

# Power Cord Guide to Global Standards



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# Power Cord Products

MEGA Electronics is a leading manufacturer of power cords that meet global standards for quality and safety. Our products have the necessary approvals to ship to any location in the world, usually from stock. We strive to be a “one-stop” source for all components that bring power from the wall into your product, for any location, anywhere in the world.

The Company headquarters and engineering support are located in New Jersey, with ISO 9001 certified production facilities in the Philippines and Huizhou, Guangdong China. The combination of vertical integration and the UL listing for cord sets and wire harnesses in New Jersey combine to allow MEGA to provide you with the fastest possible service at the most reasonable prices.



***Please find following a guide to specifying the correct power cord to be used with your power supply to meet domestic and international standards.***

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# Guide to Specifying Cord Sets and Power Cords

- **What plug is required? / What is your destination country?**

- How many amps and volts? (i.e. 10A/125V, 10A/250V, etc.)
- How many conductors? (Most common 2 or 3)

- **What cordage is required?**

- What size, temperature rating, color, conductor colors?

- **Is a connector required?**

- If yes, which type? (i.e. C7, C13, C19)
- If no, what end preparations are required:

ROJ (Remove outer jacket) + Strip (conductors), tinning, terminals?

- **What length is required?**

- **Optional extras: special packaging, bagging, blister pack, labeling, etc.**

Note: The completed cord set will be rated only as high as the lowest rated components

# North American NEMA Standards



## **N1/15P Rated 15A/125V**

Available polarized (Wide blade) or non-polarized  
For use with all two-conductor cordages



## **N5/15P Rated 15A/125V**

For use with all three-conductor cordages  
Also available with cord grip



## **N6/15P Rated 15A/250V**

For use with all three-conductor cordages  
Horizontal pins

See Catalog Page 4-14

# North American NEMA Standards

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## **N5/20P Rated 20A/125V**

For use with all three-conductor cordages

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## **N6/20P Rated 20A/250V**

For use with all three-conductor cordages

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## **N6/30P Rated 30A/250V**

Higher rated plugs are available. Please see page 14 in MEGA catalog.

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See Catalog Page 14

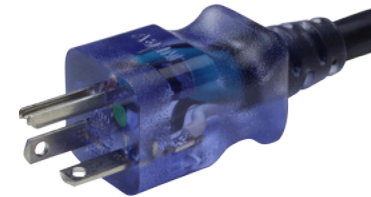
# Hospital Grade NEMA Plugs

A special use section of cord sets had been created for use on medical and dental equipment as defined by UL 544, which has since been replaced by UL60601. The purpose of this regulation is to provide a “safer” environment for patients coming into contact with medical equipment. This is achieved through the following requirements:



- **Solid plug pins to lower the risk of bending**
- **Larger bodies lower the risk of wire to outer contour shock**
- **Plug surface skin testing**

- In addition to the above, hospital grade cord sets are required to meet the standard testing requirements under UL and CSA(cUL) per UL 817. Once approved, the plugs will be stamped with the “Green Dot” on the plug face.
- As added safety precautions MEGA solders the conductors to the plug pins and adds a hog ring to the cable prior to over molding the plug, further increasing cable retention force.
- Tooling is in place for the hospital grade plugs in the below configurations:
  - NEMA 5/15(15A/125V)
  - NEMA 6/15(15A/250V)
  - NEMA 5/20(20A/125V)
  - NEMA 6/20(20A/250V)



See Catalog Page 10-11

# Molded Twist Lock Cord Sets

The use of twist locks is becoming increasingly more common when the flow of continuous power is critical. The use of the twist lock ensures that once the plug has been inserted and turned (“locked”), the plug cannot be removed by tripping over a wire or by similar accidents. The twist lock mirrors the nomenclature of the NEMA standards in regards to amperage and voltage rating, but differ significantly in plug shape and configuration.



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# Additional NEMA Angle Plugs

Plugs are available with various cordage types and gauges. Ratings shown in catalog are the highest allowable by appropriate standards. Ratings will vary with cordage gauges.



See Catalog Page 12-13

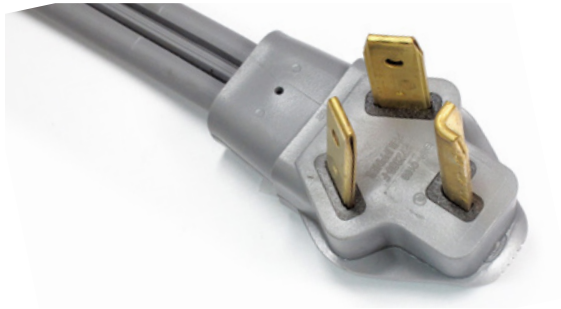
# NEMA 5/15P with Circuit Breaker

The circuit breaker is UL recognized to 15A/125VAC-60Hz and has a push to reset function. UL listed for use with 12 - 16AWG SJT, SJTO, and SJTOW cable, it is suitable for indoor and outdoor applications. For use in hard wire power cord, detachable cord set or extension cord applications.

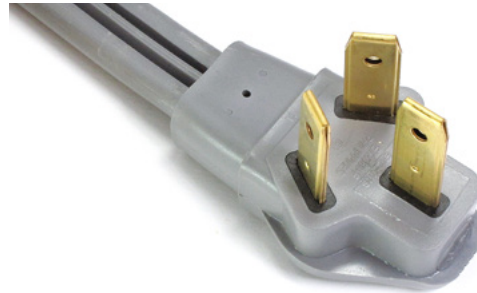


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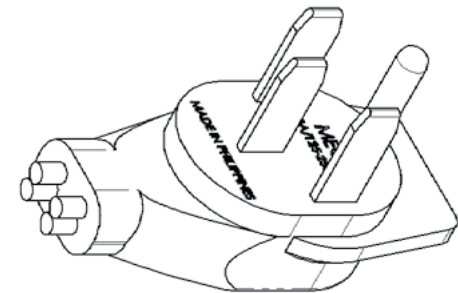
# Dryer and Range Cords



**NEMA 10/30P (Dryer type)**  
**30A 125A/250V**  
SRDT 10/4C



**NEMA 10/50P 50A 125V/250V**  
SRDT 10/3C, 8/3C, 6/3C



**Custom Tooled**  
N14/50P flat face

See Catalog Page 14

# Branched Power Cords with Circuit Breaker

Branches allow multiple devices to be run from a single power source. Branches can be used with a variety of plugs and cables. MEGA currently offers two and three way branches.

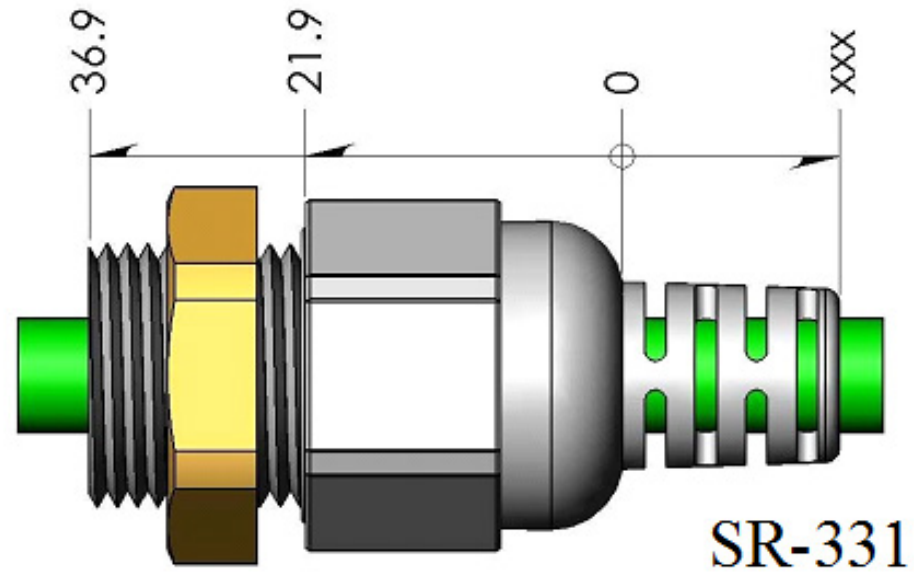


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# Fully Molded Strain Reliefs

Fully molded threaded strain reliefs are available from our stock tooling or custom made.



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# International Three Conductor Plug Standards

Country	Maximum AMP/V	Standard
Continental Europe	16/250	CEE(7)VII
United Kingdom	13/250	BS 1363
(Singapore/Saudi Arabia/Gulf States)		(PSB/SASO2203/G Mark)
Italy	16/250	CEI 23-50(10A)/CEI 23-16(16A)
Switzerland	10/250	SEV 1011(Type 12)
Denmark	10/250	DS/IEC 60884-1 (Sheet DK2-1A)
Australia/New Zealand	15/250	AS/NZS 3112
Argentina	20/250	IRAM 2073
China	15/250	GB 2099.1-1996
Brazil	20/250	NBR14136
South Africa	16/250	SANS164-1 (Based on BS546)
India	16/250	IS 1293
Israel	16/250	S1 32/1971
Japan	15/125	JIS 8303
South Korea	16/250	K60884-1 & KSC8305
Taiwan	10/250	CNS10917
Thailand	16/250	TIS 166-2549

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# Continental Europe Type: CEE 7 (VII) "Schuko"

**The Continental Europe plug** has two round pin contacts and two grounding clips on the sides of the plug body, allowing the plug to be inserted in sockets without regard to polarization. Only in France and Belgium is this plug polarized because of the permanently mounted pin in the socket which mates with the hole in the plug face. A very similar plug is used in South Korea. This plug will cover 75% of the European market. Available with splash proof collar (shown) providing IP44 rating.

This plug will be used everywhere in Europe except the UK, Switzerland, Italy and Denmark



Also available right angled

## Eurocord



For low amperage (2.5A/250V) ungrounded applications **the Eurocord (EN50075)** can be used throughout Europe, except in the UK and Switzerland

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# BS 1363 United Kingdom



As with most things, the Brits do things completely different than the rest of Europe with regard to their plug configuration. The plugs must have an internal fuse. 3AMP, 5AMP, 10AMP, or 13AMP fuses. The most commonly used fuse is the 13 Amp.

**The British plugs** must be approved by ASTA or BSI for the UK, by PSB in Singapore, and Saudi Arabia has implemented a Product Conformity Program requiring a Certificate of Conformity also referred to as a SASO CoC to be cleared through Customs. The G-Mark for Low-Voltage Electrical products is regulated by the Gulf Technical Regulation for Low-Voltage Electrical Equipment and Appliances (BD-142004-01) and is required for products shipped to the UAE, Baharain, Qatar, Kuwait, and Oman. Saudi Arabia will accept the G Mark as well.

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# Italian/Swiss/Danish



**Italian to 10A/250V Alternate plug to 16A/250V**



**Swiss to 10A/250V**

In 2013 it became mandatory for the Swiss plug to have insulated pins. A plug with square pins is approved to 16A.



**Danish to 13A/250V**

Denmark has approved the Schuko plug, but this is infrequently used as it is ungrounded in Danish outlets. There is a separate plug standards for both data com and medical applications.

See Catalog Page 22-23

# Australia/New Zealand



**The Australian plug** can be approved by one of five state agencies. The standard plug is 10A/250V rated, but 15A and 20A models are available. Australian standard AS/NZS 3112 has been updated and as of April 3, 2005 requires the use of insulated line and neutral pins.

For hospital applications, a clear plug is recommended, but not required.

# Argentina



**The Argentine plug** mirrors the Australian, except for three major differences: the plug pins are 1 mm longer, no safety contacts are required and the pin polarity is reversed. The IRAM approval is required.



See Catalog Page 24-26

# China



**The 10A Chinese plug** also mirrors the Australian, except that the contact pins are 1 mm longer and they are required to have the CCC approval.

In addition there is 16A, 250V plug under the standard GB 2099.1-2008, GB 1002-2008

China has implemented the Regulation for Pollution Control of Electronics Products (WEEE) to mirror the European RoHS



# Brazil



As of January 1, 2010 Brazil requires the use of the new plugs under standard NBR14136. **The new Brazil plug** is very similar to the Swiss standard.

There are now two conductor and three conductor standards in place



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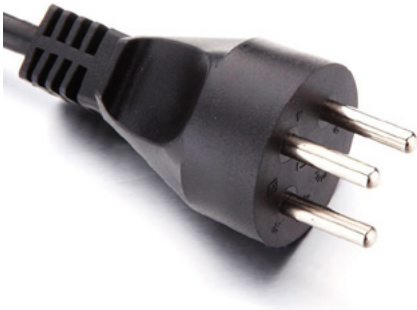
## South Africa/India



**The South Africa plug uses** the old British style defined in BS546. For S. Africa the SABS approval to SANS 164-1 is required.

India plug is per IS1293. BIS approval is now required on the power cord and the internal color code is now Black, Red, Green/Yellow, making it impossible to have one cord approved for both India and S. Africa.

## Israel



**The Israel plug** is defined in SI-32 and can be used in applications up to 16A/250V. The Europlug is used for 2 conductor applications

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# Japan



**The Japanese plug** and the EN60320 C13 connector are specified in JIS 8303. Cord sets exported to Japan require the PSE approval and CTI. The plug configurations for Japan mirror the NEMA standards used in North America, with one major exception. Japanese mains occasionally do not provide for grounding and a molded two-prong plug with a grounding fork can be used to ground the cord set to the wall socket.

Use of medical grade plugs can be required by some hospitals in Japan, but this is a very infrequent request.

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# Japan Comparative Tracking Index

The Comparative Tracking Index or CTI is used to measure the electrical breakdown (tracking) properties of an insulating material. To measure the tracking, 50 drops of 0.1% ammonium chloride solution are dropped on the material, and the voltage measured for a 3 mm thickness is considered representative of the material performance. Also, the term PTI (Proof Tracking Index) is used: it means voltage at which during testing on five samples the samples pass the test with no failures.

Tracking is an electrical breakdown on the surface of an insulating material. A large voltage difference gradually creates a conductive leakage path across the surface of the material by forming a carbonized track that could ultimately cause risk of fire.

PTI requirement on plugs surface has been introduced by Japan as a mandatory requirement approximately one year ago, you can see in attachment the PSE requirement.

All Japan plugs supplied by MEGA Electronics Inc are in conformity with the PTI requirement as they have been made with particular plastic materials and design specifications to assure that this test is passed.

# South Korea



**The South Korean plug** standard mirrors the Continental European plug, except that it required the KC approval mark (shown below). The cable type has been revised from the Japanese standard of the past to the European cable nomenclature.

As of 2012 the old KETI mark has been replaced by the KC (Korean Certification) mark. KETI approval documentation allows a manufacturer to apply the KC mark.

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# Taiwan



All powercord products to be used within Taiwan are required to have the BSMI certification and mark. The BSMI mark is issued by the Bureau of Standards, Metrology and Inspection of the Ministry of Economic Affairs in Taiwan.

**The Taiwan plug** mirrors the NEMA standards of North America, but the cabling is based on the Japanese system, the most common type being VCTF3x1.25mm.

# Thailand



**Thailand has set a new standard** TIS 166-2549. Within the standard are 2 and 3 conductor pin configurations, both having semi insulated pins.

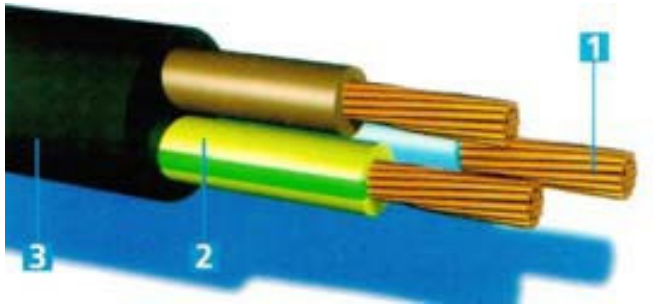
Both plugs will be used in conjunction with European cable.



See Catalog Pages 28 & 29



# Cordage Types

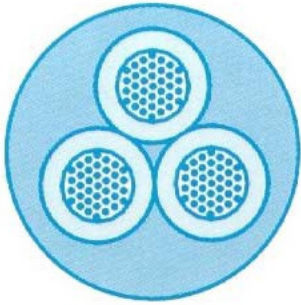


**There are five major types of cable possible:**

- UL/CSA (North America)
- Harmonized (Europe)
- Australian (Australia/New Zealand)
- Japanese (Japan)
- Chinese (China)

It is not permissible to ship products with cordage not approved for the country of destination, i.e. products cannot be shipped to Europe with UL/CSA cordage. The exception is that the Australian standard mirrors the European standard with minor differences and it is possible to make a cable that is approved by both jurisdictions.

# UL / CSA Cordage



UL listed cable is measured in the American Wire Gauge (AWG) system. The smaller the AWG the larger the size and rating.

**When used in conjunction with plugs or connectors the cable ratings are:**

- 18AWG = 10Amps 12AWG = 20Amps
- 16AWG = 13Amps 10AWG = 30Amps
- 14AWG = 15Amps 8AWG = 50Amps

**Internal color codes can be:** Black, white, green (or green/yellow) or Blue, brown, green/yellow

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# Common Flexible UL/CSA Cords

TYPE	SHAPE	GAUGE	NO OF COND.	CONDUCTOR INSULATION	JACKET MATERIAL	VOLT	REMARKS
SPT-1	Parallel	18	2	PVC	-	300	Light Duty, Lamps
SPT-2	Parallel	16-18	2-3	PVC	-	300	Light Duty, Lamps
SPT-3	Parallel	12-18	2-3	PVC	-	300	Refrigerators, Air Conditioners, Extension cords
SVT	Round	18	2-3	PVC	PVC	300	Vacuum Cleaners
SJ	Rouwnd	12-18	2-4	Rubber	Rubber	300	Small Appliances, Hand Tools
SJO	Round	12-18	2-4	Rubber	Neoprene	300	Oil Resistant Jacket, Small Appliances, Hand Tools
SJT	Round	12-18	2-4	PVC	PVC	300	Small Appliances, Hand Tools
SJTO	Round	12-18	2-4	PVC	PVC	300	Oil Resistant Jacket, Small Appliances, Hand Tools
SJTW	Round	12-18	2-4	PVC	PVC	300	Outdoor Use, Garden Tools
S	Round	12-18	2-4	Rubber	Rubber	600	Heavy (Hard) Duty Service
SO	Round	12-18	2-4	Rubber	Neoprene	600	Oil Resistant Jacket, Heavy (Hard) Duty Service
ST	Round	12-18	2-4	PVC	PVC	600	Heavy (Hard) Duty Service
STO	Round	12-18	2-4	PVC	PVC	600	Oil Resistant Jacket, Heavy (Hard) Duty Service
STW	Round	12-18	2-4	PVC	PVC	600	Outdoor Use, Garden Tools
HPN	Round	12-18	2-3	Neoprene	-	300	Heater Cord, Toasters, Heaters
HSJ	Round	12-18	2-4	Rubber	Rubber	300	Heater Cord, Oil Resistant Jackets

**MEGA is producing EV cables for electric vehicle charging**

# European Cordage

European cables are measured in square millimeters. The larger the number the larger the cable and rating.

**H 05 V V F 3 G 1.0mm**

H = Harmonized (Does not signify <HAR>)

05 = 300/500V rating : 07 = 500V/700V rating

V = PVC : R = Rubber : N = Neoprene (Outer jacket/Conductor Jacket)

F = Fine Stranded

3 = The number of conductors

G = Grounded (For two conductor applications the G is absent)

The above is the most common power cord cable example. MEGA stocks a variety of PVC and rubber European cables.

See Catalog Page 48-49

# European Cordage Sizes

**When used in conjunction with plugs or connectors the cable ratings are:**

0.75mm = 6Amps      2.5mm = 25Amps

1.0mm = 10Amps      4.0mm = 32Amps

1.5mm = 16Amps      6.0mm = 44Amps

Internal color codes must be blue, brown, green/yellow

MEGA can supply cable cut and terminated or in bulk



# Australian Cordage

Australian cable is very similar to the European cable, it is measured in cross sectional sizes, but Australia has a more stringent flammability rating. It is possible for European cable to also be approved by one of the state agencies in Australia as long as it meets the standards.

Approved cable will have a file number on the cable jacket.

See Catalog Page 48-49

# Japanese Cordage

Unlike the Japanese plug, which mirrors the NEMA styles, the cordage used in Japan is a completely different system. Not only is the approval different, but the cordage is measured in cross sectional sizes like the European system. But the similarity to the European cordage ends there, as the sizes and amperage ratings do not correspond.

## Japanese Cordage vs. UL/CSA

Japanese	UL/CSA	Sizes and Ratings of Japanese Cordage	
		Cross Sectional Size	AMP Rating
VFF	SPT-2		
VCTF	SJT	0.75mm	7 Amps
HVCTF	SJT (Rated 75°C)	1.25mm	12 Amps
PNCTF	SJO	2.00 mm	15 Amps

# Chinese Cordage

China has developed their own cable nomenclature, but the cable is measured in cross section sizes similar to European cable. All approved Chinese cable is required to be approved with the CCC (Chinese Compulsory Certification) marking. Below is a cross from CCC standards to European.

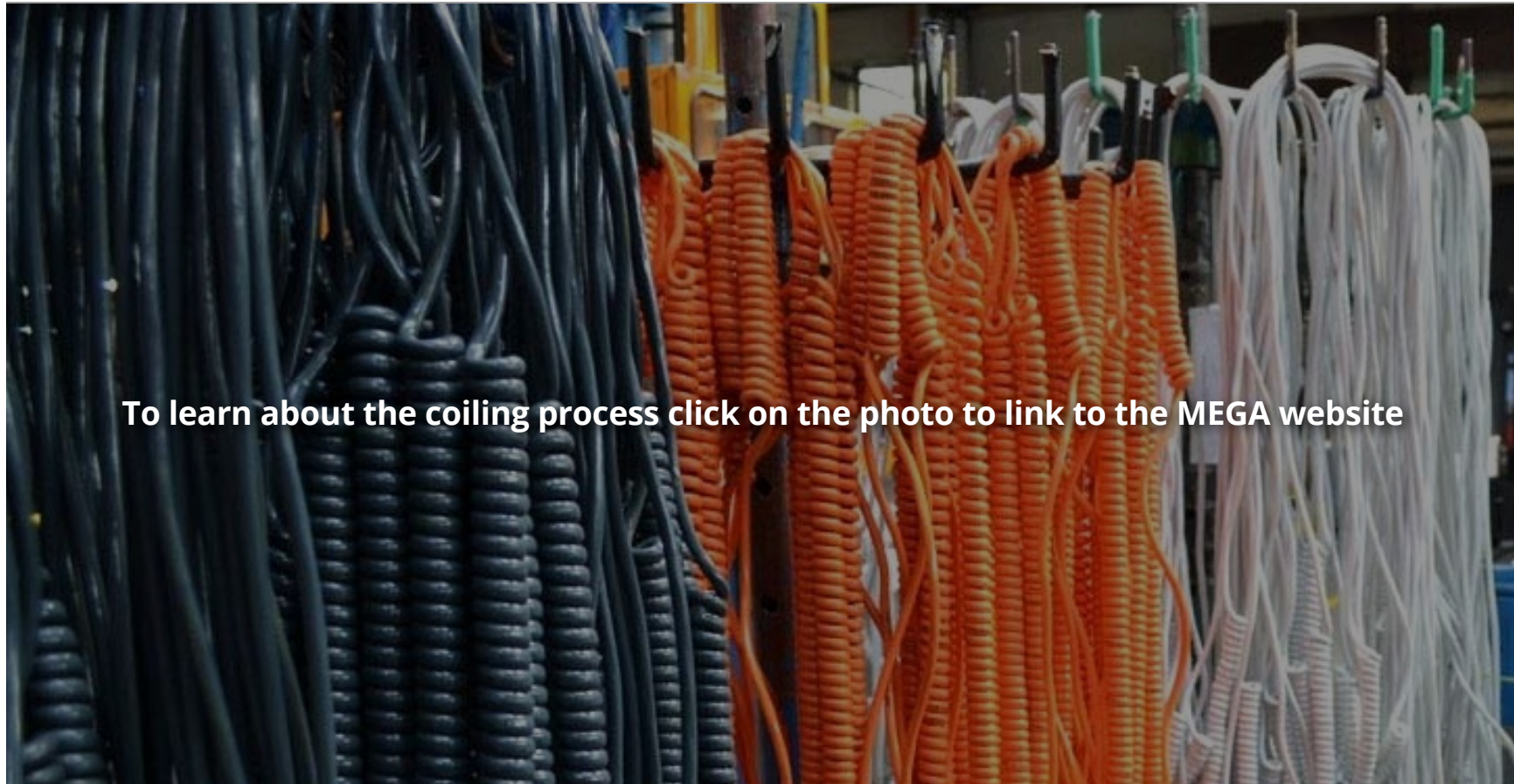
**IEC to CCC and CENELEC Conversion Table**

IEC	CCC	CENELEC
227 IEC 52	RW 300/300	H03VV-F 300/300
227 IEC 52 flat	RVVB 300/300	H03VVH2-F 300/300
227 IEC 53	RW 300/500	H05VV-F 300/500
227 IEC 53 flat	RVVB 300/500	H05VVH2-F 300/500
245 IEC 51	RX 300/300	H03RT-H 300/300
245 IEC 53	YZ 300/500	H05RR-F 300/500
245 IEC 57	YZW 300/500	H05RN-F 300/500
245 IEC 66	YCW 450/750	H07RN-F 450/750



# Coil Cords

Cords for the US Market are made from a PVC/TPE blend and are made to the BQF standard for Europe.





# EN60320 Molded Connectors

European / UL ratings



**C7**  
2.5A/250V  
10A/125V



**C5**  
2.5A/250V  
10A/125V



**C17**  
10A/250V  
15A/250V



**C13**  
10A/250V  
15A/250V



**C15**  
10A/250V  
15A/250V



**C19**  
16A/250V  
20A/250V



120C max.

See Catalog Page 20

# EN60320 Locking Connectors

**NEW!**

Use locking outlets to create a completely secure connection.



## Suitable for use with 'Any Standard' C14 or C20 inlet

- Protects appliances that are vulnerable to vibration
- Connector cannot be accidentally pulled or vibrated out of the inlet



# Universal Approved Jumper Cords

Jumper cords allow the transfer of power from one device to a second. Considered wiring harnesses, a single jumper cord can carry both the North American and European approvals making it universally approved.



## C14/C13


Rated: 15A(UL)10A(Europe)/250V



## C20/C19

Rated: 20A(UL)16A(Europe)/250V

See Catalog Page 19



Our commitment to providing the highest quality power cord solutions is demonstrated by our rigorous testing standards. We supply fully tested products that meet all global requirements.

**Our tests include:**

**Pull test:**


A pull-test is where a wire is pulled upward (effectively pulling it away from the substrate) by a hook until there is either a bond failure or the wire breaks. The connection between the blade terminal and the conductor shouldn't break under a weight pull force of 20-30 lbs. for one minute.

UL 817 is the U.S. standard for cord sets and power supply cords. NEMA plugs used in these cords are required to pass a strain relief test in UL 817 section 99, known as the abrupt pull test.

**Hi-pot test:**

A hi-pot test “makes sure current does not flow between points where there should be no flow (using high voltage to ensure current does not flow).”

This is a stress test of the insulation of a device under test (DUT). This means the voltage used in a hi-pot test can either be AC or DC.



A hi-pot test checks for “good isolation.” A hi-pot test checks that no current flows between points where there should be no current. In some ways, a hi-pot test is the opposite of a continuity test.

A hi-pot test takes two conductors that should be isolated and applies a very high voltage between the conductors. The current that flows is watched. If too much current flows the points are not well isolated and they fail the test.

### **Continuity Test:**

This test “makes sure current flows easily from one point to another point.”

The continuity test is carried out under high current, simulating a fault to earth. This test is performed by applying an AC or DC current between the conductive surface and protective earth.

### **Insulation Test:**

The insulation test determines how effective the insulation is in resisting the flow of electrical current.

### **Grounding Test:**

The purpose of a grounding test is to protect the consumer from hazards that can be caused by a faulty ground connection. A ground bond test is a high current AC test that measures resistance of the ground path under high current conditions.

### **Polarity Test:**

Usually performed as a part of a hi-pot test, a polarity test is a simple test that verifies that a product with a polarized cord (3-prong-plug or a 2-prong-plug) is properly connected.

## Additional Tests Power Cords Undergo:

- Flame test
- Physical properties
- Heat shock
- Low temperature

- Blade security
- Strain relief
- Flexing test

Power cords meet the requirements under UL standards, once they pass all of these important tests

## Additional Products



**MEGA ELECTRONICS INC.**

### Power Supplies & Cords

- Wall Adapters with Interchangeable Plug Option
- Desk Top to 200W
- Open Frame with PFC
- DIN Rails to 960W
- LED Drivers
- Medical Approvals

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**MEGA ELECTRONICS INC.**

### DC/DC-AC/DC Converters

- Rated up to 150 Watts
- UL, cUL Recognized, CE Approved
- Isolations to 6kV for Medical Applications
- ROHS Compliant
- Short Lead Times
- High MTBF Rates
- Continuous Short Circuit Protected
- Website with Product Locator

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