

CHAPTER

6

SERVICE AND DISTRIBUTION EQUIPMENT

Meter Sockets	69
Current Transformer Cabinets	70
Switchboard (Switchgear)	71
Panelboards	72
Generator Panels	73
Transformers	74
Disconnects (Safety Disconnects)	75
Busways (Busducts)	76
Breakers	77
Fuses	78
Fuse Blocks (Fuse Holders)	79

Meter Sockets

Meter Socket



Dual Meter Socket



1. A meter is used by utility companies to measure power consumption.
2. Meter sockets such as the ones above are used for line voltage or direct metering.
3. Meter sockets come in many styles and amperages, including:
 - a. standard meter socket
 - b. meter socket with bypass horns, which allow utility companies to bypass a meter with jumpers if the meter needs to be removed
 - c. meter socket with bypass lever, which allows utility companies to bypass a meter with a lever if the meter needs to be removed.

NEC® Article 312, Cabinets, Cutout Boxes, and Meter Socket Enclosures

Current Transformer Cabinets

CT Cabinet and Meter Socket



Current Transformers inside the Cabinet



1. Current transformer (CT) metering is used by utility companies to measure power consumption by larger services, as well as by some off-peak systems.
2. The power consumed by a building moves through the center of the current transformer, inducing a voltage and current flow that spins a meter.
3. CT cabinets are enclosures where the current transformers are housed and are the point where the service conductors coming from the utility transformer connect to the service entrance conductors of the building.
4. Off-peak CT metering systems do not always use a CT cabinet. Instead, the current transformers are housed by a large junction box, and the conductors running to the heating load are run through the CTs.

Note that in CT metering, the power consumed does not actually go through the meter socket.

NEC® Article 312, Cabinets, Cutout Boxes, and Meter Socket Enclosures

Switchboard (Switchgear)



Definition (A large single-panel, frame, or assembly of panels on which are mounted on the face, back, or both, switches, overcurrent and other protective devices, buses, and usually instruments. Switchboards are generally accessible from the rear as well as from the front and are not intended to be installed in cabinets.) NEC® Article 100.

1. Switchboards are used in large commercial and industrial buildings.

NEC® Article 408, Switchboards and Panelboards

Panelboards

Three-Phase Main
Lug Panelboard



Single-Phase Main Breaker
Panelboard



Definition (A panelboard is a single panel or group of panel units designed for assembly in the form of a single panel, including buses and automatic overcurrent devices, and equipped with or without switches for the control of light, heat, or power circuits; designed to be placed in a cabinet or cutout box placed in or against a wall, partition, or other support; and accessible only from the front.) NEC® Article 100.

1. Main-breaker panelboards contain a large OCPD to which are connected the conductors feeding the panel. This device protects the entire panel.
2. Main-lug panelboards do not have a main breaker. Instead, the conductors feeding the subpanel connect to lugs mounted on the busbars.
3. Main-lug panels are typically used as subpanels, which are protected by the OCPD in the panelboard or switchboard that feeds the subpanel.
4. Panelboards come in many sizes and amperage ratings.

NEC® Article 408, Switchboards and Panelboards

Generator Panels



1. A generator panel is used to connect a generator to the electrical system in the case of a power outage.
2. There are many styles of generator panels; the style differentiations are based on type of feed and method of power changeover.
 - a. Types of feeds include
 - i. a receptacle to connect the generator cord on the front of the panel.
 - ii. a receptacle to connect the generator cord in a remote location (typically outside).
 - iii. a direct connection.
 - b. Ways to changeover power include
 - i. individual switches for each load (pictured above).
 - ii. one switch to changeover from utility power to generator power.
 - iii. an automatic transfer switch (changes over automatically).

Transformers

Transformer (Consumer Owned)
Dry Type



Transformer (Utility Owned-Pad Mounted)
Oil Filled



Transformer (Utility Owned-Pole Mounted)
Oil Filled

1. Transformers are used to increase voltage, decrease voltage, or provide electrical isolation.
2. Consumer-owned transformers (pictured above) are used to change the voltage on the consumer side of an electrical service. This transformer may step voltage up or down.
3. Utility-owned transformers (pictured above) are typically used to step the utility voltage down to the voltage used by the consumer.

NEC® Article 450, Transformers and Transformer Vaults

Disconnects (Safety Disconnects)

Disconnect



Three-Phase Fused Disconnect



1. Disconnects are used to disconnect the power from equipment.
2. Disconnects come in many styles and ratings:
 - a. fused and non-fused
 - i. Fused disconnects have fuses, as in the one picture above.
 - ii. Non-fused disconnects do not have fuses; instead, they work like a switch.
 - b. ampacities from 30 amps to 1000+ amps
 - c. enclosure ratings (i.e., the NEMA rating on the enclosure) indicate which environment the disconnect is rated for.
3. Disconnects can be used as service equipment if they are designed for this purpose and marked properly.

Busways (Busducts)

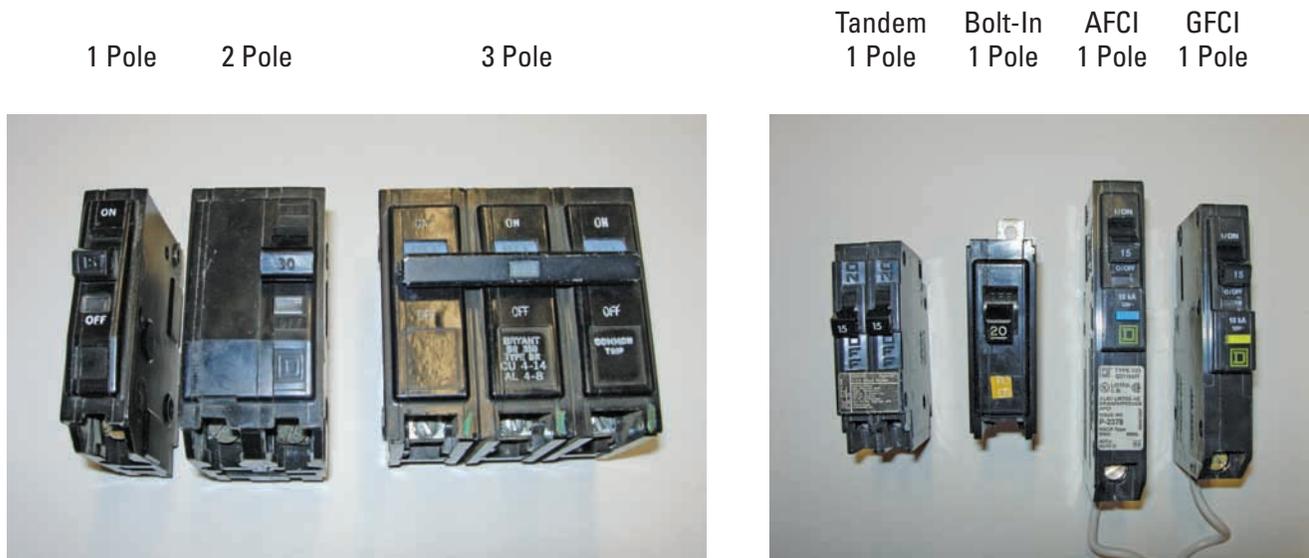


Definition (A grounded metal enclosure containing factory-mounted, bare or insulated conductors, which are usually copper or aluminum bars, rods, or tubes) NEC® Article 368.2.

1. Busways are used in large commercial and industrial locations.
2. Busways typically are run around a building to feed many loads, panels, transformers, etc.
3. Busways are protected in their originating panel by a large fuse or circuit breaker.
4. Busways have fused disconnects, sized to protect the load to be served, attached to them at the appropriate location.
5. Busways typically contain doors placed every few feet to enable the installation of a disconnect. In the busway pictured above, note the two unused doors.
6. Busways have several disconnects. (The one pictured above has three: one on the front and two on the back side.)

NEC® Article 368, Busways

Breakers



1. One-pole breakers provide branch-circuit overcurrent and short-circuit protection for loads requiring one phase conductor: for example, a 120V receptacle outlet circuit.
2. Two-pole breakers provide branch-circuit overcurrent and short-circuit protection for loads requiring two phase conductors: for example, a 240V baseboard heat circuit.
3. Three-pole breakers provide branch-circuit overcurrent and short-circuit protection for loads requiring three-phase conductors: for example, a 208V 3-phase motor circuit.
4. Tandem breakers are used when a panelboard is full and a circuit needs to be added. They take one space and turn it into two spaces. To use a tandem breaker
 - a. the panel must be rated for tandem breakers.
 - b. the panel must not exceed 42 spaces.
 - c. it cannot be used with two circuits of a multiwire branch circuit.
5. Bolt-in breakers are bolted onto the busbar to create a solid connection.
6. Arc fault circuit interrupter (AFCI) breakers provide protection against arc faults.
 - a. Both grounded and ungrounded conductors connect to these breakers.
7. Ground fault circuit interrupter (GFCI) breakers provide protection against ground faults.
 - a. Both grounded and ungrounded conductors connect to these breakers.

NEC® Article 240, Overcurrent Protection

Fuses

Cartridge Fuses
 Ferrule Knife Blade Ferrule Plug Fuses



Type S (Fusestat)
 Plug Fuses Type S (Fusestat)
 Adapter

1. Fuses provide overcurrent and short-circuit protection.
2. Fuses are available in ampacities from a fraction of an amp to 6,000 amps.
3. Replacement fuses must have the correct voltage, amp rating, interrupting rating and type (class-trip characteristic) as the fuses being replaced.
4. Ferrule-type cartridge fuses are used for applications of 60 amps and under.
5. Knife blade fuses are used for ampacities of more than 60 amps.
6. Plug fuses provide branch circuit overcurrent and short-circuit protection in fuse panels. This type of protection is no longer installed in new installations; however, it is still in many older homes and buildings.
7. Type S (Fusestat) fuses are used with type S (Fusestat) adapters.
8. Fusestat adapters are installed in a plug fuse opening to restrict the fuse size. This will prevent a 20A or 30A fuse from being installed on a circuit with conductors rated for 15A.

NEC® Article 240, Overcurrent Protection

Fuse Blocks (Fuse Holders)

Fuse Holder

Fuse Holder
(Finger-safe Protection)
(Indicator Light)

1. Fuseblocks provide a means of holding fuses and of terminating the conductors the fuse is protecting.
2. Fuseblocks are available for one, two, or three fuses.
3. Finger-safe fuseblocks allow fuses to be changed without being exposed to energized parts.
4. Indicator lights indicate whether a fuse has blown.

NEC® Article 240, Overcurrent Protection