

Tools for electrical engineers in the nuclear power industry

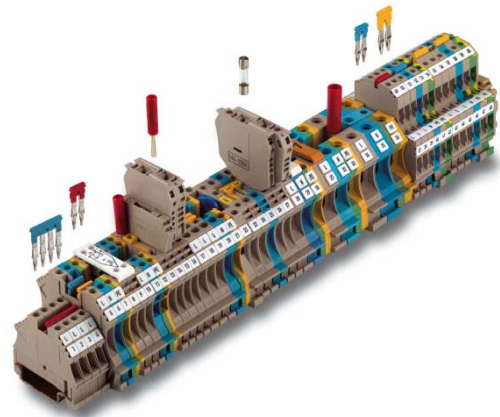
Electrical Commodities

Terminal blocks (also called terminal boards or strips) are used to securely connect and protect wires. They are usually mounted inside equipment panels and have screw-type connections.



Heavy duty (industrial) models are commonly used in nuclear plants, especially in 120-volt relay, and 120/208/220/480-volt power applications.

Industrial models are built to withstand physical abuse, high temperatures, high current, and they help shield the individual terminations from other wires and accidental bumping. They screw-mount to flat surfaces like back panels. Typically specified with 4-, 6-, or 12-point circuits, though other sizes are available. Sometimes called NEMA-type.

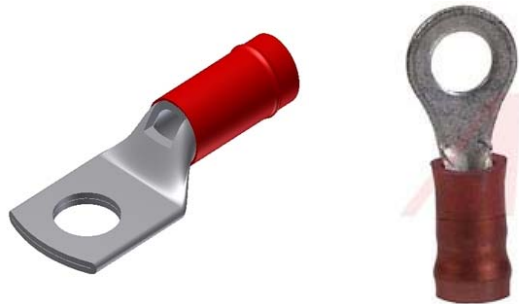


DIN rail is a versatile metal rail that accepts a variety of equipment like fuse holders, circuit breakers, relays, and terminal blocks.

Typically used in control applications and mounted inside panels. DIN-mounted terminal blocks allow greater density than the terminal boards, but they are taller. Of German origin (Deutsches Institut für Normung). Sometimes called IEC-type.

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Wire lugs are used to connect wires to terminal block studs. Lug hole sizes should match the terminal stud diameter. Standard wire lugs have one hole to connect to terminal block studs.



Ring tongue lugs are used in the nuclear industry because they offer the most secure connection, especially during earthquakes.



Spade tongue lugs are quicker to install because the entire terminal screw doesn't have to be removed, but it is more likely to fall away if the tightening screw is loose.



Short-barrel lugs are standard and used for general applications. They work well in confined spaces. Typically used for cables #4 and smaller.

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Long-barrel lugs are for heavy-duty applications. The longer barrel provides extra mechanical strength by increasing the crimping area. Typically used on cables #2 and larger.



Bolted lugs are used in bus-bar applications. The additional bolt prevents the lug from rotating under table tension. This prevents rotating lugs from shorting to nearby metal.



Butt splices are used to join two wires in line with each other; they “butt up” end to end. They are held in place by a crimp on each side. Insulated or uninsulated.

Uninsulated splices are typically insulated with Ray-Chem heat-shrink tubing.



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Ray-Chem is a popular brand of heat-shrink tubing. It provides insulation and protection, and even comes in a radiation-resistant, Class 1E-qualified version.

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Fasteners

Fasteners are the name given to screws and other hardware devices used to join and secure two objects together. Included in this category are screws, bolts, washers, nuts, hangers, clamps, clips, rods, and more.



Machine screws bind metal to metal. Instead of being secured by a nut, they are driven into a pre-tapped hole or opening with a matching thread pattern. They usually have threads along the entire length of the shank (also called a shaft). The shank is non-tapered.



Hex head cap screws have non-tapered shanks that are typically fully threaded. Their hex cap enables them to be driven by a wrench and secured with a nut.

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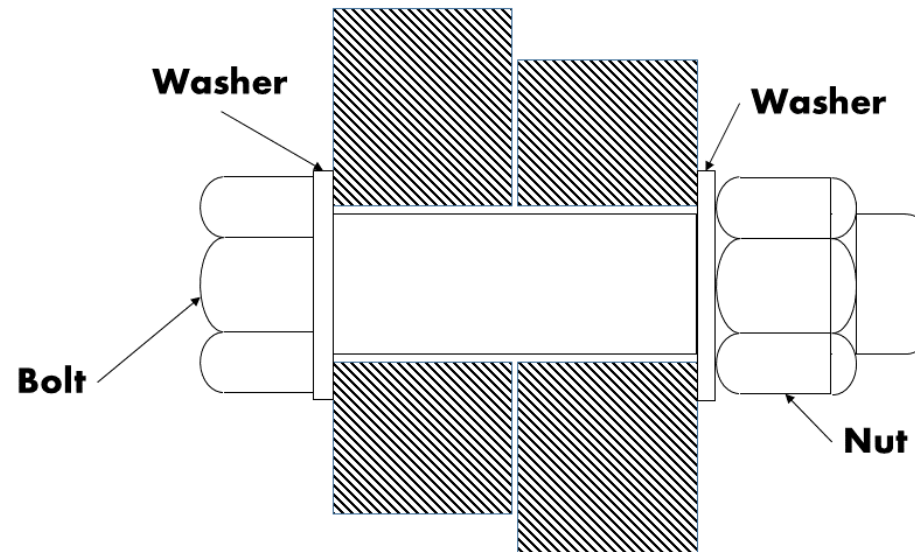
Socket head cap screws have non-tapered shanks, but they have a recessed drive hole and smaller head than the hex cap. They are used in applications where clearances are too tight to accommodate a hex head screw.



Flat washers are used to prevent bolts from loosening. They do this by distributing a bolt head's force over a wider area, protecting binding surfaces from installation damage, and generating sufficient holding tension when bolts aren't long enough or wide enough to do so on their own (which is most applications). They are also used to span oversized holes that are normally too big for the bolt head.

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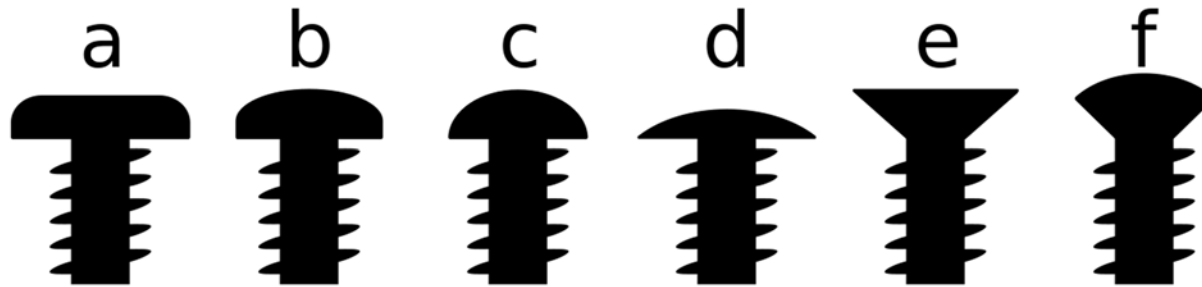
Typical Bolt Assembly



Sheet metal screws have large, sharp threads conducive to cutting and binding to sheet metal. Their shank is tapered to give them self-tapping capability.

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Screw heads come in various shapes. This diagram from Wikipedia is helpful:



A – Pan head

B – Button or dome head

C – Round head, used for decoration

D – Mushroom or truss head, has a low profile meant to prevent tampering

E – Countersunk or flat head, allows screw to sink into material

F – Oval or raised head, also used for decoration

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Conduit Commodities

Conduit is used to route and protect cable. Rigid metal conduit is made of thick-walled steel (often galvanized with a zinc coating) and offers the most heavy-duty cable protection. But conduit systems require accessories to be complete. Here are some of the most common.



Conduit elbows are pre-made bends used to change conduit direction.



Conduit nipples are short pieces of conduit used to extend conduit or make short connections between boxes. They can also be used to enlarge or reduce conduit runs by transitioning to the next size conduit (larger or smaller).

Commodity Materials Quick Reference

Find this and more like it at
<http://www.NuclearElectricalEngineer.com>

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Couplings are short unions that join two pieces of conduit together. Includes elbows.



Conduit bushings are used in conjunction with lock nuts to terminate conduit to an enclosure.



Grounding bushings are used to ground conduit by providing an easy means of attaching a grounding conductor.

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Conduit bodies with removable covers (also called “condulets”) are used to create pull points in conduit runs. They are also used in place of conduit elbows when a full-size conduit bend radius is impractical.

Their benefit over pull boxes (also called junction boxes) is that they fit into smaller areas and are easier to install. They don’t require the same elaborate support structure as a pull box. A disadvantage is that they can’t be used to splice cables unless specifically listed to do so.



An **LB fitting** is an L-shaped conduit body with a removable back.



An **LR fitting** is an L-shaped conduit body with a removable cover.

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An **LL fitting** is an L-shaped conduit body with a removable cover.



A **C-shaped fitting** is a conduit body used to insert a pull point in a straight run of conduit.



A **T-shaped fitting** is a conduit body used to insert a pull point at a common intersection.

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Conduit Supports and Miscellaneous Hanging System Materials

Though mostly the domain of civil engineers, it's beneficial for an electrical engineer to have a basic understanding of conduit hangers and hanging systems.



Unistrut is a brand name for a selection of bolted metal tubing and struts used to construct frames, conduit supports, and seismically rugged supports in general. B-Line offers a competing product. Both brands are commonly used in the nuclear power industry.



Spring nuts are used in metal framing systems. The spring allows the nut to be positioned precisely along the metal channel.

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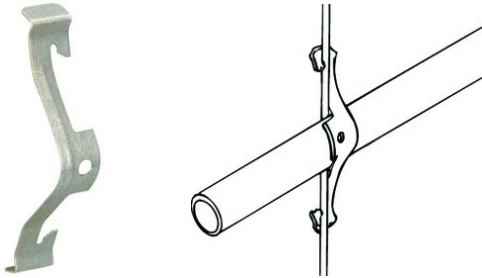


Conduit straps are used to secure conduits to mounting surfaces and structural members (such as Unistrut).



Bolted conduit (beam) clamps are a versatile fastener used to attach hanger rods to structural members without needing to weld or drill. May be referred to as a “caddy clamp.” Caddy is a brand.

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Conduit clips (spring steel) are used for quick installation of conduit to support members.



J-hooks are a type of cable support system. These aren't typically used in the nuclear industry.



Wedge anchors are used to anchor objects to concrete. A hole is pre-drilled, and then the bolt is hammered in. The expansion cone on the anchor's tip deforms and forces open the expansion element. Hilti Qwik Bolts are a popular wedge anchor brand.
