processed such as to meet the requirements of this specification.

3.2 SILICONE RUBBER INSULATION

The insulation shall be extruded concentrically about the conductor. The diameter of the insulated conductor shall be in accordance with Table 3-1 and as measured in accordance with paragraph 6.1.4. The insulation shall be applied to be readily stripped from the conductor so that the conductor is clean for soldering and crimping. A clean conductor shall have no particles of insulation visible to the unaided eye.

3.3 BRAID MATERIAL

The braid, when specified, shall be synthetic textile conforming to type P of MIL-C-572 or glass yarn conforming to MIL-Y-1140. It shall be a closely woven over the insulation and shall be saturated with fungus, heat, flame and moisture resistant lacquer to a smooth finish that shall minimize fraying at the cut ends. Coatings shall be sufficiently translucent so as not to impair the visibility of any underlying color code of the braid materials when stripes are specified. Color tracers used in braids shall be one carrier minimum revolving in the same direction. The braid shall not increase the diameter of the wire by more than the maximum amount specified in Table 3-2.

Table 3-1
DIMENSIONS-TYPE WIRES

(All Dimensions in Inches)

AWG	TYPE	Stranding	Insulation Diameter Minimum	Insulation Diameter Maximum
24	S & ZHS	7 X 32	.052	.058
24	SS & ZHSS	7 X 32	.083	.091
24	SSB	7 X 32	.083	.106
22	S & ZHS	7 X 30	.058	.064
22	SS & ZHSS	7 X 30	.089	.097
22	SSB	7 X 30	.089	.112
20	S & ZHS	7 X 28	.066	.072

20	S & ZHS	10 X 30	.066	.072
20	SS & ZHSS	7 X 28	.097	.105
20	SS & ZHSS	10 X 30	.097	.105
20	SSB	7 X 28	.097	.120
20	SSB	10 X 30	.097	.120
18	S & ZHS	7 X 26	.076	.082
18	S & ZHS	16 X 30	.076	.082
18	SS & ZHSS	7 X 26	.107	.115
18	SS & ZHSS	16 X 30	.107	.115
18	SSB	7 X 26	.107	.130
18	SSB	16 X 30	.107	.115
16	S & ZHS	19 X 29	.085	.091
16	S & ZHS	26 X 30	.085	.091

AWG	**TYPE**	**Stranding**	**Insulation Diameter Minimum**	**Insulation Diameter Maximum**
16	SS & ZHSS	19 X 29	.116	.124
16	SS & ZHSS	26 X 30	.116	.124
16	SSB	19 X 29	.116	.139
16	SSB	26 X 30	.116	.139
14	S & ZHS	19 X 27	.116	.122
14	S & ZHS	41 X 30	.116	.122
14	SS & ZHSS	19 X 27	.161	.171
14	SS & ZHSS	41 X 30	.161	.171
14	SSB	19 X 27	.161	.191
14	SSB	41 X 30	.161	.191
12	S & ZHS	19 X 25	.135	.141
12	S & ZHS	65 X 30	.135	.141
12	SS & ZHSS	19 X 25	.180	.190
12	SS & ZHSS	65 X 30	.180	.190
12	SSB	19 X 25	.180	.210

12	SSB	65 X 30	.180	.210
10	S & ZHS	105 X 30	.156	.166
10	SS & ZHSS	37 X 26	.200	.210
10	SS & ZHSS	105 X 30	.200	.210
10	SSB	37 X 26	.200	.230
10	SSB	105 X 30	.200	.230
8	SS	133 X 29	.282	.307
8	SSB	133 X 29	.282	.342
8	ZHSS	168 X 30	.282	.307
6	SS	133 X 27	.326	.351
6	SSB	133 X 27	.326	.386
6	ZHSS	259 X 30	.326	.351
4	SS & ZHSS	133 X 25	.382	.407
4	SSB	133 X 25	.382	.442
4	ZHSS	420 X 30	.382	.407
2	SS & ZHSS	133 X 23	.448	.473
2	SSB	133 X 23	.448	.508
2	ZHSS	665 X 30	.448	.473
1	SS & ZHSS	259 X 25	.519	.550
1	SSB	259 X 25	.519	.585
1	ZHSS	817 X 30	.519	.550
0	SS & ZHSS	259 X 24	.565	.596
0	SSB	259 X 24	.565	.631
0	ZHSS	1045 X 30	.565	.596
00	SS & ZHSS	259 X 23	.618	.649
00	SSB	259 X 23	.618	.684
00	ZHSS	1330 X 30	.618	.649
000	SS & ZHSS	259 X 22	.694	.725
000	SSB	259 X 22	.694	.725
000	ZHSS	1672 X 30	.694	.725

0000	SS & ZHSS	259 X 21	.742	.773
0000	SSB	259 X 21	.742	.808
0000	ZHSS	2109 X 30	.742	.773
250	ZHSS	2449 X 30	.840	.880
350	ZHSS	3458 X 30	.900	.940
400	ZHSS	3990 X 30	.975	1.025

Table 3-2
OUTSIDE DIAMETER INCREASE DUE TO BRAID

Diameter over insulation before application of braid (in.)	Maximum diameter increase (in.)
.125 or less	.015
.126 – .250	.020
Greater than .250	.035

Section 4
WIRE IDENTIFICATION

4.1 CIRCUIT IDENTIFICATION

Circuit identification if required shall be accomplished by use of an insulation color. Colored stripe or band tracers on the insulation, and or printed numbers or letters shall be permitted, in addition to the colored insulation.

4.1.1 Lay of Stripes

The length of lay of colored stripes shall conform to Table 4-1.

Table 4-1
LENGTH OF LAY OF STRIPES

Diameter over Finished Wire (in.)	Length of Lay, Maximum (in.)
0.000 to 0.083	1.00
0.084 to 0.110	1.50
0.111 and larger	2.00

4.2 IDENTIFICATION BY PRINTING

Identification by printing on the wire is available for all types. Print should be clear, legible and of a contrasting color to the insulation. The PIN printed on wire shall not include color designation. Identification marks shall not be applied by hot stamp marking or other methods, which could penetrate the insulation.

4.2.1 Identification of Product

When specified, the printed identification shall be marked at intervals of 9 to 60 inches measured from the beginning of one complete marking to the beginning of the succeeding marking. Per paragraph 1.4, the identification shall consist of:

- NEMA standard for silicone rubber (HP 6)
- NEMA type (S, ZHS, SS, ZHSS, or SSB)
- Conductor material and coating
- AWG Size
- Number of strands
- Manufacturer's identification (Name or CAGE code)

Example: HP 6-S-HGB 12345

Section 5
PHYSICAL AND ELECTRICAL REQUIREMENTS

5.1 GENERAL

The physical and electrical requirements for Types S, ZHS, SS, ZHSS, and SSB wire shall be in accordance with this Section and Tables 2-1, 3-1 and 3-2, and 5-1. Testing shall be conducted in accordance with Section 6.

5.1.1 Sampling Inspection

When required (Types ZHS, and ZHSS), Acid Gas, Halogen, Smoke and Toxicity, shall be tested per paragraph 6.1.7 – 6.1.10. All other tests shall use a sampling plan in accordance with special inspection level S-2 in ANSI/ASQC Z1.4.

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 on 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

All other tests shall use a sampling plan 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 uniform and consistent product and should be free from defects that will adversely affect the serviceability of the product of the intended use, as described in section 1.2.

5.4 MATERIALS CERTIFICATION

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

Table 5-1
PHYSICAL AND ELECTRICAL REQUIREMENTS FOR TYPES S, ZHS, SS, ZHSS, and SSB WIRES

TEST	ZHS 150°C/600V	S 200°C/600V	ZHSS 150°C/1000V	SS 200°C/1000V	SSB 150°C/1000V	SSB 200°C/1000V
Dimensional Inspection (See 6.1.4)	See WC-67and 3-1	See WC-67and 3-1	See WC-67and 3-1	See WC-67and 3-1	See WC-67and 3-1	See WC-67and 3-1
Conductor Resistance (See 6.2.1)	See WC-67	See WC-67	See WC-67	See WC-67	See WC-67	See WC-67
High Frequency Spark Test Voltage	4.6 kV	4.6 kV	7.1 kV	7.1 kV	7.1 kV	7.1 kV
or Impulse Test Voltage (See 6.2.2)	6.5 kV	6.5 kV	10.0 kV	10kV	10 kV	10kV
Concentricity (Minimum) (See 6.1.4.3)	70%	70%	70%	70%	70%	70%
Heat Resistance (See 6.1.2)	195°C	250°C	195°C	250°C	195°C	250°C
Dielectric Strength (See 6.2.3)	2.2 kV	2.2 kV	3.0 kV	3.0 kV	3.0 kV	3.0 kV
Surface Resistance Minimum (See 6.2.5)	Not Required	Not Required	Not Required	Not Required	5 MΩ-in.	5 MΩ-in.
Insulation Resistance /1000ft (Minimum) (see 6.2.4)	100 MΩ	100 MΩ	100 MΩ	100 MΩ	100 MΩ	100 MΩ

Insulation Tensile Strength (Minimum) (See 6.1.3)	700 psi	700 psi	700 psi	700 psi	700 psi	700 psi
Insulation Elongation (Minimum) (See 6.1.3)	125%	125%	125%	125%	125%	125%
Flammability (See 6.1.5)	Horizontal flame	Horizontal flame	Horizontal flame	Horizontal flame	Horizontal flame	Horizontal flame
Cold Bend (See 6.1.6)	-55°C	-55°C	-55°C	-55°C	-55°C	-55°C
Identification of Product (See 4.2.1)	When specified	When specified	When specified	When specified	When specified	When specified
Halogen Content (See 6.1.7)	0.2%	—	0.2%	—	—	—
Smoke Index (See 6.1.8)	35	—	35	—	—	—
Toxicity Index (See 6.1.9)	5	—	5	—	—	—
Acid Gas (See 6.1.10)	18%	—	18%	—	—	—

Section 6
TEST PROCEDURES

6.1 PHYSICAL TESTS

Physical tests 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 the temperature specified in Table 5-1 for the applicable wire type, for a period of 96 hours. They shall be removed from the conditioning chamber and allowed to return to room temperature. 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 .125 inch. If the construction includes an overall braid, there shall be no exudation of the insulation through the braid.

Following the oven aging, specimens shall be wound tightly around a mandrel approximately but not more than, three times the overall diameter of the wire for five close turns and removed as a helical coil. No readily visible defects shall result. Slight discoloration shall be considered normal and acceptable. The coiled sections shall then 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 D 3032, Section 17, except that the rate of travel of the jaws shall be between 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° from 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° from each other. For sizes 8 and larger, a circumferential measuring tape may be used. Report the average of the readings.

6.1.4.3 Concentricity

The concentricity of the insulation shall be measured on a cross section of the finished wire at 10X magnification. In making the determination, the minimum thickness of the insulation shall be located and measured in the cross section. The maximum thickness of the insulation wall shall be located and measured in the same cross section. The percent concentricity is 100 times the ratio of the minimum measurement to the corresponding maximum measurement. Three cross sections shall be measured in each specimen. The failure of the concentricity of any cross section shall constitute failure of the entire specimen.

6.1.5 Flammability

A finished wire or cable of any construction shall not convey flame along its length or to combustible materials in its vicinity when a specimen is subjected to the test, FT2/FH/Horizontal flame, in UL 2556. The total length of char on the specimen shall not exceed 4 inches, and the dripping particles emitted by the specimen during or after the application of flame shall not ignite the cotton on the floor of the enclosure, on the base of the burner, or on the wedge. Flameless charring of the cotton shall be ignored.

6.1.6 Cold Bend

The cold bend test shall be performed in accordance with method 2011 of FED-STD-228 with the following exceptions.

- Specimen length shall be 12 inches plus the length required for wrapping on the mandrel.
- Specimen shall be stripped to the bare conductor for 1 inch on each end.
- Mandrel size shall be per Table 6-1 or 6-2 as applicable.
- Mandrels of less than 3-inch diameter shall rotate at a rate of 15 ±3 revolutions per minute.
- Specimens for which a 3-inch or larger mandrel is specified shall be subjected to a 180° bend over the mandrel, then unwound and bent 180° in the opposite direction over the mandrel. Specimens for which a mandrel less than 3-inch in diameter is specified shall be subjected to at least three close turns of wire on the mandrel and rewrapped in the opposite direction in a similar manner.
- The specimen shall be removed from the mandrel and examined without straightening.
- The wire shall be submitted to the dielectric withstanding voltage test specified in 6.2.3.

Table 6-1
Cold Bend Mandrel, Sizes Type S and ZHS

Wire Size	Mandrel Diameter (in.), maximum
24 through 18	1
16 through 10	2

Table 6-2
Cold Bend Mandrel, Sizes Type SS, ZHSS and SSB

Wire Size	Mandrel Diameter (in.), maximum
24, 22	1
20 through12	2
10 through 6	3
4, 2	4.5
1,0	6
00, 000, 0000	10

6.1.7 Halogen Content

Halogen Content shall be tested per MIL-DTL-24643 Paragraph 4.8.25 to determine compliance with the requirements of Table 5-1.

Note: The reference tests are to be performed at a 3 year interval or at the time of change in raw material. The data to be kept on file for inspection and shall be part of the certified test data.

6.1.8 Smoke Index

Smoke Index shall be tested per MIL-DTL-24643 Paragraph 4.8.26 to determine compliance with the requirements of Table 5-1.

Note: The reference tests are to be performed at a 3 year interval or at the time of change in raw material. The data to be kept on file for inspection and shall be part of the certified test data.

6.1.9 Toxicity Index

Toxicity Index shall be tested per MIL-DTL-24643 paragraph 4.8.28 to determine compliance with the requirements of Table 5-1.

Note: The reference tests are to be performed at a 3 year interval or at the time of change in raw material. The data to be kept on file for inspection and shall be part of the certified test data.

6.1.10 Acid Gas

Acid Gas shall be tested per MIL-DTL-24643 paragraph 4.8.27 to determine compliance with the requirements of Table 5-1.

Note: The reference tests are to be performed at a 3 year interval or at the time of change in raw material. The data to be kept on file for inspection and shall be part of the certified test data.

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 6021.1 and shall meet the requirements specified in WC-67.

6.2.2 Spark or Impulse Test

Spark testing shall be conducted on 100% of all lengths of insulated wire per NEMA WC 52 or NEMA WC 56 at the voltages specified in the requirements of Table 5-1.

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 5-1 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 s, maintained at that voltage for a period of 1 minute, and uniformly reduced to zero in 30 s.

6.2.4 Insulation Resistance

Insulation resistance shall be conducted on the same wire used for dielectric strength test (see 6.2.3). The test shall be performed in accordance with FED-STD-228 method 6031 with the following exceptions:

- The test voltage shall be 500 ± 5 Vdc applied for 60 +5, -0 s
- The stirrer need not be used

6.2.5 Surface Resistance (for Wires With Outer Braid Only)

Surface resistance shall be measured in accordance with method 6041 of FED STD-228 with the following exceptions and additions:

- Two .25-inch electrodes consisting of ring-type metal foil shall be allowed
- Electrodes shall be attached near the center of the specimen length
- The specimen shall be conditioned at 25 ±5°C and 95 ±5 % relative humidity
- If the initial surface resistance is greater than 1,000 MΩ-inch, the test shall be considered complete

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

7.3 LENGTHS

Table 7-1 specifies the minimum lengths and quantity of lengths per spool or reel that are acceptable unless otherwise specified.

Table 7-1
MINIMUM LENGTHS

AWG Range	Percentage of Order	Length (ft) One Continuous Length	Max. No. Lengths per spool 500 – 1000 ft	Max. No. Lengths per spool greater than 1000 ft
24 – 20	25	250 ft.	2	5
—	25	500ft	—	—
—	50	1000 ft.	—	—
18 – 10	25	250 ft.	2	5
—	25	500ft.	—	—
—	50	1000 ft.	—	—
8 – Larger	25	100 ft	5	5

—	25	250 ft	—	—
—	50	500 ft	—	—

Section 8
ORDERING DATA

8.1 ORDERING INFORMATION

Purchasing documents should specify the following information:

- Part identification number (see 1.4)
- Packaging requirements
- Length requirements
- Quantity
- Optional identification (stripes, bands, tracers, printing, lot coding)

§