



*Marking and Application Guide*

# **PANELBOARDS**

Panelboards  
Marking and Application Guide

**JANUARY 2012**

## PREFACE

Panelboards are no longer a simple assembly of switches, fuses and circuit breakers for single ampere and voltage systems. Today, there are panelboards for a variety of electrical supply systems with overcurrent protections for many short-circuit capabilities. This has resulted in a complex marking system.

UL developed the Panelboard Marking Guide for electrical inspectors, electric utilities, contractors, installers, users, designers, and other interested parties to aid in understanding panelboards and the applicable codes and standards in order to facilitate a reasonably safe and code-compliant installation of panelboards used in ordinary locations, rated 600 volts or less. These panelboards are intended to be installed in accordance with the *National Electrical Code*® (NEC®) and their listing. These markings are required by UL 67, and are part of the listing.

The term “panelboard” used in this booklet also applies to modular panelboards unless otherwise noted.

The Table of Contents lists the main headings and their page numbers. The Index gives an alphabetical list of specific items and the section numbers where information about them can be found. Marking guides are available for Deadfront Switchboards and Molded Case Circuit Breakers.

Complete information regarding the provision of markings and instructions for these panelboards is contained in the Standard for Panelboards, UL 67. Unless otherwise noted, references to the *National Electrical Code*® (NEC) are to the 2011 edition.

Revisions to the 2008 edition of the NEC resulted in panelboards no longer being classified as “Lighting and Appliance Branch-Circuit Panelboards” and “Power Panelboards”, and the 2008 NEC no longer limits the number of overcurrent devices in a lighting and appliance branch-circuit panelboard to 42 circuits. Requirements in UL 67 permit manufacturers to identify “Class CTL” panelboards as those with a physical means to prevent the installation of more than 42 overcurrent devices (or if fewer than 42, that number for which the panelboard was designed and rated). Since existing optional requirements, and legacy products continue to be utilized based on NEC requirements that were part of the 2005 and earlier editions, multiple references in this marking guide identify the earlier edition of the NEC as being the relevant NEC requirement.

UL Marking and Application Guides are updated as necessary due to new product development, changes in the codes, or the need for clarification. To confirm the current status of any UL Marking Guide, please consult the Code Authorities page of the UL Web Site at <http://www.ul.com/codeauthorities>.

Your comments or suggestions are welcome and appreciated. They should be sent to:

Regulatory Services Department  
UL  
333 Pfingsten Road  
Northbrook, IL 60062  
[ulregulatoryservices@ul.com](mailto:ulregulatoryservices@ul.com)  
800-595-9844

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# INTRODUCTION

## USE OF THIS GUIDE

This guide is intended to assist regulatory authorities, designers, and installers in determining the suitability of panelboards in a particular installation and use, and to address concerns related to fire, shock, and mechanical hazards.

Products are Listed or Classified by UL under an appropriate product category. A four-letter code (shown in parenthesis) following every category title in this guide is the UL product category code designation.

Each UL product category code provides a direct link to the Guide Information for the product category. The Guide Information includes the scope of the products covered, information relating to limitations or special conditions applying to the product, the requirements used for the investigation of the products, installation and use information, and information on product markings and the UL Mark to be used on the product. Additional information on marking requirements can be found in the guide information for Panelboards (QEUY) and Modular Panelboards (QFOF), which is located in the UL White Book and online at [www.ul.com/database](http://www.ul.com/database).

The product markings identified in this guide do not include every possible marking that could be provided either on a product or in its installation or operation instructions. The purpose of these markings is to provide you with an indication of the type of text and location of markings that address features that may be critical in determining if a product is certified and / or if it is installed correctly. Refer to the specific Guide Information for the product category for additional marking information.

The numbering for code sections used in this document may change as the specific code is updated.

Additional information can be found at [www.ul.com](http://www.ul.com).

## INFORMATION ON LISTING VERSUS CLASSIFICATION

Most codes and regulations require the certification of power distribution equipment to applicable safety-related standards. They also may require this equipment to be certified to energy performance standards as well. Products that are certified to safety-related standards have been evaluated with regard to all reasonably foreseeable safety-related hazards, including fire, electrical shock and mechanical hazards. Such products are termed “UL Certified” or “UL Listed.” Products that are certified to a limited range of hazards, or for use under specific conditions are termed “UL Classified.”

It is important to distinguish the difference between “UL Certified” or “UL Listed” and “UL Classified” and the relation these terms have with the term “listed,” as used in various codes. The term “listed” in the codes generally indicates that the product is required to be evaluated in accordance with the appropriate standard(s) by an independent third party certification organization such as UL. The term “listed” in the codes should not be confused with the term “UL Listed,” as explained above. It is important to recognize that not all certification agencies make this distinction in their certification services.

## INFORMATION ON UL MARKS

There are several types of UL Marks that can be found on power distribution equipment. General information on each of these Marks is provided below. Each has its own specific meaning and significance. The only way to determine if a product has been certified by UL is to look for the UL Mark on the product itself.

The UL Mark on a product means that UL has tested and evaluated representative samples of that product and determined that they meet the requirements in the applicable standard(s). Under a variety of UL programs, certified products are periodically checked by UL at the manufacturing facility to determine that they continue to comply with the standard(s).

The UL Marks may only be used on, or in connection with products certified by UL, and under the terms of a written agreement between the manufacturer and UL.

### UL Listing Mark

This is one of the most common UL Marks. If a product carries this Mark, it means UL found that representative samples of this product met UL's *safety* requirements. These requirements are primarily based on UL's own published Standards for Safety, or other recognized third party standards. The UL Listed Mark includes the UL symbol, the word "Listed," the product or category name, and a control number assigned by UL.




### UL Classification Mark

This Mark appears on representative samples of products that UL has evaluated but only with respect to specific properties, a limited range of hazards, or suitability for use under limited or special conditions. The UL Classified Mark includes the UL symbol, the word "Classified," a statement of the scope of evaluation, the product or category name, and a control number assigned by UL.



## FIELD EVALUATIONS

You may encounter situations in which you are unable to determine if a product has been listed by a third-party organization. Or in other situations you might encounter a product bearing a listing label that may have been modified in the field, and now you question whether or not the product still complies with the applicable standard. UL offers a field evaluation service that provides data to assist you in making your decision whether to accept the product and/or approve the installation. Anyone directly involved with a product – including manufacturers, owners, contractors, and regulatory authorities – can request a Field Evaluation. Detailed information for this program can be found on UL's Web site at [www.ul.com/field](http://www.ul.com/field).

<b>FIELD</b>	No. FE-0000
	<b>EVALUATED</b>
	<b>PRODUCT</b>
Date	Model #
Evaluation of this product limited to those features and characteristics apparent at the installed site.	

## 1. GENERAL INFORMATION

The evidence of Listing is the Listing Mark on the product. The Listing Mark for panelboards includes the name and/or symbol of UL, together with the word “Listed,” a control number, and one of the following product names as appropriate: “Panelboard,” “Enclosed Panelboard,” and “Marine, Enclosed Panelboard For Use on Vessels Over 65 Feet.” The product name may include the wording “Class CTL” or “Suitable for Use as Service Equipment” where appropriate. The product name “Enclosed Panelboard” covers both the panel and enclosure with which it is provided.

The product names for modular panelboards are “Panelboard Module” and “Panelboard Accessory Module.”

The basic Standard used to investigate products in these categories is the Standard for Panelboards, UL 67. In addition, each accessory module in a modular panelboard system is investigated in accordance with the applicable UL Standard.

Panelboard markings may be molded, die-stamped, paint-stenciled, stamped, etched in metal that is permanently secured, or printed on a label secured by adhesive and located so that it will not be covered when the units are installed. Some markings may be located on a wiring diagram in a pocket within the panelboard.

## 2. GLOSSARY

**Ampacity** - The current in amperes a conductor can carry continuously under the conditions of use without exceeding its temperature rating.

**Bonding** - The permanent joining of metallic parts to form an electrical conductive path that ensures electrical continuity and the capacity to conduct safely any current likely to be imposed.

**Bonding Jumper** - A reliable conductor to ensure the required electrical conductivity between metal parts required to be electrically connected.

**Bonding Screw** - A screw that is used as a bonding jumper.

**Cabinet** - An enclosure designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.

**Cartridge Fuse** - A fuse consisting of a current-responsive element inside a fuse body with contacts on both ends.

**Circuit Breaker** - A device designed to open and close a circuit by nonautomatic means, and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating.

**Class CTL Panelboard** - A panelboard that has physical means to prevent the installation of more than 42 overcurrent devices, or if fewer than 42, that number for which the panelboard was

designed and rated. Note - When properly installed, Class CTL panelboards will comply with the Lighting and Appliance Branch-Circuit Panelboard requirements in previous editions of the National Electrical Code.

**Continuous Duty** - Operation at a substantially constant load for an indefinitely long time.

**Current-Limiting Device (AC)** - An overcurrent protective device that, when interrupting currents in its current-limiting range, will reduce the current flowing in the faulted circuit to a magnitude substantially less than that obtainable in the same circuit if the device were replaced with a solid conductor having a comparable impedance.

**Current Rating** - The designated maximum direct or alternating current in rms A at rated frequency that a device can carry continuously under specified conditions.

**Cutout Box** - An enclosure designed for surface mounting that has swinging doors or covers secured directly to and telescoping with the walls of the box proper.

**Device** - A unit of an electrical system that is intended to carry or control, but not utilize, electrical energy.

**Enclosed Panelboard** - An assembly of buses and connections, overcurrent devices, and control apparatus with or without switches, or other equipment, installed in a suitable cabinet, cutout box, or enclosure suitable for a panelboard application.

**Enclosure** - A surrounding case constructed to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection to the enclosed equipment against specified environmental conditions.

**Filler Plate** - A plate intended to close an opening that would otherwise be closed by the subsequent installation of a circuit breaker or other device.

**Flush-Mounted (Type)** - A device designed to be set into and secured to a flat surface, with a minimal front projection.

**Frame Size** - A term applied to a group of molded case circuit breakers of similar physical configuration. Frame size is expressed in amperes and corresponds to the largest ampere rating available in the group. The same frame size designation may be applied to more than one group of circuit breakers.

**Fuse** - A non-resettable protective device which opens a circuit during specified overcurrent conditions by means of a current responsive element or elements.

**Fuse Clips** - The contacts of the fuseholder that support the fuse and connect the fuse terminals with the circuit.

**Fusible Switch** - A switch in which one or more poles have a fuse in series in a composite unit.

**Fuseholder** - An assembly of a base, fuse clips, and necessary insulation for the mounting and

connecting of a fuse into a circuit.

**Ground-Fault Protection of Equipment** - A system intended to provide protection of equipment from damaging line-to-ground fault currents by operating to cause a disconnecting means to open all ungrounded conductors of the faulted circuit. This protection is provided at current levels less than those required to protect conductors from damage through the operation of a supply circuit overcurrent device.

**Grounded Conductor** - A system or circuit conductor that is intentionally grounded.

**$I^2t$  (Ampere Squared Seconds)** - An expression related to the circuit energy as a result of current flow. The " $I^2$ " stands for the square of the effective (rms) let-through current and the "t" stands for the time of current flow in seconds. " $I^2t$ " is a common expression for the circuit energy between the initiation of the fault current and the clearing of the circuit.

**Interrupting Rating** - The highest current at rated voltage that a device is intended to interrupt under standard test conditions.

**Knockout** - A portion of the wall of an enclosure so fashioned that it is capable of being readily removed by a hammer, screw driver, and pliers at the time of installation in order to provide an opening or hole for the attachment of a raceway, cable, or fitting.

**Lighting and Appliance Branch Circuit Panelboard** - A lighting and appliance branch circuit panelboard is one having more than 10 percent of its overcurrent devices protecting lighting and appliance branch circuits. Such circuits have a connection to the neutral of the panelboard and overcurrent protection of 30 A or less in one or more conductors.

**Mains (Main Terminals)** - The terminals, or main device, provided for the connection of the main incoming line conductors.

**Neutral (Assembly); Solid Neutral** - An assembly consisting of enough terminals to provide for the connection of the grounded (neutral) line and load conductors. When used as a component of service equipment, the neutral also includes the following: a) a means for making the required bonding connection between the neutral and the enclosure; and b) a terminal for the grounding electrode conductor.

**Neutral Conductor** - A conductor that is connected to the midpoint of a three-wire single-phase system, the center point of a wye-connected three-phase system, or the midpoint of one side of a delta-connected three-phase system. Note: The neutral conductor is the grounded conductor.

**Overcurrent Protective Device** - An individual fuse or circuit breaker pole.

**Panelboard** - A single panel or a group of panel units designed for assembly in the form of a single panel; includes buses, automatic overcurrent devices, and may be equipped with 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 or partition and accessible only from the front.

**Plug Fuse** - A screw-in type fuse for use in an Edison base type fuseholder.

**Power Panelboard** - A power panelboard is one having 10 percent or fewer of its overcurrent devices protecting lighting and appliance branch circuits.

**Pressure Wire Connector** - A reusable connector into which the conductor (wire) is secured by mechanical pressure applied by an integral screw, cone, or other mechanical parts.

**Pullout Switch** - A switch, enclosed or nonenclosed, that is operated to open a circuit by manually separating the movable contact from the stationary contact, and is operated to close a circuit by manually reconnecting the movable contact and the stationary contact.

**Service** - The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

**Service Equipment** - The necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s), and their accessories, connected to the load end of service conductors to a building or other structure, or an otherwise designated area, and intended to constitute the main control and cutoff of the supply.

**Short-Circuit-Current Rating** - The maximum rms available current to which a device can be connected. The rating is expressed in amperes and volts.

**Switch** - A device, manually operated, unless otherwise designated, for opening and closing or for changing the connection of a circuit.

**Symmetrical Current** - Alternating current having no offset or transient component and, therefore, having a wave form essentially symmetrical about the zero axis. Symmetrical current is expressed in terms of rms A.

### 3. MANUFACTURER'S IDENTIFICATION

If there is a question on the design or construction of a panelboard, the identification of the organization responsible for the product is important. This is one of the basic markings required by Section 110.21 of the National Electrical Code® (NEC).

For manufacturers who produce panelboards at more than one factory, UL also requires a distinctive marking to identify the factory at which the panelboard was made. This information is generally found on the UL Listing label. It enables the manufacturer to pinpoint problems and take immediate action.

UL requires the manufacturer's identification be visible without disturbing interior parts and factory or field installed wiring. Whether the marking appears on an inside wall of the enclosure or on the side of a barrier, the manufacturer's identification must be located near the front edge of the box or barrier.

### 4. CATALOG DESIGNATION

Panelboards are marked with a catalog number, a general type designation, or other distinctive marking identifying the particular panelboard construction. Additional designations are provided on modular panelboards.

## 5. ELECTRICAL RATING

UL requires that the basic electrical rating markings be visible without disturbing wiring or other interior parts. Electrical rating information includes voltage and ampere ratings. For alternating current ratings, the information includes the number of phases, if other than single phase, and the frequency, if other than 50 or 60 hertz.

## 6. VOLTAGE RATING

The basic voltage rating markings must be visible without disturbing wiring and other interior parts. A panelboard designed and intended for use only on a supply circuit involving two different potentials (for example, 120/240 volts, three-wire; or 208Y/120 volts, three-phase, four-wire) is so marked.

In many cases, however, the basic voltage rating marking — for example, 480 volts, 3-phase — indicates that the panelboard is suitable for various supply systems (such as 208Y/120 volts, 3-phase, 4-wire; 120/240 volts, 3-wire; 240/120 volts, 3-phase, 4-wire delta, etc.). These voltage ratings may be shown on a wiring diagram affixed to the panelboard or its enclosure.

A single-phase, 3-wire panelboard is not permitted to be marked with a 120/240 volt, 3-phase, 4-wire delta rating. 3-wire panelboards should not be used for this system. The use of a delta breaker to adapt a 3-wire panelboard to the system has been prohibited by Section 408.36(C) of the NEC.

Although delta breakers could be used properly in 3-wire, split-bus panelboards, they were being misused in 3-wire panelboards with a single main disconnect.

Misusing delta breakers in this manner allows voltage to backfeed through the delta breaker load when the panelboard main disconnect is opened. This allows voltage to be present on the main bus bars when none is expected.

## 7. CURRENT RATING

The current rating of a panelboard is the maximum continuous current that can be supplied through the main terminals.

Unless the assembly, including the overcurrent device(s), are marked for use at 100 percent of their current rating, overcurrent protection devices should not be loaded continuously to more than 80 percent of their rating if nuisance opening of the overcurrent device is to be avoided.

The current rating of a panelboard may be supplemented by one or more reduced ratings, each applicable under specified conditions.

For example, a manufacturer may wish to provide terminals suitable for both copper or aluminum wire but space in the panelboard may not be sufficient for terminals and wire bending space. In this case, the ampere rating is reduced to compensate for the size of aluminum wire that can be used. Sometimes there is a need for a lighting and appliance panelboard with a main circuit breaker to have a current rating less than the normally required rating of the panelboard. In this case, the marked current rating is followed by the words "Maximum — See main circuit breaker rating." This does not apply to panelboards having a main fused switch. Such panelboards are not provided with fuses when stocked. Lower rated fuses within the same case size, however, can be installed later.

A lighting and appliance panelboard marked as suitable for use as service equipment is limited to two main disconnects. To prevent overloading, the current rating of such panelboards shall equal the combined current ratings of the two disconnects as required by Section 408.36(A) of the NEC (2005 Edition) or Section 408.36, Exception 2 (2011 Edition). Where main disconnects are not provided with the panelboard, the NEC requires that main overcurrent protection be provided in the feeder circuit supplying the panelboard.

If the ampacities of the ungrounded (main) bus bars and the grounded (neutral) bus bars are not identical, the current rating markings of the panelboard are required to show the ampacity of each bus bar.

While it is unusual for the phase bars to be of different ampacities, the neutral can be a reduced size according to Section 220.61 of the *NEC*.

Because neutrals are often fabricated from connector bars with unusual shapes, in most cases it is not possible to judge ampacity from physical dimensions. UL conducts a temperature test on the assembly to determine ampacity.

If a panelboard employs a snap switch rated 30 amperes or less in any branch circuit, it cannot be rated more than 200 amperes unless there is a supply side overcurrent protection at 200 amperes or less within the panelboard. This requirement assumes that panelboards rated 200 amperes or less will be installed with overcurrent protection in accordance with Section 408.36(A) of the *NEC*.

Section 408.36(A) of the *NEC* was adopted years ago when snap switch panelboards were common and short circuit problems were caused by small electrical spacings between live parts and the ground within snap switches. It should be noted that this Section does not apply to snap switches rated over 30 amperes or to switches or circuit breakers that have larger electrical spacings and are suitable for use as service disconnects.

## **8. SHORT-CIRCUIT CURRENT RATINGS**

A panelboard is required to be marked with the phrase "Short-Circuit Current Rating" and the rating in rms symmetrical amperes. This phrase indicates that (1) that the overcurrent devices are capable of opening the circuit under fault conditions; and (2) the panelboard bus structure will withstand the magnetic forces generated by fault current passing through it. These markings are provided to ensure proper installation with respect to Section 110.10 of the *NEC*.

Also, switches and circuit breakers under switching operations must be capable of closing in on a fault of the magnitude indicated. In addition, they must open satisfactorily on lesser faults of such

magnitude that the opening of the overcurrent feature is delayed.

The letters “rms” stand for root-mean-square. This is the value that would be read on an ordinary ammeter. The marked short circuit current rating on the panelboard is the steady-state value of the fault current the panelboard can withstand without extensive damage.

Since the ability of an overcurrent protection device to open on fault currents is affected by the voltage rating of the circuit, a panelboard may have several short-circuit current ratings, each associated with a specific voltage rating.

Panelboards that contain watt-hour meter sockets other than those intended for use with current transformers are additionally marked with the phrase “Watt-hour meter not included in the short-circuit current rating” since the meters are not evaluated during the performance of the short-circuit current test.

Many panelboards are designed to accept various types of circuit breakers or fused switches with different interrupting ratings. Some of these ratings may be less than the panelboard ratings. Panelboards are required to be marked to indicate that the short-circuit current rating is limited to the lowest interrupting capacity of any device installed in the panelboard.

Some panelboards may be marked to indicate one or more short-circuit current ratings which are dependent on the use of specific integral or remote main overcurrent protective devices. An example of such a marking is: “When protected by \_\_\_\_\_ ampere maximum Class \_\_\_\_\_ fuse or (Manufacturer’s name and type designation) circuit breaker rated not more than \_\_\_\_\_ amperes, this panelboard is suitable for use on a circuit capable of delivering not more than \_\_\_\_\_ rms symmetrical amperes, \_\_\_\_\_ volts maximum,” or an equivalent statement.

Some panelboards are marked for installation of circuit breakers having a lower interrupting rating than the panelboard short-circuit-current rating. The circuit breakers are acceptable for use above their marked interrupting rating if used on the load side of a specific overcurrent device. In such cases, the panelboard is marked as follows (the blank spaces would be filled with the appropriate information):

1. The short-circuit current rating of this panelboard is equal to the lowest interrupting rating of any installed circuit breaker or fused switch, but not more than \_\_\_\_\_ rms symmetrical amperes at \_\_\_\_\_ volts, 3-phase, or \_\_\_\_\_ rms symmetrical amperes at \_\_\_\_\_ volts, single-phase; and
2. The interrupting rating of a circuit breaker is 5,000 rms symmetrical amperes and for a fused switch is 10,000 rms symmetrical amperes, or as marked on the device, except for the following series combination ratings:

<b>Load Side Circuit Breakers</b>	<b>Line Side Circuit Breakers</b>	<b>Interrupting Rating</b>
Mfr. Type Poles Amp Rating	Mfr. Type Amp Rating	Symmet. Amp rms Volts ac Phases
<b>Load Side Circuit Breakers</b>	<b>Line Side Circuit Breakers</b>	<b>Interrupting Rating</b>

A load side circuit breaker may be a branch, sub-main, or an integral main used on the load side of a remote main. A line side circuit breaker or fused switch may be a sub-main, integral main, or a remote main. This series combination interrupting rating shall not exceed that of the line side circuit breaker or fused switch.

There are other markings that identify special conditions when a short-circuit current rating is applicable. These markings must be followed whenever overcurrent devices are added or replaced.

## **9. SUITABLE FOR USE AS SERVICE EQUIPMENT**

These are the basic requirements that a panelboard rated 600 volts or less must meet in order to be used as service equipment:

- A. Service disconnecting means must be provided.
- B. Each service disconnect provided must have a switching feature that disconnects all conductors from the service-entrance conductors and that is suitable for use as a service disconnect. There is one exception: the neutral service conductor can be disconnected by removing the wires from the pressure wire connectors on the service neutral bus as noted in Section 230.75 of the *NEC*.

In general, snap, toggle or similar switches, are not acceptable because their internal electrical spacings are too small. The exception in Section 225.36 of the *NEC* for branch circuit switches used to disconnect garages and out buildings on residential property does not apply to the service disconnects in a panelboard.

Circuit breakers, either molded case, fused, or in combination with ground fault circuit interrupters, are suitable for use as service disconnects. Other devices that are used to protect individual circuits, circuits within equipment or appliances, or circuit protectors without on and off features, are not suitable for use as service disconnects.

The removal of a plug or cartridge fuse from its fuseholder, while serving to de-energize the circuit, does not provide service disconnection. Panelboard switches, pullout switches and some industrial control switches are suitable as service disconnects. Note that pullout switches, while they serve as a fuse puller, do have switchblades and contact jaws and are tested as switches.

- C. Overcurrent protection suitable as branch or feeder protection must be provided for service conductors. Miscellaneous, miniature and micro fuses, thermal cutouts, relays and other supplementary overcurrent protection are not acceptable.
- D. The number of service disconnects and overcurrent devices must conform to the *NEC*, Section 230.71.
- E. As required in Section 230.95 of the *NEC*, Panelboards rated for use on solidly grounded wye electrical services of more than 150 volts to ground must provide ground fault protection for each service disconnect rated 1000 amperes, or more. An exception is covered under

## Item 53.

- F. There must be provision for connecting a grounded service conductor and a grounding-electrode conductor. If there is a neutral bus, a means to bond the panelboard enclosure or mounting pan to the neutral bus is required unless the bus is mounted in electrical contact with the enclosure or pan.

In general, the grounding-electrode connection in service equipment is required to be made to the grounded service conductor at the neutral bar. However, Section 250.24(A)(4) of the NEC permits this connection to be made to the equipment grounding terminal bar, provided the main bonding jumper is a wire or a bus bar and is installed from the neutral bar to the equipment grounding terminal bar. If in a panelboard suitable for use as service equipment, the main bonding jumper wire or bus bar is provided for field installation, instructions are marked on the panelboard for proper installation of the jumper.

A panelboard with the neutral insulated from the enclosure may be marked “Suitable for use as service equipment when not more than six main disconnecting means are provided” when the following conditions are met:

- A. There must be at least one combination of switching units that can be mounted to occupy all available space for switching units; and, whether by using handle ties or similar devices, not more than six main disconnects will result (including factory-installed disconnects).
- B. With this combination of switching units, no more than six overcurrent-protective devices will be connected to each ungrounded service conductor.

Note that a panelboard marked “Suitable for use as service equipment when not more than six main disconnecting means are provided” may permit some combinations of switching units varying in ampere ratings and physical size that would exceed the six disconnect rule on a completely filled panelboard. The six disconnect rule can be exceeded if handle-ties are not installed where needed.

Panelboards marked as noted above and used as service equipment must have the neutral bonded to the enclosure as required by Section 408.3(C) of the *NEC*. These panelboards are provided with means to accomplish this bonding. When the panelboard is not used as service equipment, the neutral bonding means must not be installed. This would violate Section 250.24(A)(5) of the *NEC* and would constitute a fire hazard as noted in Item 50 of this Marking Guide.

A panelboard with the neutral factory-bonded to the enclosure is marked “Suitable only for use as service equipment. Install no more than six main disconnecting means.”

Some panelboards may have the required number of handles and service overcurrent devices, when the maximum number of the smallest units are installed and used without handles ties or similar devices. These panelboards may have the shorter marking “Suitable for use as service equipment” or “Suitable only for use as service equipment.”

Class CTL lighting and appliance panelboards without main overcurrent protection usually are not marked suitable for service equipment use. Such panelboards, with not more than 10 percent of

their overcurrent devices rated 30 amperes or less, however, may be suitable for use as service equipment. They are marked "Suitable for use as service equipment when not more than six main disconnecting means are provided and when not used as a lighting and appliance branch-circuit panelboard; see Section 408.34 of the 2005 NEC."

A panelboard intended for service equipment use must have the marking "Service Disconnects" near the switch or circuit breaker handles. If this is not done in the factory, pressure sensitive labels must be provided. This marking identifies the service disconnects when branch disconnects are also present. This is required by Section 230.70(B) of the NEC.

## **10. CABINETS AND ENCLOSURES**

Panelboards are installed in cabinets, cutout boxes, or within compartments of other equipment, such as deadfront switchboards. Some panelboards are shipped from the factory in an enclosure designed for their use. When they are, the manufacturer is permitted to place the UL Listing Mark "Enclosed Panelboard" with or without additional modifying phrases on the assembly or use a "Panelboard" Listing Mark with or without additional modifying phrases with an "Electric Cabinet Box" Listing Mark and an "Electric Cabinet Front" Listing Mark.

Except for the panelboards intended for service equipment use discussed in Item 27, it is the responsibility of the installer to match a panelboard with an enclosure that is suitable in size and construction. The enclosure must meet the requirements of the NEC including wiring space, wire bending space, and environmental conditions.

Because of the importance of grounding and bonding at service locations, UL requires that a panelboard marked as suitable for use as service equipment be identified with a particular box. Unless the panelboard cannot readily be removed from the box in which it is shipped from the factory, UL also requires that the panelboard marking identify the box or boxes with which it is intended to be used.

The suitability of an enclosure for environmental conditions for which it has been investigated is indicated by an enclosure type designation. One or more of the type designations indicated on the following pages are marked inside or outside the panelboard enclosure. This marking helps inspection authorities to judge whether an enclosure is suitable for a specific environment as mentioned in Section 110.3(A)(1) of the NEC. Enclosure type designations are coordinated with requirements in Section 110.28 of the NEC.

**\*See page 15 for Enclosure Types.**

An enclosed panelboard marked with an enclosure designation of Type 3, 3S, 4, 4X, 6 or 6P may additionally be marked "Raintight" or "Rainproof." An enclosed panelboard marked with an enclosure designation of Type 3R may additionally be marked "Rainproof."

Some enclosed panelboards have a semi-flush enclosure which has a flange extending from the sidewalls. This type of enclosure is intended to be mounted such that the front portion of the enclosure projects out of the wall and the rear portion extends within the wall in which it is mounted. These panelboards are marked with instructions regarding the proper overlap or flashing to be provided in the installation.

For some panelboards, it is intended that unused openings in the enclosure be closed by filler plates. These panelboards are marked with the catalog number of the filler plates to be used, and the manufacturer is required to have the plates available. Use of the filler plates facilitates compliance with Sections 110.12(A) and 408.7 of the NEC, which requires unused openings in cabinets, equipment housings, etc., to be effectively closed.

## 11. ENCLOSURE TYPES

Type	Number Intended Use and Description
1	Indoor use primarily to provide a degree of protection against limited amounts of falling dirt.
2	Indoor use primarily to provide a degree of protection against limited amounts of falling water and dirt.
3	Outdoor use primarily to provide a degree of protection against windblown dust, rain, sleet and damage from external ice formation.
3R	Outdoor use primarily to provide a degree of protection against rain, sleet and damage from external ice formation.
3S	Outdoor use primarily to provide a degree of protection against windblown dust, rain and sleet; external mechanisms remain operable while ice laden.
4	Indoor or outdoor use primarily to provide a degree of protection against splashing water, windblown dust and rain, hose-directed water, and damage from external ice formation.
4X	Indoor or outdoor use primarily to provide a degree of protection against splashing water, corrosion, windblown dust and rain, hose-directed water, and damage from external ice formation.
5	Indoor use primarily to provide a degree of protection against settling airborne dust, falling dirt and dripping non-corrosive liquids.
6	Indoor or outdoor use primarily to provide a degree of protection against hose-directed water, the entry of water during occasional temporary submersion at a limited depth, and damage from external ice formation.
6P	Indoor or outdoor use primarily to provide a degree of protection against hose-directed water, the entry of water during prolonged submersion at a limited depth, and damage from external ice formation.
12, 12K	Indoor use primarily to provide a degree of protection against circulating dust, falling dirt and dripping non-corrosive liquids.
13	Indoor use primarily to provide a degree of protection against dust and spraying of water, oil and non-corrosive coolants.

## **12. PANELBOARDS WITH OVER 42 OVERCURRENT PROTECTIVE DEVICES - OPTIONAL MARKING**

A marking may be applied by the manufacturer to indicate compliance with Section 408.34 of the 2005 NEC. This marking indicates that “Lighting or appliance branch circuits are not to be supplied directly through more than 10 percent of the branch circuit overcurrent protective devices.”

If applied, this marking is required to be readily visible after the panelboard has been installed and is intended to alert the installer and inspection authorities that the panelboard does not meet the requirements for lighting and appliance panelboards as described in the 2005 NEC.

## **13. COPPER OR ALUMINUM WIRING**

Panelboards intended for use with aluminum wire require special consideration. First, panelboard wire connectors must be recognized for use with aluminum wire. Second, the size of the enclosure must be increased because aluminum wire is larger than copper wire of the same ampacity. This requires more cross sectional area for the wiring gutters and more wire bending space at terminals and where wires enter the enclosure. Third, the larger wiring terminals may make it necessary to check through-air electrical spacings between adjacent terminals of opposite polarity.

Because of these considerations, UL requires the wiring diagram or nameplate to be marked to indicate the use of copper and/or aluminum wire if the symbol “AL” appears on any part that is intended for use in the panelboard. It may be necessary to remove a cover, front or trim to see the marking.

If the panelboard has not been evaluated for use with aluminum wire, the marking will read “Use Copper Wire Only.”

If the wiring terminals and other factors have been evaluated for use with copper and aluminum wire, the panelboard is required to be marked “Use Copper or Aluminum Wire.”

If only some terminals have been evaluated for use with aluminum and copper wire with the remainder acceptable for use with copper wire only, the panelboard is required to be marked “Use copper wire only, except at terminals...” Variations of this marking are also permitted if the terminals that have been evaluated for use with aluminum wire are identified.

## **14. TEMPERATURE RATING OF INSTALLED CONDUCTORS**

In general, the testing and construction of panelboards are based on the use of 60°C ampacities for wire size Nos. 14–1 AWG and 75°C ampacities for wire size Nos. 1/0 AWG and larger, taken from Table 310.15(B)(16) of the NEC, with no adjustment made for correction factors. Panelboards are marked to indicate temperature ratings and sizes of conductors that can be used.

If the equipment is normally intended for wire sizes within the range 14–1 AWG but is marked 75 °C only or 60/ 75 °C, it means that the 75 °C wire may be used at full 75 °C ampacity.

Higher temperature rated conductors than specified may be used if the size is based on the

preceding statements. When the connection is made to a circuit breaker or switch unit within the equipment, such a unit must also be marked for the temperature rating of the conductor.

Single-phase, 3-wire panelboards may be marked for use with reduced wire sizes as indicated in Section 310.15(B)(7) and Table 310.15(B)(7) of the NEC, when installed as residential service equipment.

A panelboard not having facilities for the normal size wire may have an ampere rating that is based solely on use in accordance with the requirement. In this case, the panelboard must be marked to indicate that the rating is applicable only if the panelboard is installed as single-phase, 3-wire residential service equipment. For example, a panelboard rated “200 ampere maximum— see main circuit rating” could be designed for an enclosure that provides 6 inches of wire bending space suitable for 2/0 AWG in accordance with Table 312.6(B) of the *NEC*. The panelboard would then have to be marked to indicate that the 200 ampere rating applies only if the panelboard is installed as single-phase, 3-wire residential service equipment. With a 175 ampere or smaller main breaker installed, the panelboard could be installed elsewhere since bending space would be adequate for the wire sizes required by Table 310.15(B)(16).

## 15. FIELD INSTALLED UNITS OR EQUIPMENT

A panelboard to which a unit, such as a circuit breaker, switch, or the like, may be added in the field is required to be marked to identify the units that can be added. Units made by different manufacturers or of a different style are not identical in all details and therefore may not be interchangeable.

The only exception is for Classified molded-case circuit breakers rated 15 to 60 A, 120/240 V ac, that have been investigated and found suitable for use in place of other Listed circuit breakers in specific Listed panelboards. These breakers are limited for use with panelboards rated 225 A or less, 120/240 V ac. The circuit breakers are Classified for use in specific panelboards in accordance with the details described on the circuit breaker, or in the publication provided therewith. These breakers are suitable for use in equipment connected to circuits having a maximum available system short-circuit current of 10 kA.

Plug-in clips and blades must be matched if poor connections and overheating are to be avoided. Additionally, over-surface and through-air electrical spacings, between live parts of opposite polarity and to grounded metal, often depend on the proper mating of units and the bases into which they are plugged or bolted.

Panelboards are usually provided with the required main line and neutral terminals. The overcurrent protection units are furnished with required load terminals. However, if the pressure wire connectors are not provided on the panelboard when shipped, the panelboard is required to be marked stating which pressure wire connectors or component terminal kits are acceptable for use with the panelboard.

A main terminal kit consisting of individual wire connectors or an assembly of terminals, bus connectors and means for bolting or plugging, is required to be marked with the manufacturer's identification and catalog designation. If this is not done, the carton is required to be marked. A separate feed-through terminal kit requires similar marking and, if a separate enclosure is required for its use, this too must be marked and provided with instructions for its use.

If a panelboard is intended to be used in a certain box or boxes and neutral terminals are mounted in that box, both the panelboard and the box are required to be marked. These markings must indicate that each shall be used with the other unless the panelboard and box are shipped together from the factory. Some column type panelboards have the neutrals mounted in a separately listed junction box. In this case, correlating markings on each device are required.

Some panelboards have multiple voltage ratings, some of which require the use of a neutral while others do not. In this case, the neutral is not required to be mounted in place at the factory. Markings on the neutral assembly and panelboard, however, are required to correlate the two devices and provide instructions for installing the neutral.

A panelboard that has space for the installation of additional branch circuit switches, circuit breakers or fuseholders may be shipped from the factory without the necessary branch-circuit bus bars. In this case, the panelboard must be marked to indicate the catalog number or the equivalent of the bus bar kit that is to be used when the unit is installed.

A panelboard supplied with branch-circuit bus bars for adding a branch-circuit unit is required to be marked on a wiring diagram, on the branch-circuit bus bar or in some other location. This marking indicates the ampacity of the bus bar, unless its ampacity is equal to or greater than the maximum current rating of any unit to be connected to the panelboard.

Markings on panelboards that employ plug-in units require the use of a hold-down kit when the units are back-fed and field installed supply conductors are terminated on the plug-in unit. The marking indicates: "Back-fed \_\_\_\_\_ requires hold-down kit Cat. No. \_\_\_\_\_ " or the equivalent. An identification of the applicable back-fed unit is specified in the first blank - for example, circuit breaker, fused switch, or terminal kit; and the catalog number of the required hold-down kit is specified in the second blank.

## **16. MODULAR PANELBOARDS**

A modular panelboard system includes the following types of modules: an enclosed panelboard or a column- type panelboard, and one or more accessory modules such as termination boxes, enclosed switches, or circuit breaker enclosures. Each module of the system has one or more openings in one or more sides of the enclosure for bus bar connections, or terminals for field wiring connections to other related modules. Typical applications for these modular systems include apartment houses and strip malls. Panelboard modules used in these modular panelboard systems are labeled "Panelboard Module" and all other system modules are labeled "Panelboard Accessory Module."

A panelboard module to which another panelboard accessory module — such as a termination box, enclosed switch, circuit breaker enclosure or the like — may be added in the field is required to be marked to identify the panelboard accessory modules that can be added unless the entire modular panelboard system is marked with a common series designation. In this case, the series designation is marked on the panelboard module and each panelboard accessory module.

## 17. CLASS CTL PANELBOARDS

Section 408.34 of the 2005 *NEC* defines a lighting and appliance panelboard as a panelboard having more than 10 percent of its overcurrent devices rated 30 amperes or less, for which neutral connections are provided. Once a panelboard is classified as a lighting and appliance branch-circuit panelboard, certain limitations are placed on the number of overcurrent devices that may be installed.

Section 408.35 of the 2005 *NEC* states that physical means shall be provided to prevent the installation of more overcurrent devices than the number for which the panelboard was designed, rated and approved. In no case shall the number exceed 42 (other than those provided for in the mains) in any one cabinet or cutout box. This has the effect of limiting the number of circuits in a lighting and appliance branch-circuit panelboard.

Using this concept, UL adopted the term “Class CTL” (a contraction of “Circuit Limiting”) to help electrical inspectors approve installations of lighting and appliance panelboards. Panelboards classified as lighting and appliance branch-circuit panelboards may be marked “Class CTL Panelboard” before they leave the factory.

Some panelboards that have more than 42 branch- circuit overcurrent protective devices and neutral terminals have space for field installation of extra units. This could mean more than 10 percent of the overcurrent devices will be rated 30 amperes or less when the panelboard is completely filled. In order to prevent misapplications, specific markings are permitted on panelboards of this design. See Item 30 for details.

If more than one size unit is intended for use in a lighting and appliance branch-circuit panelboard (such as a full-size and half-size circuit breaker), the smaller unit is required to be marked “Class CTL” or “CTL.” The larger may also be so marked.

Since space is limited on these units, the marking may not be visible after the unit is installed. The CTL Unit marking is of significance only in those areas where the older style non-CTL, half-size, twin, and similar units are still available to the installer.

## 18. IDENTIFICATION OF PHASE ARRANGEMENT AND THREE-PHASE, FOUR-WIRE DELTA SYSTEMS

Section 408.3(E) of the *NEC* specifies the required phase arrangement for 3-phase buses. This Section also notes that the B-phase shall be that having the higher voltage to ground on a 4-wire delta system. This Section does allow other busbar arrangements for addition to existing installations so long as the arrangement is marked. Section 110.15 of the *NEC* requires markings to identify the B-phase as the higher voltage to ground on a 4-wire delta connected system when the midpoint of one phase is grounded.

Accordingly, UL requires that panelboards with other than an A-B-C bus bar arrangement be marked to indicate the bus bar arrangement. Also, UL requires that panelboards intended for a 240/120 volt, 3-phase, 4-wire, delta system be marked to identify the different bus bars with reference to the voltage between them. However, if a panelboard is intended for use only on this system, the main bus bar having the higher voltage to ground may be identified by an orange

marking or by tagging. Such a panelboard must be marked to indicate the necessary voltage rating of the device for each branch-circuit position.

B-phase is 208 volts to ground while the A- and C-phases are only 120 volts to ground. Some circuit breakers, like single-pole breakers for use with handle ties rated 120-240 volts, should not be connected to the phase that is 208 volts to ground. Also, fuse holders for plug fuses should not be connected where the voltage to ground exceeds 150 volts.

Generally, the B-phase is used only in conjunction with either the A- or C-phase for a 240 volt single phase branch circuit or with both the A- and C-phase for a 3-phase branch circuit. Circuit breakers or cartridge fuses rated for straight 240 volt systems are suitable for this use.

The NEC requirements in Section 408.3(E) do not cover 3-phase panelboards having two buses and a neutral and intended for use on a 240 volt, 3-phase, 3-wire grounded B phase system. In these panelboards, the neutral is connected to the grounded B-phase. UL requires a phase arrangement of A-, C-, with the neutral as the B-phase.

## **19. FACTORY BONDED NEUTRALS**

Some panelboards are intended only for service equipment use on an AC system requiring grounding of the system (see Items 18-21 under “Suitable for Use as Service Equipment”). These panelboards may have the enclosure bonded to the neutral at the factory. This eliminates the need for a neutral insulating support base.

It is difficult to check for unintentional grounds on the installed building wiring when the neutral is mounted directly on the enclosure. Therefore, some manufacturers provide an insulating liner under the neutral to permit use of a megger or similar resistance measurement instrument. However, this does not provide the electrical spacings required for the neutral if the panelboard is used away from the service as a feeder or branch-circuit panelboard. These panelboards are required to be marked “Bonded Neutral — Remove bonding device for test purposes only” or an equivalent marking.

Most installers recognize the importance of bonding the neutral to the enclosure at the service. Many do not realize, however, that it is just as important to omit the bonding and provide a fully insulated neutral when the panelboard is used in non-service applications

If neutrals are bonded at distribution points on the load side of the service disconnecting means, the neutral currents take parallel paths through neutral conductors and the grounding conductor (which may include metal raceways). If neutral conductors open, the full neutral current flows over the grounding conductor system (which may include metal raceways). As a result of this loss of the neutral connection, steel raceway joints and box connections overheat, creating a potential fire hazard.

## **20. EQUIPMENT GROUNDING TERMINAL BAR**

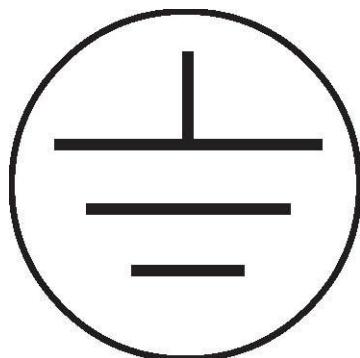
Section 408.40 of the NEC requires the installation and use of a terminal bar for equipment grounding conductors for panelboards used with non-metallic raceway or cable, or where separate equipment grounding conductors are provided. This terminal bar may be installed on the

panelboard or its enclosure. A terminal bar assembly kit must include instructions for installation and panelboard or enclosure markings.

Unless it employs a wire-binding screw, markings must show all acceptable wire sizes and wire combinations for each terminal. A panelboard for use without equipment grounding conductors is not required to provide for a grounding terminal bar. In this case, however, the panelboard must be marked to limit its use to installations in which equipment is grounded by connection to metal raceway or metallic cable sheaths.

The equipment grounding terminal or terminal assembly in a panelboard is identified by one of the following methods:

- The terminal assembly or the heads of the terminal screws being green;
- Marking adjacent to the terminal or on the wiring diagram indicating “Equipment Grounding Terminal” or equivalent wording; or
- Marking of the grounding symbol (see below) adjacent to the terminal or on the wiring diagram along with “Equipment Grounding Terminal” or other words defining the symbol. The symbol may be used without the additional wording if markings provided with the Panelboard define the symbol.



GROUNDING SYMBOL  
(IEC417, Symbol 5019)

## 21. GROUND-FAULT PROTECTION OF EQUIPMENT

In accordance with Section 230.95 of the NEC, a panelboard marked for use as service equipment for 3-phase, 4-wire solidly grounded wye-connected services rated in excess of 150 volts to ground but not exceeding 600 volts phase-to-phase shall be provided with ground-fault protection for each service disconnecting means rated 1000 amperes or more.

Exception No.1 for Section 230.95 of the *NEC* indicates that this does not apply to service disconnects for a continuous industrial process, where a non-orderly shutdown introduces additional or increased fire and shock hazards.

In accordance with this Exception, UL permits a Listed panelboard marked for service equipment use and rated for use on solidly grounded wye-connected electrical services of more than 150 volts to ground to omit ground-fault protection if the panelboard is marked “Suitable For Use As Service Equipment Only When Supplying A Continuous Industrial Process.” This shortened wording is not

intended to circumvent the need for a judgment. Inspectors concerned about the hazards of a non-orderly shutdown decide whether or not ground-fault protection is needed.

In some panelboards, only a shunt trip service disconnect is provided. In this case, the marking on the panelboards gives the manufacturer's name and the catalog number of the ground-fault protection equipment with instructions covering its interconnections.

Panelboards provided with ground-fault protection are required to be marked to indicate the circuit-main, feeder, or branch-circuit that is so protected. If a marking on the ground-fault sensing or relaying equipment is not visible from the front of the panelboard with its cover removed, a separate marking, such as on the wiring diagram, is required.

If a transformer providing control voltage for ground-fault protection is connected to the line side of the main disconnect, this disconnect may be identified as the "main." In this case, the panelboard is required to be marked "Danger — this main does not disconnect control and instrument circuits" adjacent to the main disconnect.

In a panelboard with ground-fault protection, the part of the neutral bus used for load terminations is required to be marked "WARNING — Do not connect grounding conductors to these or any other neutral terminals, to do so will defeat ground-fault protection." This marking must be placed on or adjacent to the neutral.

## **22. MAXIMUM SIZE FUSEHOLDERS OR CIRCUIT BREAKERS**

If the ampacity of a branch bus bar or wire is less than the maximum current rating of any fuse accommodated by a fuseholder it supplies, or if it is less than the current rating of any trip unit (including rating plugs) of an interchangeable trip circuit breaker that it supplies, UL requires a clear and permanent marking, plainly visible when the fuse or trip unit is being replaced. This prevents the use of a fuse, trip unit, or rating plug having more ampacity than a bus bar or wire.

A panelboard with branch-circuit bus bars that permit adding a branch-circuit unit, circuit breaker, switch, or fuseholder requires markings on the wiring diagram, the branch-circuit bus bars, or some other location. Markings indicate the ampacity of the bus. This marking is not required if the ampacity of the bus bar is not less than a) the maximum current rating of any unit to be connected to it; or b) the current rating of the panelboard.

## **23. PANELBOARDS WITH PROVISIONS FOR WATT-HOUR METERS**

Separate meter sockets are required to be marked with a continuous ampere rating. In some cases, meter sockets also may have a maximum use (intermittent) ampere rating of not more than 125 percent of the continuous ampere rating. Similar markings are required for any meter mounting base in a panelboard. The continuous ampere rating may be less than the circuit that contains the meter mounting base. This means that, for example, a 125 ampere panelboard can have a meter mounting base rated "125 Amps (100 Amps Continuous)." Some inspectors may judge that a continuous duty meter socket is not needed because of a panelboard's load diversity. Continuous duty sockets can be required when load and environmental conditions would cause overheating in panelboards.

If the socket jaws of meter mounting bases are mounted on terminals intended for field wiring, the panelboard is required to be marked to indicate the maximum torque to be applied to these terminals.

## 24. CIRCUIT BREAKER TRIP INDICATION

If the handle of a circuit breaker, or a simple extension of that handle, assumes other than the off position when the breaker trips, the trip position of the handle is required to be indicated. The method for resetting the breaker is also a required panelboard marking.

Marking the tripped position is not required for a separate, external operating handle that is not part of the circuit breaker. Such a handle may remain in the on position when the breaker trips. These constructions may be encountered in panelboards Listed for use in hazardous locations where operating springs in the circuit breaker mechanism do not provide sufficient tension to operate external handles.

## 25. WIRING TERMINALS

Section 110.14 of the NEC, states that terminals for more than one conductor must be identified. In all cases, marking is required to identify the combinations and sizes of conductors for each terminal. Marking is not required where conductors in parallel are secured by a single wiring terminal having individual holes and set screws for each conductor.

Where conductors in parallel are secured at a terminal (one connector with one or more barrels or multiple individual wire connectors) of an enclosed panelboard and where the connectors will accommodate more than one combination of conductors (size and number) that will have the required ampacity, the wiring diagram will state the number and size of wires for which the terminal is acceptable unless the wiring space is suitable for all combinations of conductors that have the required ampacity.

Tightening torque is marked for all panelboard terminals (other than wire binding screws) except when installed units have their own marking.

UL requires that an individual terminal be provided for the connection of each branch-circuit neutral conductor and, with one exception, that the number of individual terminals be not less than 75 percent of the total number of individual fuseholder or circuit-breaker poles capable of being installed in the panelboard. Under the exception, the number of terminals may be reduced to 50 percent if the panelboard is marked to indicate the maximum number of circuits and the need to use multipole branch-circuit units to limit the number of terminals to a specified number.

## 26. MAIN OR MAIN DISCONNECT

Except for a panelboard that has the “Service Disconnect(s)” identified, a switch or circuit breaker that controls all load circuits from the panelboard, other than a feed-through circuit, is required to be marked “Main” and no other switching device is permitted to have this marking. If two or more switches or circuit breakers control all load circuits, other than a feed-through circuit, they are required to be marked “Main Disconnect” either on or adjacent to each unit if there are other

switches or circuit breakers in the panelboard.

## **27. WIRE BENDING SPACE**

A panelboard constructed in accordance with Exception No. 3 of Section 408.55 of the NEC is required to be marked by means of a diagram that shows and specifies the method of wiring that shall be used to accomplish the 90-degree bend.

Minimum wire bending space requirements for panelboards rated for use with aluminum conductors are based on the use of compact stranded conductors made from AA-8000 series electrical grade aluminum alloy. See NEC Section 310.106(B).

## **28. ACCESSIBLE ONLY TO QUALIFIED PERSONS**

Section 240.40 of the *NEC* requires a disconnecting means on the supply side of cartridge fuses where the fuses are accessible to other than qualified persons. Section 408.38 requires all panelboards to be deadfront unless they are accessible only to qualified persons. UL requires such panelboards to be marked “This panelboard shall be located where accessible only to qualified persons.”

## **29. INVESTIGATED FOR USE IN OPTIONAL STANDBY SYSTEMS**

Panelboards may be constructed with interlocked switching devices or designed for use with interlock kits that have been investigated for use in optional standby systems in accordance with Article 702 of the NEC. Panelboards shipped with factory installed interlocked switching devices that have been investigated for use in optional standby systems are marked “Suitable for use in accordance with Article 702 of the National Electrical Code ANSI/NFPA 70;” panelboards available for use with field installable assemblies that have been investigated for use in optional standby systems are marked “Suitable for use in accordance with Article 702 of the National Electrical Code ANSI/NFPA 70 when provided with interlock kit Cat. No. \_\_\_\_\_.”

## **30. TAPS**

Some panelboards may have terminals or provisions for terminals, marked as taps, located on the supply side of the service disconnecting means. The suitability of these terminals as taps connected on the supply side of the service disconnect is intended to be determined in accordance with *NEC*® Sections 230.46, 230.82, and 705.12.

Panelboards are not Listed to have their busbars tapped in the field unless there are existing holes in the busbars marked with the word “Tap” adjacent to the holes in the factory. Other holes in the busbar that are not marked with the word “Tap” are intended for the connection of overcurrent devices, other device’s as identified by the product markings and in the installation instructions, or other uses identified by the manufacturer. When the electrical equipment Listing does not include product markings or instructions for tapping busbars, this situation should be treated like any other field modification of Listed equipment.

Some Listed power equipment may have installation instructions with specific directions on tapping the busbars. If this is the case, this equipment can be field modified, following those manufacturer's instructions, in accordance with the National Electrical Code® (NEC) Section 110.3(B). The UL White Book identifies the required markings for field-installed equipment that have been evaluated by UL. For additional information, please see the guide information for Panelboards (QEUY).

Drilling or enlarging holes in busbars can increase the current density and reduce current carrying capacity. Some equipment is constructed with fully rated busbars, which have a typical current density of 1000 A per square inch of cross sectional area for copper and 750 A per square inch of cross sectional area for aluminum. However, some equipment use busbars at a higher current density and have temperature testing conducted to determine compliance with UL's requirements.

Removing busbar material can result in higher operating temperatures, and additional holes can potentially weaken the busbar, which adversely affects the short circuit rating of the equipment required by NEC Section 110.10. Both sufficient wiring space and wire bending space need to be provided for the conductors and the wire connector at the tap connection. In measuring the wiring space, AHJs need to consider the possibility of the connectors rotating, which may result in reduction of the spacing between uninsulated live parts of opposite polarity and uninsulated live parts and ground.

Wire connectors (lugs) need to be Listed for the purpose and have the proper ratings for specific application, and the mounting hardware for wire connectors needs to be properly selected and attached with the correct torque. The potential reduction of required spacings from the wire connectors or fasteners to the enclosure or other busbars also needs to be evaluated. In completing the modification, all foreign material such as cutting oil, burrs and metal shavings needs to be removed from the equipment enclosure. Temporarily removed materials such as insulating barriers need to be returned to their original positions and secured. The above are just a few of the concerns and items that must be inspected, checked and reviewed where such modifications are made to this type equipment.