

# ASSOCIATIONS AND REFERENCE STANDARDS

## Organizations Involved in Specifications for the Wire & Cable Industry

<b>AAR</b>	Association of American Railroads	<b>IMSA</b>	International Municipal Signal Association
<b>AEIC</b>	Association of Edison Illuminating Companies	<b>ICEA</b>	Insulated Cable Engineers Association
<b>ANI</b>	American Nuclear Insurers	<b>MESA</b>	Mine Environmental Safety Act
<b>ASA</b>	American Standards Association, Inc.	<b>NEC</b>	National Electrical Code (under auspices of NFPA)
<b>ASTM</b>	American Society for Testing Materials	<b>NEMA</b>	National Electrical Manufacturer's Association
<b>CAA</b>	Civil Aeronautics Administration	<b>NBS</b>	National Bureau of Standards
<b>CSA</b>	Canadian Standards Association	<b>NBFU</b>	National Board of Fire Underwriters
<b>EIA</b>	Electronic Industries Association	<b>NFPA</b>	National Fire Protection Association International
<b>FAA</b>	Federal Aviation Agency	<b>REA</b>	Rural Electrification Administration
<b>IEEE</b>	Institute of Electrical and Electronics Engineers	<b>UL</b>	Underwriters' Laboratories, Inc.

## American Society for Testing and Materials (ASTM)

The ASTM is an organization which develops voluntary consensus standards for materials and material testing. The standards, written by professionals from a wide variety of industries, are recognized nationwide as the preferred materials-testing procedures.

### ASTM Manufacturing Specifications in General Use by the Manufacturers of Electrical Wires and Cables:

<b>B1</b>	Hard Drawn Copper Wire	<b>B232</b>	Concentric-Lay Stranded Aluminum Conductors (ACSR)
<b>B3</b>	Soft or Annealed Copper Wire	<b>B246</b>	Tinned Hard Drawn and Medium Hard Drawn Copper Wire
<b>B8</b>	Concentric-Lay, Stranded Copper Conductors	<b>B496</b>	Compact Round Concentric-Lay Stranded Copper Conductors
<b>B33</b>	Tinned Soft or Annealed Copper Wire	<b>D734</b>	Insulated Wire and Cable: Vinyl Chloride Insulating Compound
<b>B172</b>	Rope-Lay-Stranded Copper Conductors (bunch stranded members)	<b>D752</b>	Heavy Duty Black Neoprene Sheath for Wire and Cable
<b>B173</b>	Rope-Lay-Stranded Copper Conductors (concentric-stranded members)	<b>D754</b>	Synthetic Rubber Insulation for Wire and Cable, 75°C Operation
<b>B174</b>	Bunch Stranded Copper Conductors	<b>D1352</b>	Ozone-Resisting Butyl Rubber Insulation for Wire and Cable
<b>B189</b>	Lead Alloy Coated Soft Copper Wire		
<b>B230</b>	Standard Specification for Aluminum 1350-H19 Wire for Electric Purposes		
<b>B231</b>	Concentric-Lay Stranded Aluminum Conductors		

## Canadian Standards Association (CSA)

The Canadian certification and test agency, which tests devices, materials and components for quality and safety, is comparable to UL in function. Like the UL label, the CSA seal is recognized in many countries throughout the world.

## Electronic Industries Association (EIA)

The EIA was a non-profit organization representing manufacturers of electronic products. There were 300 member companies and approximately 200 committees and working groups in domestic and international standards development. The former sectors of EIA are the Electronics Components Association (ECA), JEDEC, Government Electronics and Information Technology Association (GEIA), now part of Tech America Telecommunications Industry Association (TIA) and Consumer Electronics Association (CEA). The standards below are presented for reference.

### EIA RECOMMENDED STANDARDS

<b>RS-214</b>	Ampacity Calculations, method of calculation of current rating on hookup wire.
<b>RS-232-C</b>	Interface between data terminal equipment and data communication equipment employing serial binary data interchange. This is the most common type of microcomputer interface, typically employing a 25-position connector.
<b>RS-422</b>	Electrical characteristics of balanced digital interface circuits.
<b>RS-423</b>	Electrical characteristics of unbalanced digital interface circuits.
<b>RS-449</b>	General purpose 37-position and 9-position interfaces for data terminal equipment and data circuit terminating equipment employing serial binary data interchange with control information on separate control circuits.

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## Insulated Cable Engineers Association (IECA)

The Insulated Cable Engineers Association (IECA) is a professional organization dedicated to developing cable standards for the electric power, control and telecommunications industries. Since 1925, the objective has been to ensure safe, economical and efficient cable systems utilizing proven state-of-the-art materials and concepts. Now with the proliferation of new materials and cable designs, this mission has gained in importance. IECA documents are of interest to industry participants worldwide, i.e. cable manufacturers, architects and engineers, utility and manufacturing plant personnel, telecommunication engineers, consultants, and OEM's

IECA is a "Not-For-Profit" association whose members are sponsored by over thirty of North America's leading cable manufacturers. The technical development work is performed in four semi-autonomous sections: namely the Power, Control & Instrumentation, Portable and Communications Cable sections. In addition there are currently two very active major technical advisory committees, one for Telecommunications Wire and Cable Standards (TWCS TAC) and another Utility Power Cable Standards (UPCS TAC).

<b>IECA S-75-381/NEMA WC58</b>	Portable & Power Feeder Cables for Use in Mines and Similar Applications
<b>IECA T-26-465/NEMA WC54</b>	Frequency of Sampling Extruded Dielectric Cables
<b>IECA S-76-474/ANSI S-26-474</b>	Neutral-Supported Power Cable Assemblies with Weather-Resistant Extruded Insulation, 600V
<b>IECA S-73-532/NEMA WC57</b>	Control Cables
<b>IECA S-70-547</b>	Weather-Resistant Polyolefin-Covered Wire & Cable
<b>IECA T-27-581/NEMA WC53</b>	Standard Test Methods

The Insulated Cable Engineers Association (IECA) has issued several new standards for solid-dielectric insulated power cables. Several of these standards are joint-standards with the National Electrical Manufacturers Association (NEMA). The new standards have been submitted to ANSI for recognition as National Standards.

The new IECA standards reflect a change in IECA's standards writing objective. They are written as "application standards" rather than the "insulation material-based standards" of the past. These new standards have been updated to reflect the latest conductor constructions, insulations and jacket materials being used to manufacture wires and cables. The advantage of having an application standard is that all insulations suitable for use on a specific product are contained in one document. With material-based standards, only one type of insulation and its requirements are defined. If a different insulation was to be considered, a separate standard would be required.

As a result of the new IECA / NEMA application standards being issued, the older, more-familiar materials-based IECA/ NEMA standards are being withdrawn. This is necessary to eliminate duplication and because the materials-based standards are no longer being maintained. The withdrawn IECA / NEMA standards are:

<b>IECA S-66-524/NEMA WC7</b>	Cross-Linked-Thermosetting-Polyethylene Insulated Wire and Cable
<b>IECA S-68-516/NEMA WC8</b>	Ethylene-Propylene-Rubber Insulated Wire and Cable
<b>IECA S-61-402/NEMA WC5</b>	Thermoplastic-Insulated Wire and Cable
<b>IECA S-19-81/NEMA WC3</b>	Rubber-Insulated Wire and Cable
<b>IECA S-82-552/NEMA WC55</b>	Instrumentation and Thermocouple Wire and Cable

## ASSOCIATIONS AND REFERENCE STANDARDS

Withdrawn Standards	Title	Replacement Standards	Title
ICEA S-66-524/NEMA WC7	Crosslinked -Thermosetting- Polyethylene Insulated Wire & Cable	ICEA S-95-658/NEMA WC70 ICEA S-96-659/NEMA WC71 ICEA S-93-639/NEMA WC74 ICEA S-94-649  ICEA S-97-682  ICEA S-105-692  ICEA S-81-570	Non-shielded 0-2 KV Cables Non-shielded 2,001-5 KV Cables Shielded Power Cable 5-46 KV Concentric Neutral Cables Rated 5-46 KV Utility Shielded Power Cable Rated 5-46 KV 600 V Single Layer Thermoset Insulated Utility Underground Distribution Cable Direct Burial, 600 V Ruggedized Insulation
ICEA S-68-516/NEMA WC8	Ethylene-Propylene-Rubber Insulated Wire & Cable	ICEA S-95-658/NEMA WC70 ICEA S-96-659/NEMA WC71 ICEA S-93-639/NEMA WC74 ICEA S-94-649  ICEA S-97-682  ICEA S-105-692	Non-shielded 0-2 KV Cables Non-shielded 2,001-5 KV Cables Shielded Power Cable 5-46 KV Concentric Neutral Cables Rated 5-46 KV Utility Shielded Power Cable Rated 5-46 KV 600 V Single Layer Thermoset Insulated Utility Underground Distribution Cable
ICEA S-61-402/NEMA WC5	Rubber-Insulated Wire & Cable	ICEA S-95-658/NEMA WC70 ICEA S-96-659/NEMA WC71 ICEA S-93-639/NEMA WC74 ICEA S-94-649  ICEA S-97-682  ICEA S-105-692	Non-shielded 0-2 KV Cables Non-shielded 2,001-5 KV Cables Shielded Power Cable 5-46 KV Concentric Neutral Cables Rated 5-46 KV Utility Shielded Power Cable Rated 5-46 KV 600 V Single Layer Thermoset Insulated Utility Underground Distribution Cable
ICEA S-19-81/NEMA WC3	Thermoplastic-Insulated Wire & Cable	ICEA S-95-658/NEMA WC70	Non-shielded 0-2 KV Cables

### NEMA

Adopted in the public interest and designed to eliminate misunderstandings between the manufacturer and the purchaser and to assist the purchaser in selecting and obtaining the proper product for its particular need.

NEMA Code	Same as ICEA
WC53	T-27-581
WC54	T-26-465
WC57	S-73-532
WC58	S-75-381
WC70	S-95-658
WC71	S-96-659
WC74	S-93-639

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## Institute of Electrical and Electronic Engineers

IEEE is the world's largest professional engineering society. One of its objectives is to provide standards for rating the performance of equipment and materials. The institute also offers courses to allow engineers to keep abreast of developments in the electrical and electronic engineering fields.

## Military and Government Wire Specifications

<b>J-C-90</b>	Flexible Cord and Fixture Wire	<b>MIL-C-25038</b>	Cable, Electrical, High Temperature and Fire Resistant
<b>J-C-96</b>	Neoprene Jacketed Telephone Wire		
<b>J-C-741</b>	Rubber and/or Neoprene Welding Cable	<b>MIL-C-26468</b>	(USAF) - Cables, Guided Missile, Ground Installation, General Requirements
<b>MIL-C-3078</b>	Cable, Electric, Insulated, Low Tension, Single Conductor	<b>MIL-C-27072</b>	Multi-Conductor, Ground Support Cable
<b>MIL-C-3432</b>	300 and 600 V Rubber Insulated Power and Control Cable	<b>MIL-C-27212</b>	Cable, Power, Electrical, Airport Lighting Control
<b>MIL-C-4912A (ASG)</b>	Single Conductor 8 AWG 5 KV Cable with Butyl Compound Insulation and Polychloroprene for Airport Lighting	<b>MIL-C-38359</b>	(USAF) - Power Cable of Two Voltage Range for Airport Lightin, 8 AWG (3-5KV) CCLP Insulated
<b>MIL-C-5756</b>	Low Temperature Rubber Portable Cords	<b>MIL-C-55036</b>	Cable, Telephone, WM130##/6
<b>MIL-C-6166</b>	Cord, Head-Set-Microphone CX1301/AR	<b>MIL-E-9088</b>	(USAF) - Electrical Cord - WF-14/U
<b>MIL-C-7078</b>	600 V Aircraft Wire using MIL-W5086 Components	<b>MIL-R-8333</b>	(USAF) - RF Cable - RG122/U
<b>MIL-C-11097</b>	Cable, Telephone (Wire W-50-A)	<b>MIL-STD-122</b>	Color Code for Chassis Wiring for Electronic Equipment
<b>MIL-C-11440</b>	Cable, Power Electrical	<b>MIL-STD-681</b>	Identification Coding and Application of Hook-Up Wire
<b>MIL-C-12064</b>	Low Temperature Power Cable and Cords for Arctic Service	<b>MIL-W-76</b>	General Purpose Hok-Up Wire, Vinyl Insulated Types LW, MW and HW
<b>MIL-C-12881</b>	Cables, Telephone, Switchboard (Cables and Cable Assemblies)	<b>MIL-W-538</b>	Wire, Magnet, Electrical
<b>MIL-C-13777</b>	Multi-Conductor Missile Ground Support Cable	<b>MIL-W-5274</b>	Spec for Aircraft Wire, Type I 600 V, Type II 600 V, Type III 300 V Rating
<b>MIL-C-14189</b>	Cable, Power, Electrical, 3 KV, for Field Use	<b>MIL-W-6370</b>	Wire, Electrical, Insulated Antenna
<b>MIL-C-18959</b>	Cable, Power, Electrical, Portable, Neoprene Jacketed 600 V	<b>MIL-W-13074</b>	Wire, Electrical (W-27 & WS-19[U])
<b>MIL-C-18962</b>	Cable, Power, Electrical, Direct Burial, Neoprene Jacketed 600 V	<b>MIL-W-13075</b>	Wire, Electrical
<b>MIL-C-19381 (SHIPS)</b>	Cables, Special Purpose, Electrical (Nuclear Plant)	<b>MIL-W-13169</b>	Wire, Electrical (for Instrument Test Leads)
<b>MIL-C-21609</b>	Cable, Electrical, Shield, 600 V (Non-Flexing Service)	<b>MIL-W-13241</b>	Wire, Electrical, Antenna
<b>MIL-C-24640</b>	Cable, Electrical, Lightweight for Shipboard Use	<b>MIL-W-16878</b>	Electronic Hook-Up Wire, Includes Vinyl (Types B, C and D); Teflon (Types ET, E, EE, K and KK); and Polyethylene (Type J)
<b>MIL-C-24643</b>	Cable Cord, Electrical, Low Smoke for Shipboard Use	<b>MIL-W-19583</b>	(Navy) - Wire, Electrical, Magnet, High Temperature, Film Insulated

## National Electrical Code (NEC)

The NEC is developed by NFPA's Committee on the National Electrical Code, which consists of 19 code-making panels and a technical correlating committee. Work on the NEC is sponsored by the National Fire Protection Association. The NEC is approved as an American national standard by the American National Standards Institute (ANSI). It is formally identified as ANSO/NFPA 70®.

First published in 1897, the NEC is updated and published every three years. The *National Electrical Code Handbook*®, © 2011, is the current edition (Effective Date: August 25,2010). Most states adopt the most recent edition within a couple of years of its publication. As with any "uniform" ode, a few jurisdictions regularly omit or modify some sections, or add their own requirements (sometimes based upon earlier versions of the NEC, or locally accepted practices). However, the NEC is the least amended model code, even with it setting minimum standards. No court has faulted anyone for using the latest version of the NEC, even when the local code was not updated.

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## National Electrical Code (NEC) Cont.

In the United States, anyone, including the city issuing building permits, may face a civil liability lawsuit (be sued) for negligently creating a situation that results in loss of life or property. Those who fail to adhere to well known best practices for safety have been held negligent. This means that the city should adopt and enforce building codes that specify standards and practices for electrical systems (as well as other departments such as water as fuel-gas systems). This creates a system whereby a city can best avoid lawsuits by adopting a single, standard set of building code laws. This has led to the NEC becoming the de facto standard set of electrical requirements. A licensed electrician will have spent years of apprenticeship studying and practicing the NEC requirements prior to obtaining his or her license.

## Rural Electrification Administration (REA)

Rural Electrification Administration (REA), former agency of the United States Department of Agriculture charged with administering loan programs for electrification and telephone service in rural areas. The REA was created in 1935 by executive order as an independent federal bureau, authorized by the Congress in 1936, and later reorganized in 1939 reorganized as a division of the U.S. Department of Agriculture. The REA undertook to provide farms with inexpensive electric lighting and power. To implement those goals the administration made long-term, self-liquidating loans to state and local governments, to farmers' cooperatives and to non-profit organizations; no loans were made directly to consumers. In 1949, the REA was authorized to make loans for telephone improvements; in 1988, the REA was permitted to give interest-free loans for job creation and rural electric systems. By the early 1970's, about 98% of all farms in the United States had electric service, a demonstration of REA's success. The administration was abolished in 1994 and its functions assumed by the Rural Utilities Service.

## Underwriters Laboratories (UL)

Underwriters Laboratories Inc. (UL) is an independent product safety certification organization. Established in 1894, the company has its headquarters in Northbrook, Illinois. UL develops standards and test procedures for products, materials, components, assemblies, tools and equipment, chiefly dealing with product safety. UL also evaluates and certifies the efficiency of a company's business processes through its management system registration programs. Additionally, UL analyzes drinking and other clean water samples through its drinking water laboratory in South Bend, Indiana and evaluates products for environmental stainability through its subsidiary, UL Environment.

UL is one of several companies approved for such testing by the U.S. federal agency OSHA. OSHA maintains a list of approved testing laboratories, known as Nationally recognized Testing Laboratories.

### CABLE STANDARDS

<b>UL Standard 13</b>	Power Limited
<b>UL Standard 4</b>	Armored Cables
<b>UL Standard 62</b>	Flexible Cord and Fixture Wires
<b>UL Standard 44</b>	Thermoset Insulated Wire and Cables
<b>UL Standard 83</b>	Thermoplastic Insulated Wire and Cables
<b>UL Standard 719</b>	Non-Metallic Sheathed Cables

The UL Categories of approval, detailed below, are recognized and respected by electrical inspectors, fire marshals, insurance underwriters and regulatory personnel.

### UL LISTED

To be labeled UL Listed, a product must successfully complete a series of mechanical, electrical and thermal characteristic tests which simulate all reasonable and foreseeable hazards. A UL Listing is assigned exclusively for the specific application for which it was tested and not valid for other applications. A UL Listing does not mean that the device will do what it is advertised to do, only that it is reasonably safe.

### UL CLASSIFIED

For UL Classified labels, products are evaluated with respect to one or more of the following:

- Specific Hazards Only
- Performance Under Specific Conditions
- Regulatory Codes
- Other Standards, Including International Standards

The UL "Classified" rating is generally restricted to industrial or commercial products.

### UL RECOGNIZED

Products bearing UL Recognized labels have been tested for use as a component in a UL Listed package. These component products are tested for electrical, mechanical and thermal characteristics.

UL Recognized is a more general purpose approval than UL Listing in that it allows a product to be certified for a category of equipment uses. An example is hookup wire, which has been UL Recognized as appliance wiring material, a category of uses that includes data communications, telecommunications and instrumentation.