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ANSI/NEMA HP 8-2013

*Electrical and Electronic Cross-Linked, Modified Low-Smoke Polyolefin (XLPO)
Insulated Hook-Up Wire, Types LS (rated 105°C; 600 V), ZHDM (rated 90°C; 600 V),
ZHDH (rated 90°C; 600 V), ZH (rated 125°C; 600 V), and ZHX (rated 125°C; 1000 V)*

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Foreword

ANSI/NEMA HP 8-2013 (hereinafter referred to as ANSI/NEMA HP 8) was developed by the NEMA High Performance Wire and Cable Section to define hook-up cables using low smoke and low or zero halogen insulation materials that might be used as an alternative to PVC-insulated cables for applications requiring these types of characteristics.

In the preparation of ANSI/NEMA HP 8, input of users and other interested parties has been considered. Proposed revisions, comments, and suggestions for the improvement of this document are encouraged. They should be sent to:

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Section approval of ANSI/NEMA HP 8 does not necessarily imply that all Section members voted for its approval or participated in its development. At the time ANSI/NEMA HP 8 was approved, the Section was composed of the following members:

- AFC Cable Systems, Inc., New Bedford, MA
- AmerCable, El Dorado, AR
- Apical Division, Kaneka North America, Pasadena, TX
- Belden, St. Louis, MO
- Berk-Tek, a Nexans Company, Elm City, NC
- Cable USA LLC, Naples, FL
- Coleman Cable Inc., Waukegan, IL
- General Cable, Highland Heights, KY
- Harbour Industries LLC, Shelburne, VT
- IWG High Performance Conductors, Inman, SC
- Leviton Manufacturing Co., Inc., Gardena, CA
- Quirk Wire Company, Inc., West Brookfield, MA
- Radix Wire, Euclid, OH
- RSCC Aerospace and Defense, East Granby, CT
- Southwire Company, Carrollton, GA
- The Monroe Cable Company, Inc., Middletown, NY
- The Okonite Company, Ramsey, NJ
- TE Connectivity, Menlo Park, CA

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SECTION 1 GENERAL

1.1 SCOPE

ANSI/NEMA HP 8 covers specific requirements for cross-linked, modified polyolefin insulated solid and stranded wire designed for the internal wiring of high-reliability electrical and electronic equipment. ANSI/NEMA HP 8 addresses 600 V (Types LS, ZHDM, ZHDH, and ZH) and 1000 V (Type ZHX) wire and permits continuous conductor temperature ratings of -40°C to 90°C, 105°C, or 125°C with either tin- or silver-coated conductors. These types of hook-up wire are used when the following requirements are called for:

- a) Moderate temperature resistance
- b) Low temperature resistance
- c) Good dielectric constant (Type ZHDM and ZHDH)
- d) Moderate dielectric constant (Type LS)
- e) Good flexibility and flex life when stranded conductors are used
- f) Solder iron resistance for easier solder terminations without potential damage
- g) Low smoke (Types LS, ZHDM, ZHDH, ZH, ZHX)
- h) Zero halogen (Types ZHDM, ZHDH, ZH, ZHX)
- i) Low toxicity (Types LS, ZHDM, ZHDH, ZH, ZHX)
- j) Low acid gas generation (Types LS, ZHDM, ZHDH, ZH, ZHX)

1.2 REFERENCE STANDARDS AND SPECIFICATIONS

From the American Society for Testing and Materials (ASTM):

D3032, *Methods of Testing Hook-Up Wire Insulation*

G21, *Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi*

From the American Society for Quality Control (ASQC):

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

From the Electronic Industries Alliance (EIA):

EIA-359-A, *EIA Standard Colors for Color Identification and Coding*

From the Department of Defense Index of Specifications and Standards (DODISS):

MIL-STD-2223, *Test Methods for Insulated Electronic Wire*

MIL-DTL-24643, *Cables and Cords, Electric, Low Smoke, For Shipboard Use, General Specification For*

FED-STD-228, *Methods of Testing Cable and Wire, Insulated*

From Underwriters Laboratories (UL):

UL1581, *Reference Standard for Electrical Wires, Cables, and Flexible Cords*

From the National Electrical Manufacturers Association (NEMA):

NEMA WC 52-2005, *High-Temperature and Electronic Insulated Wire, Impulse Dielectric Testing*

NEMA WC 56-1986 (R1993, R2000, R2005, R2012), *3.0 kHz Insulation Continuity Proof Testing of Wire and Cable*

ANSI/NEMA WC 67-2012, *Standard for Uninsulated Conductors Used in Electrical and Electronic Applications*

1.3 RECOMMENDED USES OF WIRE TYPES

1.3.1 TYPE LS

Type LS wire is intended for use in 600 V, medium temperature applications (Replaces M16878/36).

1.3.2 TYPE ZHDM and ZHDH

Type ZHDM and ZHDH wire is intended for use in 600 V or less signal applications where a good dielectric constant is required to meet the specific electrical properties (see Table 3–2) in low temperature (90°C) applications. The insulation contains zero halogens.

1.3.3 TYPE ZH

Type ZHM wire is intended for use in 600 V, medium temperature (125°C) applications. The insulation contains zero halogens.

1.3.4 TYPE ZHX

Type ZHX wire is intended for use in 1000 V, medium temperature (125°C) applications. The insulation contains zero halogens.

1.4 PART IDENTIFICATION NUMBER (PIN)

The part numbers shall be of the following form:

HP 8–(TYPE)-(CONDUCTOR MATERIAL)(AWG)(STRANDS)(COLOR)

NEMA STANDARD
for XLPO insulated wire

Example: HP 8–LS-BJE9

Type LS, Tin-Coated Copper, 16 AWG, 19 Strands White

Table 1–1 Conductor Material and Coating

Letter	Conductor Material & Coating
B	Tin-Coated Copper
S	Silver-Coated Copper

Table 1–2 AWG Nominal Conductor Size

AWG	Letter	AWG	Letter
32	A	10	M
30	B	8	N
28	C	6	P
26	D	4	R
24	E	2	S
22	F		
20	G		
18	H		
16	J		
14	K		
12	L		

Table 1–3 Number of Strands

Letter	Number of Strands
A	1
B	7
E	19
G	37
J	65
L	133
M	168
N	259
P	665
R	817
S	1045
T	1330

Table 1–4 Color (see Section 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