

IEC & UL Standards

Founded in 1906, the International Electrotechnical Commission (IEC) is the global organization that prepares and publishes international standards for all electrical, electronic, and related technologies. The IEC was founded as a result of a resolution passed at the International Electrical Congress held in St. Louis, Missouri in 1904. The membership consists of more than 60 participating countries, including all the world's major trading nations, and a growing number of industrialized countries.

IEC 60309-1 (1999-02)

Plugs, socket-outlets, and couplers for industrial purposes

Part 1: General Requirements

Applies to plugs and socket-outlets, cable couplers, and appliance couplers with a rated operating voltage not exceeding 690V DC or AC, 500Hz AC, and a rated current not exceeding 250A, primarily intended for industrial use, either indoors or outdoors, when the ambient temperature does not normally exceed 40°C.

Part 2: Dimensional Interchangeability Requirements for Pin and Contact-tube Accessories

Applies to plugs and socket-outlets, cable couplers, and appliance couplers with a rated operating voltage not exceeding 690V, 500Hz, and a rated current not exceeding 125A, primarily intended for industrial use, either indoors or outdoors. Together, the IEC 60309 standards provide industrial pin and sleeve connectors that are coded to provide positive voltage and frequency matching. Physical characteristics of these connectors make it virtually impossible to mis-match plugs and receptacles of different voltage and current ratings. The size of the device is determined by its amperage rating. Devices with different amperage ratings cannot be coupled due to the size variance used.

Pin & sleeve devices conforming to IEC 309-2 are single-rated with their voltage determined by the location of the oversized female ground contact relative to a keyway molded into the bottom of the housing. Twelve positions are possible (conforming to the positions of a clock face) to represent the ground pin location for specific voltages. Mis-matched voltage devices are impossible to couple. In addition, each device is clearly marked and color-coded to indicate the voltage for which it is intended to be used.

The IEC's mission is to promote international cooperation on all electrotechnical standardization questions and related matters in the fields of electricity, electronics, and related technologies. IEC's international standards ensure that a component or system manufactured in one country to IEC specifications can be sold to and used in any other country using the same standards.

As a result of this standardization, all manufacturers' devices that conform to these standards are intermateable and interchangeable.

All North American products in this catalog are designed, tested, and approved by Underwriters Labs in accordance with UL 1682 and UL 1686 standards:

UL 1682

Plugs, Receptacles, and Cable Connectors of the Pin & Sleeve Type

Describes the electrical and mechanical characteristics.

UL 1686

Pin & Sleeve Configurations

Describes contact location and other requirements relative to voltage rating for interchangeability.

The following charts show the ground pin location (referenced to the female connector) and color coding for both the North American and international product configurations.

Ground Pin Location & Voltage

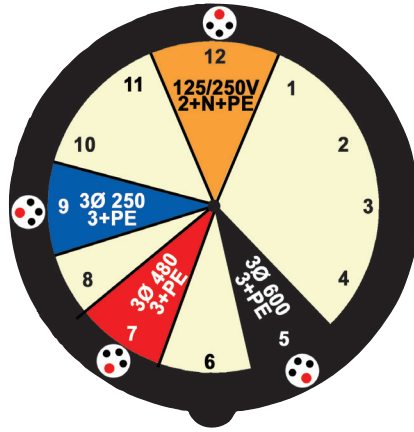
Ground pin location is specified for the female connector referenced to the hour positions on the face of a clock. The keyway is always at the 6 o'clock position. Color slices represent voltages. Voltage is represented by the color of the connector.

North American Standard

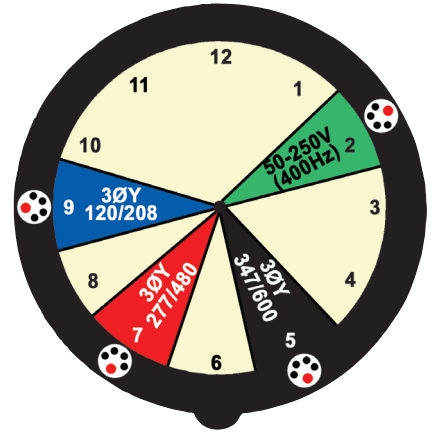
3 Wires: 2+PE & 1+N+PE



4 Wires: 2+N+PE & 3+PE

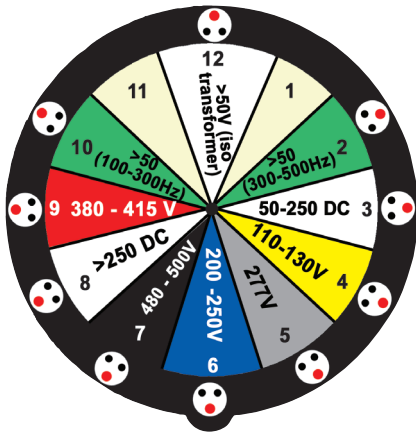


5 Wires: 3+N+PE

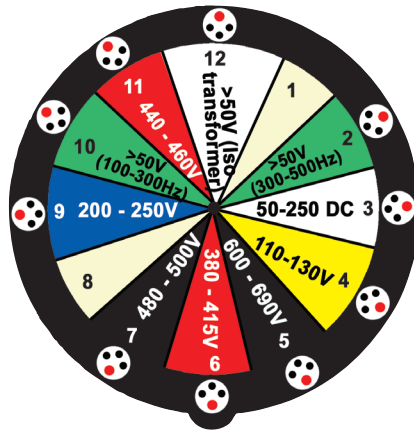


International Standard

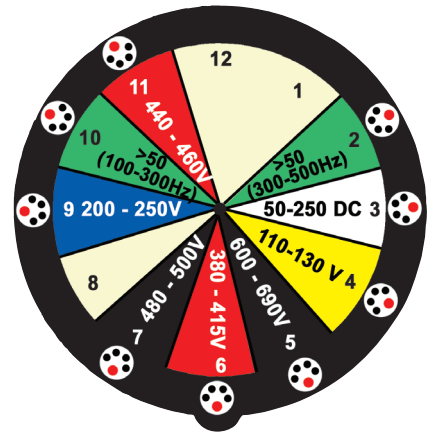
3 Wires: 2+PE



4 Wires: 3+PE



5 Wires: 3+N+PE



Key Features

EPIC® MULTIMAX Series

- Patented click-lock housing
- Patented integral cable grip with shade ring locking device
- Patented universal membrane seal
- High-copper solid brass contacts

EPIC® CEE Series

- Integral cable clamp
- Peelable neoprene grommet
- PG-threaded cable gland
- Stainless steel assembly screws
- High-copper solid brass contacts with nickel-plated male pins for IP67 plugs:
 - North American: 20A & 30A plugs
 - International: All plugs

Common Features

- Tough type 6 nylon housing
- Mate first/break last ground contact
- Voltage-polarized contacts and color-coded housings
- Conforms to IEC 60309-1 & -2
- UL 1682 & 1686 approved

Electrical Features

Dielectric Voltage Withstand:	up to 3000V for 1 minute
Maximum Working Voltage:	600V (North American), 690V (International)
Insulation Resistance:	5 mΩ minimum
Overload:	150% rated current at rated voltage for 50 make/break cycles
Current Interrupting/Load Breaking:	tested to 125% rated current at 110% rated voltage per IEC 60309-1, clause 20
Conditional Short Circuit Current:	10,000A at rated voltage per IEC 60309-1, clause 29
Endurance, Connect & Disconnect Cycles:	see Table 2 on next page
Ground Path Current:	see Table 1 on next page

Mechanical Features

Impact Resistance (-25°C for 6 hours):	per UL 1682, section 34 & IEC 60309-1, clause 24
Crush Resistance (-25°C for 6 hours):	250 lbs for 1 minute
Withdrawal Force:	see Table 4 on next page
Cable Security:	see Table 3 on next page
Polarization Integrity:	maintained by oversized ground pin and clock key
Wire Size Accommodation:	see Table 6 on next page
Cable Outer Diameter Accommodation:	see Table 5 on next page

Environmental Features

Operating Temperature Range:	-25°C to +50°C	
Flammability (self-extinguishing):	20/16A & 30/32A contact holders:	Glow Wire 850°C (V-2 per UL 94)
	60/63A & 100/125A contact holders:	Glow Wire 960°C (V-0 per UL 94)
	other components:	Glow Wire 650°C
	EPIC® ULYSSE series:	Glow Wire 960°C (V-0 per UL 94)
Moisture Resistance:	EPIC® MULTIMAX series:	IP44 (indoor splash-proof)
	EPIC® CEE series:	IP44 (indoor splash-proof) & IP67 (indoor/outdoor watertight)
	EPIC® ULYSSE series:	IP66/67 (indoor/outdoor watertight)
	EPIC® ALUPRES series:	IP55/67 (indoor/outdoor watertight)
Corrosion Resistance:	external screws & cover springs:	stainless steel
	EPIC® CEE series contact pins: (North American: 20A & 30A; Int'l: all)	nickel-plated brass
Chemical Resistance:	resists standard industrial hydrocarbons, acids, bases, and solvents	
UV Resistance:	exposed plastic materials are UV-stabilized	

Test Data & Cable Outer Diameter Accommodation

Table 1: Ground Path Current Test

A test current that far exceeds the device rating is passed through the mating device and grounding wires.

Device Rating (A)	Grounding Conductor Min. Size (AWG)	Min. Size (mm ²)	Time (sec)	Test Current (A)
20/16	12	3.3	4	470
30/32	10	5.3	4	750
60/63	10	5.3	4	750
100/125	8	8.4	4	1180

Table 2: Endurance Test

The test sequence is conducted using a no-load, followed by a loading sequence. The power factor of the load is 0.75 - 0.80.

Device Rating (A)	Cycles with Load @ Rated Current & Voltage	No-Load Cycles	Sequence
20/16	5000	0	—
30/32	1000	1000	Alternating
60/63	1000	1000	Alternating
100/125	250	250	Alternating

Table 3: Cable Security Test

The flexible cord or cable is simultaneously twisted and pulled. Values for the applied twisting torque and force of pull are shown. In all cases, the cord displacement is less than 3/32"

Device Rating (A)	Force (lb) (N)		Torque (ft/lb) (N/m)		Max. Displacement (inches) (mm)	
20/16	30	133	0.4	0.54	3/32	2.38
30/32	75	333	0.5	0.68	3/32	2.38
60/63	150	667	1.0	1.4	3/32	2.38
100/125	150	667	2.0	2.7	3/32	2.38

Table 4: Withdrawal Force Test

The pressure exerted by mating contacts of a plug and a connector must be sufficient to prevent unintentional withdrawal during normal use. During the test any locked rings or retaining means are not engaged.

Device Rating (A)	Min. Withdrawal Force (lb) (N)	
20/16	5	22
30/32	6	27
60/63	15	67
100/125	20	89

Table 5: Cable Outer Diameter Accommodation

Device Rating & Configuration	Sleeve / Cable Gland	Cable Diameter Range: 2+PE (mm)		Cable Diameter Range: 3+PE (mm)		Cable Diameter Range: 3+N+PE (mm)		
EPIC® MULTIMAX Series								
20/16 A	—	0.32 - 0.55	8.1 - 14.0	0.33 - 0.55	8.5 - 14.0	0.39 - 0.60	10.0 - 15.3	
30/32 A	—	0.45 - 0.68	11.5 - 17.3	0.49 - 0.76	12.5 - 19.3	0.55 - 0.84	14.0 - 21.3	
EPIC® CEE Series								
20/16 A: 2P+PE	PG 13	0.32 - 0.53	8.1 - 13.5	—	—	—	—	
20/16 A: 3P+PE	PG 16	—	—	0.35 - 0.60	8.8 - 15.3	—	—	
20/16 A: 3P+N+PE	PG 16	—	—	—	—	0.35 - 0.60	8.8 - 15.3	
30/32 A	PG 21	0.45 - 0.84	11.5 - 21.3	0.45 - 0.84	11.5 - 21.3	0.45 - 0.84	11.5 - 21.3	
60/63 A	PG 29	0.63 - 1.12	16.0 - 28.5	0.63 - 1.12	16.0 - 28.5	0.63 - 1.12	16.0 - 28.5	
100/125 A	NPT 2"	1.02 - 1.93	26.0 - 49.0	1.02 - 1.93	26.0 - 49.0	1.02 - 1.93	26.0 - 49.0	
EPIC® ULYSSE Series								
20/16 A	PG 29	0.71 - 0.98	18.0 - 25.0	0.71 - 0.98	18.0 - 25.0	0.71 - 0.98	18.0 - 25.0	
30/32 A	PG 29	0.71 - 0.98	18.0 - 25.0	0.71 - 0.98	18.0 - 25.0	0.71 - 0.98	18.0 - 25.0	
60/63 A	2x PG 29	0.71 - 0.98	18.0 - 25.0	0.71 - 0.98	18.0 - 25.0	0.71 - 0.98	18.0 - 25.0	
EPIC® ALUPRES Series								
20/16 A: 2+PE, 3+PE	FO-NPT 1/2"	0.35 - 0.47	9.0 - 12.0	0.35 - 0.47	9.0 - 12.0	0.47 - 0.63	—	
20/16 A: 3+N+PE	FO-NPT 3/4"	—	—	—	—	0.47 - 0.63	12.0 - 16.0	
30/32 A & 60/63 A (order flanges separately)	F1-NPT 1/2"	0.35 - 0.47	9.0 - 12.0	0.35 - 0.47	9.0 - 12.0	0.35 - 0.47	9.0 - 12.0	
	F1-NPT 3/4"	0.55 - 0.63	14.0 - 16.0	0.55 - 0.63	14.0 - 16.0	0.55 - 0.63	14.0 - 16.0	
	F1-NPT 1"	0.63 - 0.87	16.0 - 22.0	0.63 - 0.87	16.0 - 22.0	0.63 - 0.87	16.0 - 22.0	
	F1-NPT 1 1/4"	0.98 - 1.02	25.0 - 26.0	0.98 - 1.02	25.0 - 26.0	0.98 - 1.02	25.0 - 26.0	

Table 6: Wire Size Accommodation

Rated Current (A)	Max. Wire Size*		Recommended Torque for CEE Contact Set Screws		Recommended Torque for MULTIMAX Contact Set Screws	
	(AWG)	(mm ²)	(ft/lb)	(N/m)	(ft/lb)	(N/m)
20/16	12	4	0.60	0.8	0.60	0.8
30/32	8	10	2x 0.60	2x 0.8	1.48	2.0
60/63	6	16	2x 1.48	2x 2.0	—	—
100/125	1	50	2x 2.95	2x 4.0	—	—

* subject to stranding configuration.

Construction Materials

Plugs, Connectors, Receptacles & Inlets

Component	Material
Housing	Thermoplastic
Cable grip	Thermoplastic
Cover (splash-proof)	Thermoplastic
Locking ring / cover (watertight)	Thermoplastic
Contact carrier (20/16A & 30/32A)	Thermoplastic
Contact carrier (60/63A & 100/125A)	Thermoset plastic
Cable grommet / seal	Neoprene
Locking ring gasket	Neoprene
Flange seal gasket	Neoprene
EPIC® MULTIMAX contact pins	High-copper brass
EPIC® CEE contact pins	Nickel-plated high-copper brass
Contact sleeves	High-copper brass
Terminal screws (splash-proof)	Brass
Terminal screws (watertight)	Nickel-plated brass
Assembly screws	Stainless steel
Cover spring	Stainless steel

Interlocked Switched-Socket Outlets

Component	Material	
	EPIC® ULYSSE	EPIC® ALUPRES
Housing	Thermoset plastic	Aluminum alloy with baked polymerized paint finish
Control grip	Thermoset plastic	Thermoplastic
Locking ring / cover	Thermoplastic	Thermoplastic
Entry gland	Thermoplastic	—
Contact carrier (20/16A & 30/32A)	Thermoplastic	Thermoplastic
Contact carrier (60/63A)	Thermoset plastic	Thermoset plastic
Cable grommet	Neoprene	Neoprene
Locking ring gasket	Neoprene	Neoprene
Contact sleeves	High-copper brass	High-copper brass
Terminal screws	Brass	Brass
Mechanical interlock	Tropicalized steel	Tropicalized steel
Switch lock-out device	Stainless steel	—
Assembly screws	Stainless steel	Stainless Steel
Cover spring	Stainless steel	Stainless Steel

Reference Data

Plugs & Connectors

Reference Standards

• General characteristics:	CEI EN 60309-1	IEC 309	CEI 23-12/1
• Standardization:	CEI EN 60309-2	IEC 309-2	CEI 23-12/2
• Protection ratings:	CEI EN 60529	IEC 529	CEI 70-1

Construction Characteristics

IP44 & IP67 rated products

- Pins and plug contacts are made of solid brass bars with a high level of copper.
- External screws, where present, and spring clasps for lids are made of stainless steel.
- The cable clamp is designed to prevent strain from torque and/or traction on the wires in the terminals and also assures that the wire covering stays in good condition
- Elements holding live parts (for 20A & 30A North American or 16A & 32A international standards) are made of self-extinguishing thermoplastic technopolymer (V-2 per UL 94), with Glow Wire resistance to 850°C and resistance to tracking of > 600V. For products to 60A & 100A North American and 63A & 125A international standards, they are made of self-extinguishing thermoset technopolymer (V-0 per UL 94), with Glow Wire resistance to 960°C and resistance to tracking of > 600V.
- Body and lids are made of technopolymer with high impact resistance and excellent dimensional stability.

IP67 rated products

- Pins are subject to a thick nickel-plating treatment to increase their resistance to oxidation and wear even under the worst operating conditions.
- In products to 60A & 100A North American and 63A & 125A international standards, a standard pilot contact is included.
- Cable glands have parts in peelable rubber for adapting to a variety of cable sizes.
- For plug and socket-outlets to 60A & 100A North American and 63A & 125A international standards, bodies are made of extra-durable thermoplastic technopolymer to assure improved impact resistance even under extreme conditions.

Resistance & Testing

Resistance to excess heat and fire

Glow Wire test (according to IEC Publication 695-2-1): This test checks the reaction of a given insulation after overheating of adjacent metallic parts caused by bad connections or faults in the system. A glow wire coil is pressed into the specimen for 30 seconds, penetrating up to 7 mm. A sheet of tissue paper is put under the point of contact. The temperature of the wire required by the standard is 850°C for items used for holding parts that carry current and 650°C for other insulations. The test is considered to have a positive outcome if the specimen does not catch fire or if it self-extinguishes within 30 seconds of the wire being removed without burning entirely and causing continuous burning of the tissue paper beneath.

All plugs and connector components meet or exceed the temperature test requirements set by IEC.

UL 94: self-extinguishing test

A Bunsen burner is twice brought into contact with an insulation specimen in a vertical position, each time lasting 10 seconds. Cotton wool is placed under the point of contact.

Classification	Reaction of Specimen
V-0	Extinguishes within 5 seconds. The cotton beneath does not ignite.
V-1	Extinguishes within 25 seconds. The cotton beneath does not ignite.
V-2	Extinguishes within 25 seconds. The cotton beneath ignites.
HB	Does not extinguish within 25 seconds. When testing the specimen horizontally, burns at a speed lower than 38 mm/min (at a thickness greater than 3 mm) and less than 76 mm/min (at a thickness of up to 3 mm).

Testing for resistance to tracking (in compliance with IEC 112)

The surfaces of the insulated item being tested are arranged horizontally and two platinum electrodes are placed on them at a distance of 4 mm. The electrodes are connected to a 50 Hz supply source. Every 30 seconds a drop of 0.1% ammonium chloride in distilled water falls between the two electrodes. The test is passed if there are no electrical charges between the two electrodes before 50 drops have fallen. Results depend on the level of voltage applied to the electrodes, and this is taken as the index of resistance to tracking.

All plugs and connectors comply with the tracking resistance requirement of IEC.

Reference Standards

• Socket outlets:	CEI EN 60309-1	IEC 309	CEI 23-12/1	CEI EN 60309-2	IEC 309-2	CEI 23-12/2
• Enclosures:	CEI EN 60529	IEC 309-2	CEI 70-1			
• Safety transformer:	CEI EN 60742	IEC 742	CEI 96-2			
• Switches:	CEI EN 60974-3	IEC 947-3	CEI 17-11			

Construction Characteristics

Socket outlets with mechanical interlock

- Socket outlets that are interlocked, both mechanically & electrically, make it possible to create electricity distribution systems in maximum safety. They also meet specific requirements of system regulations for special system configurations, as described in the following:
 - “socket outlets with a power load over 16A must be the interlocking type.” (CEI 64-8/7, sect. 752.55.1: In electrical systems for public entertainment places)
 - “in C2 sites the socket outlets must be of the interlocking type.” (CEI 64-2, chap. XII, sect. 3, para. 12.3.03: Socket outlet in making an operating safety system (AD-FT))
- The interlock device prevents the switch from being closed if the plug has not been inserted into the socket-outlet and thereafter stops it from being taken out if the switch is in the “closed” position. In addition to this safety feature, the switch knob is connected to a door lock that only allows the enclosure to be opened for maintenance purposes if the switch is in the “open” position.
- The complete functional unit is assembled onto the light alloy frame, which is in turn coupled to the thermoset plastic enclosure. The entire functional structure thus makes up a rigid sub-assembly that is mechanically defined, guaranteeing that the regulations and original functions are maintained in the long term.
- The parts making up the mechanical interlocking device are made in tropicalized steel plate, which guarantees the necessary rigidity and strength even if forced through incorrect use.
- The fuse-holder bases, where included, are in thermoset plastic (EPIC® ULYSSE) or ceramic-mounted (EPIC® ALUPRES) and wired in the switched outlet. Unless specifically requested, the fuses are not normally included with the equipment.
- The interlocked socket-outlets are available with a rotary control switch, with or without a fuse-holder base as indicated.

EPIC® ULYSSE interlocked socket-outlets in thermoset plastic

- Bottom boxes and covers are made of very thick reinforced thermoset plastic (SMC or CMC or BMC, according to use) with excellent dimensional stability, non-deformability, and resistance to extremes of heat and fire, to the action of chemical and atmospheric agents, and to mechanical stress even at very low temperatures. All these characteristics in the enclosure material ensures maximum performance in any environment, even when chemically aggressive, and represents perfection in terms of insulating material.
- The transparent covers are made of thick polycarbonate with a long-chain molecular structure. They are self-extinguishing and UV stabilized for maximum resistance to atmospheric and chemical agents.
- Captive screws for closing the covers are made of stainless steel, with gaskets in non-aging elastomer.
- All the enclosures in the EPIC® ULYSSE series are suitable for creating systems in compliance with standards CEI 64-8 and particularly for installation in places at “greater risk in case of fire” (64-8/7, sect. 751). They also permit the fitting out of distribution boards with protection through complete insulation (CEI EN 60439-1) and meet the requirements of the IEC 670 publication.
- The entire EPIC® ULYSSE series is completely modular and ideal for making even complex distribution boards using predefined configurations and standard accessories.

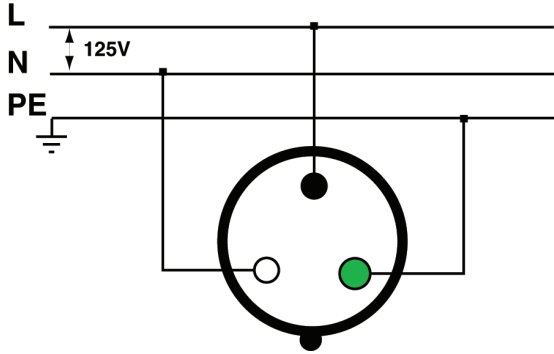
EPIC® ALUPRES interlocked socket-outlets in light alloy

- Bottom boxes and covers are made of UNI-5076 light alloy with a high aluminum content, oven-painted internally and externally over a pretreatment of chromate galvanizing for a maximum resistance to corrosion. The heavy thickness of the material used for making these enclosures assures maximum results in any environment, even when chemically aggressive, and represents perfection in terms of metal structures due to the very high impact resistance.
- Captive screws for closing the covers are made of stainless or tropicalized steel with gaskets in non-aging elastomer.
- Internal and external earth connection screws.
- All the enclosures in the EPIC® ALUPRES series are suitable for creating systems in compliance with CEI 64/8 standards, and particularly for installation in places with “greater risk in case of fire” (64-8/7, sect. 751).
- The entire EPIC® ALUPRES series is completely modular and ideal for making even complex distribution boards using predefined configurations and standard accessories.

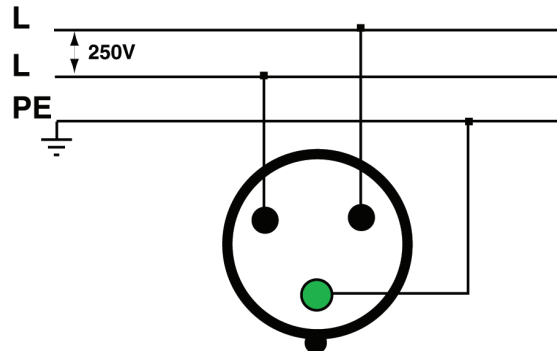
Circuit Wiring Diagrams

North American Standard Female Devices

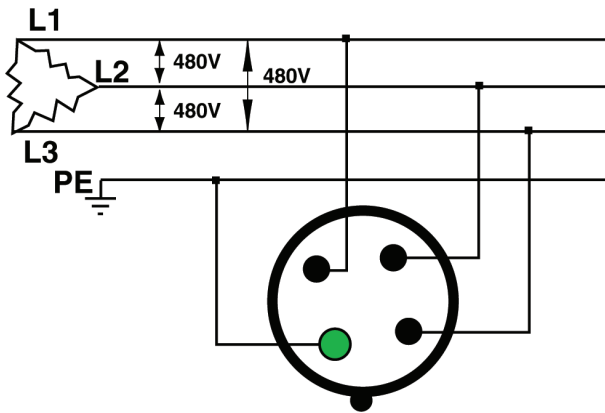
125V; 1+N+PE, 3-wire, 4h



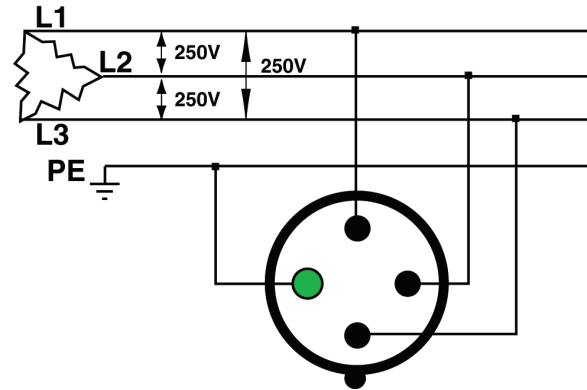
250V; 2+PE, 3-wire, 6h



480V; 3+PE, 4-wire, 7h, 3phase



250V; 3+PE, 4-wire, 9h, 3phase



120/208V; 3+N+PE, 5-wire, 9h, 3phY

