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

© 2013 National Electrical Manufacturers Association
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
Apical Division, Kaneka North America
Belden Inc.
Berk-Tek a Nexans Company
Cable USA LLC.
Champlain Cable Corporation
Coleman Cable Inc.
Comtran Cable LLC
Electrolock, Inc.
Freeport McMoRan Copper & Gold
General Cable

New Bedford, MA
Pasadena, TX
St. Louis, MO
Elm City, NC
Naples, FL
Colchester, VT
Waukegan, IL
Attleboro, MA
Hiram, OH
Phoenix, AZ
Highland Heights, KY

© 2013 National Electrical Manufacturers Association
<table>
<thead>
<tr>
<th>Company</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harbour Industries LLC.</td>
<td>Shelburne, VT</td>
</tr>
<tr>
<td>IWG High Performance Conductors</td>
<td>Inman, SC</td>
</tr>
<tr>
<td>Lockheed Martin MS2</td>
<td>Morestown, NJ</td>
</tr>
<tr>
<td>Marine Tech Wire and Cable, Inc.</td>
<td>York, PA</td>
</tr>
<tr>
<td>Nexans AmerCable</td>
<td>El Dorado, AR</td>
</tr>
<tr>
<td>Quirk Wire Company, Inc.</td>
<td>West Brookfield, MA</td>
</tr>
<tr>
<td>Radix Wire Company</td>
<td>Euclid, OH</td>
</tr>
<tr>
<td>RSCC Aerospace and Defense</td>
<td>East Granby, CT</td>
</tr>
<tr>
<td>SEA Wire and Cable, Inc.</td>
<td>Madison, AL</td>
</tr>
<tr>
<td>Southwire Company</td>
<td>Carrollton, GA</td>
</tr>
<tr>
<td>The Monroe Cable Company, Inc.</td>
<td>Middletown, NY</td>
</tr>
<tr>
<td>The Okonite Company</td>
<td>Ramsey, NJ</td>
</tr>
<tr>
<td>TE Connectivity</td>
<td>Menlo Park, CA</td>
</tr>
<tr>
<td>Wiremasters, Inc.</td>
<td>Columbia, TN</td>
</tr>
</tbody>
</table>
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 -55°C to +150°C with tin-coated copper or -55 °C to + 200 °C 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

© 2013 National Electrical Manufacturers Association