

What Do the Markings on Circuit Breakers Mean?

by Ed Larsen, P. E.

Have you ever been confused about what the markings on circuit breakers mean? Understanding the markings on electrical equipment is a fundamental need to ensure a safe and reliable electrical installation. Circuit breaker marking requirements are established by the requirements found in the *NEC* and the UL 489 product standard. This article will discuss the most common markings and where they can be found.

The UL 489 product standard for Molded Case Circuit Breakers specifies the information to be marked on circuit breakers and where it is to be located, so let's discuss what information needs to be marked on the circuit breaker and the location where you will find those markings. Keep in mind the UL® standard specifies minimum requirements. Circuit breaker manufacturers may provide additional information or provide information in a more convenient location.

Markings Visible without Removing Trims or Covers

UL 489 requires that some markings be visible without removing trims or covers. This location is typically referred to as the handle escutcheon (see photo 1).

Markings Visible with Trims or Covers Removed

UL 489 requires other markings be visible on an installed circuit breaker with trims or covers removed. This location is typically referred to as the face of the circuit breaker (see photos 2–4).

Other markings which should be visible with trims or covers removed are:

Independent trip – Multi-pole circuit breakers are constructed with either a common trip, where all poles are mechanically tripped when one of the poles trips, or an independent trip construction where only the pole that is involved with the overcurrent condition trips. If a 2-pole circuit breaker does not have an internal com-

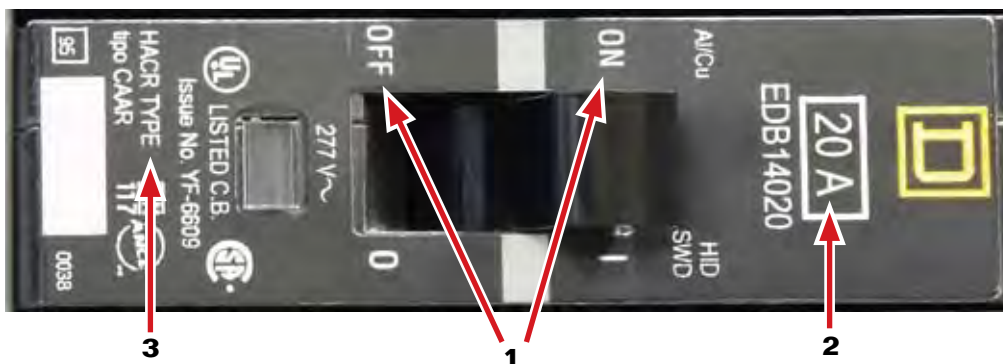


Photo 1. Markings Visible with Trims or Covers in Place

1. ON and OFF – The ON and OFF (closed and open) positions of the handle must be marked (*NEC* 240.81). These positions may also be marked with the internationally recognized “I” and “O” symbols, although this is not a UL requirement. If these markings are not visible when a motor operator is installed over the circuit breaker markings, then they must appear on the motor operator. Motor operators may be found in applications where remote or automatic operation of a circuit breaker is required.

2. Ampere rating (if 100 A or less) – The ampere rating may be located on the handle escutcheon or on the handle itself (*NEC* 240.83(B)). Circuit breakers that are rated more than 100 A may have their ampere rating marked in a position that is not visible with trims or covers in place.

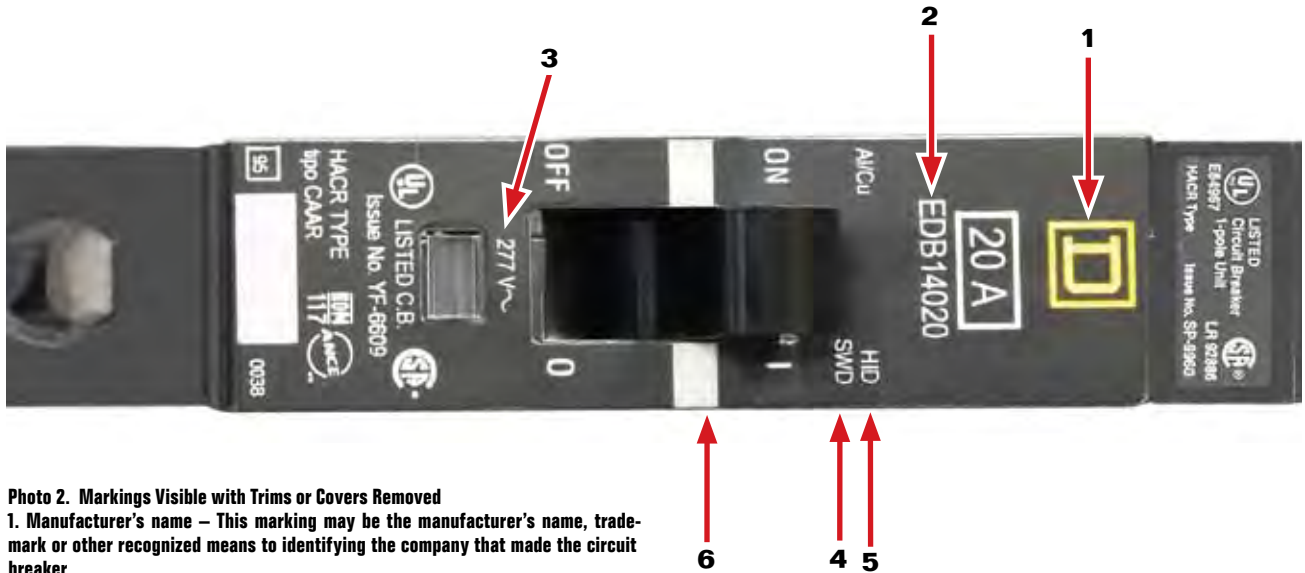


Photo 2. Markings Visible with Trims or Covers Removed

1. **Manufacturer's name** – This marking may be the manufacturer's name, trademark or other recognized means to identifying the company that made the circuit breaker.

2. **Type designation** – All circuit breakers are marked with a type designation, which may be a catalog number prefix or a separate designation. Equipment labels, such as on panelboards, will list the circuit breaker types suitable for use. Note that the word "type" may or may not be used on the circuit breaker or equipment labels. It is important to review the markings on the equipment, such as a panelboard, to make sure the circuit breaker designations on the equipment match the marking on the circuit breaker.

3. **Voltage rating** – All circuit breakers must be marked with a voltage rating. If the rating is not marked "ac" or "dc," then it is suitable for both. 120/240 V rated circuit breakers are suitable for use on single and three-phase 4-wire systems where the line-to-ground voltage does not exceed 120 V. Wye rated circuit breakers such as those rated 480Y/277 V, are suitable for use on three-phase 4-wire systems where the voltage to ground does not exceed 277 V. Special attention needs to be given to high leg or corner-grounded delta systems to insure that the circuit breaker has the appropriate rating. A review to see that the circuit breakers installed have a voltage rating suitable for the application is paramount for a code-compliant installation (NEC 240.83(E)).

mon trip feature, then it must be marked "Independent Trip" or "No Common Trip." NEC 240.20(B) is the foundational requirement for a common trip function in a circuit breaker; however, it also goes on to explain where independent trip is permitted.

For Replacement Use Only not-CTL – The Class CTL (circuit limiting) panelboard has only been in existence for about 25 years, even though the lighting and appliance branch circuit panelboard has been in the NEC for decades. CTL panelboards have a rejection means designed to reject more than the appropriate number of circuit breakers that can be installed in the panel. The marking "For replacement Use Only Not CTL Assemblies" means that the circuit breaker does not have CTL rejection provisions and is intended for replacement in older equipment pre-dating the CTL requirements for circuit breakers and panelboards. Circuit breakers with this designation should not be installed in a panelboard marked "Class CTL Panelboard" since that would be a violation of the listing of the assembly [NEC 110.3(B)].

4. **SWD** – 15- or 20-A circuit breakers rated 347 V or less may be marked "SWD," meaning that they are suitable for switching fluorescent lighting loads on a regular basis (NEC 240.83(D)). These circuit breakers are evaluated for high endurance use, since they will be used similar to a light switch.

5. **HID** – 50 A or less circuit breakers rated 480 V or less may be marked "HID," meaning they are suitable for switching high intensity discharge or fluorescent lighting loads on a regular basis. These circuit breakers may employ a different construction than a standard SWD circuit breaker in order to address the high in-rush current resulting from the lower power factor created by the HID lighting (NEC 240.83(D)). These circuit breakers also undergo additional endurance evaluation to demonstrate their ability to perform the switching duty.

6. **Trip and reset** – Circuit breaker handles typically assume an intermediate position when tripped. This position must either be marked on the circuit breaker or on the equipment into which it is to be installed. If these markings are not visible when a motor operator is installed, then a "tripped" marking may appear on the motor operator.

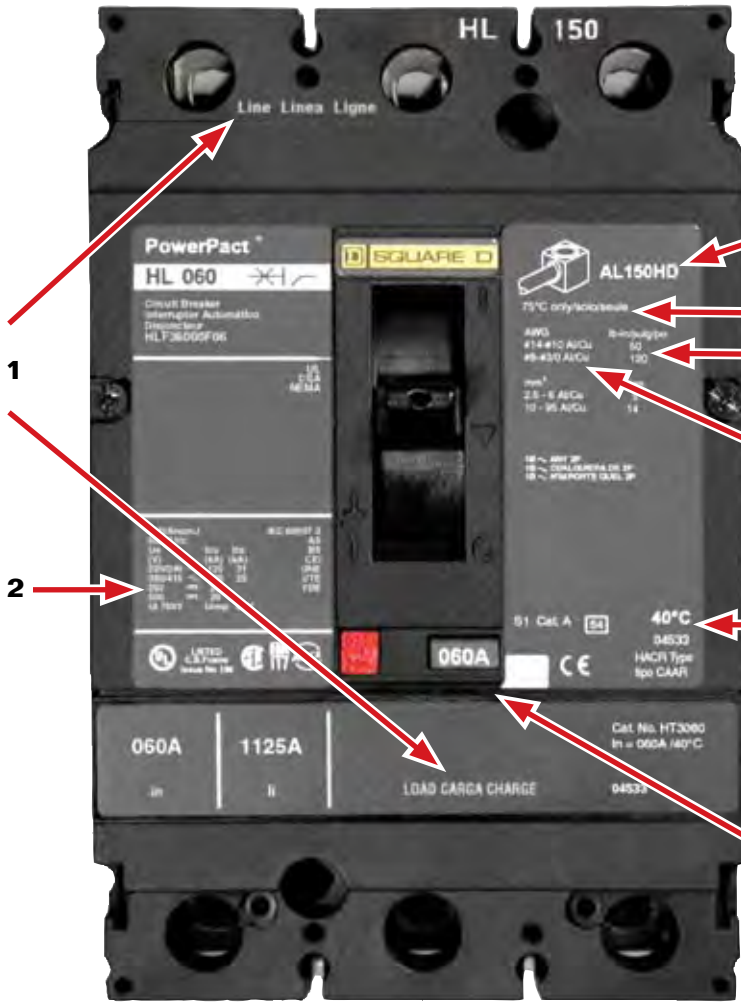
Markings Found in Other Locations

The markings we will discuss below may appear in any location except the back of the circuit breaker. These markings include:

40°C – This marking indicates the maximum ambient temperature in which the circuit breaker can be applied at its marked ampere rating without rerating the ampacity of the circuit breaker. This marking is required for thermal-magnetic circuit breakers and is optional for electronic trip circuit breakers unless they are only suitable for a 25°C ambient, in which case they must be marked 25°C. When the ambient temperature rises above 40°C, the designer may need to consult the manufacturer to obtain rerating information (see item 4 in photo 3).

Class CTL – Circuit breakers marked Class CTL have a rejection means designed into the circuit breaker. Class CTL panelboards or assemblies, in conjunction with Class CTL circuit breakers, prevent more circuit breaker poles from being installed than the number for which the equipment is rated.

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more than 125 A are rated for use with 75°C wire; the marking is optional. It is always permissible to use wire with a higher temperature rating, but it must be sized in accordance with the temperature marking on the circuit breaker and *NEC* Table 310.16. If the width of the circuit breaker is 1-½ inches per pole or less, then this marking may be in any location except on the back (*NEC* 110.14(C)(1)).

8 HACR type – This marking indicates the circuit breaker is suitable for use with the group motor installations typically found in heating, air conditioning and refrigeration equipment. The *NEC* 2005 no longer has this marking requirement. The electrical industry determined that circuit breakers are considered suitable for use with such equipment without any further testing, therefore, the HACR marking is no longer required on air conditioning and refrigeration equipment or on circuit breakers for use in these applications. The requirement for this marking has also been removed from the *UL* 1995 product standard for HVAC equipment (see item 3 in photo 1).

3 Maximum wire size – Circuit breakers are typically marked with a wire range, however that marking is not mandatory. If the circuit breaker cannot accept the next larger wire size required for the ampere rating, then the maximum wire size must be marked in any location except the back (see item 5 in photo 3).

Separately shipped connectors – If connectors are not factory installed on a circuit breaker, then it must be marked with the proper connectors or terminal kits required in any location except the back (see item 8 in photo 3).

Ground-Fault Protection for People
The GFCI function, as part of a circuit breaker, provides ground-fault protection for people and has a number of unique marking and instruction requirements.

Test function – The GFCI has a test function that requires action upon installation and on a monthly basis. GFCI circuit breakers must have a test button or switch that must be labeled in a location accessible without removing trims or covers in order to facilitate monthly testing.

- Photo 3. Markings Visible with Trims or Covers Removed**
- 1. Line and load designation** – Circuit breakers marked with “line” and “load” designations are not suitable for reverse connection. Circuit breakers with interchangeable trip units must be marked “line” and “load” unless there is no risk of shock when changing the trip unit.
 - 2. Interrupting ratings** – All circuit breakers with an interrupting rating more than 5000 A must be marked with an interrupting rating (*NEC* 240.83(C)). Interrupting ratings are stated in RMS symmetrical amperes. If the short-circuit current rating of the equipment in which the circuit breaker is installed is less than the interrupting rating of the circuit breaker, then the lesser rating applies. Circuit breakers should be reviewed after installation to ensure they have an interrupting rating suitable for the application. This marking may be found in any location except the back of circuit breakers that are 1-½ inches wide per pole or less due to the size constraint.
 - 3. Ampere rating (if more than 100 A)** – The ampere rating of a circuit breaker larger than 100 A may be found in a location that is visible after the cover or trim is removed. This marking requirement also applies to interchangeable trip units (*NEC* 240.83(A)).
 - 4. Temperature ratings** – Circuit breakers rated 125 A or less may be marked as suitable for use with 60°C, 60/75°C or 75°C only wire. Circuit breakers rated
 - 5. Terminations (Cu-Al wire)** – Circuit breakers must be marked with the type material (Cu-Al) and size of wire for which their terminals are suitable for use. If suitable for use with only copper or only aluminum, then the word “only” must be used. The abbreviations “CU” and “AL” are generally found on circuit breakers as permitted by the product standard. If only solid 10–14 AWG wire can be used, then that information must be noted. The number of wires per terminal will also be noted if more than one wire per terminal is permitted (*NEC* 110.14(A)).
 - 6. Tightening torque** – The nominal torque for all field-wiring terminals must be marked. If the width of the circuit breaker is 1-½ inches per pole or less, then this marking may be found in any location except on the back.
 - 7. Wire temperature ratings** – Circuit breakers rated 125 A or less may be marked as suitable for use with 60°C, 60/75°C or 75°C only wire. Circuit breakers rated



Photo 4. 10-30 Marking

1. 10-30 marking – A 2-pole circuit breaker used to protect a 3-phase load on a corner-grounded delta system must be rated and marked for such an installation. Circuit breakers marked “1-phase – 3-phase” or “10-30” are suitable for use on 3-phase corner-grounded delta or single-phase circuits (*NEC 240.85*).

Suitable for continuous operation at 100% of ampere rating only if used in a recognized enclosure 52 in. (1321 mm) by 20 in. (508 mm) x 7 1/2 in. (190 mm) deep or larger. Use only with 90° rated wire sized per the ampacity of 75° rated wire.

Figure 1. 100% Rated Marking

100 percent continuous rated – Circuit breakers are typically intended for use at not more than 80% of rated current where the load is considered continuous, or will continue for 3 hours or more (*NEC 210.20*). However, some circuit breakers are rated for continuous use at 100% of their current rating. These circuit breakers must be so marked in any location except on the back. Enclosure information such as a specific type or specific volume must also be marked. A requirement for the use of 90°C insulated wire sized to the 75°C column in *NEC* Table 310.16 and specific ventilation requirements may also be marked on the circuit breaker or equipment (*NEC 210.20(A)* and 215.3).

“Class A” marking – A “Class A” ground-fault device is intended to protect people. The Class A marking indicates that the trip threshold of the GFCI is between 4 mA and 6 mA. This marking may be in any location except the back.

Instructions – All GFCI circuit breakers must include instructions for the installer plus instructions on the use of the test function. A hangtag or self-adhesive label must also be provided, instructing the user to test the GFCI at least monthly. Inspectors should check to see that the tag or label has been properly installed.

Ground-Fault Protection for Equipment

Circuit breakers may also include a ground-fault protection for equipment (GFPE) function that, like GFCIs, has a number of unique marking and instruction requirements.

Test function – GFPE circuit breakers may have a test button or switch that may be labeled in a location accessible without removing trims or covers in order to facilitate testing.

Trip level – GFPE circuit breakers must be marked with their trip threshold in milliamperes in a location accessible without removing trims or covers.

Instructions – All GFPE circuit breakers must include instructions for the installer.

Arc-Fault Protection

Circuit breakers may also include arc-fault protection (AFCI) that, like GFCIs, also has a number of unique marking and instruction requirements.

Device identification – AFCIs must also be identified appropriately. Branch/feeder or Combination type AFCIs must be so marked in a location visible when the trims or covers are removed. This is an important marking to note as we move into 2008, as *NEC-2005* requires Combination AFCIs in bedrooms effective January 1, 2008 (*NEC 210.12*).

Test function – AFCI circuit breakers must have a test button or switch that must be labeled in a location accessible without removing trims or covers in order to facilitate testing.

Instructions – All AFCI circuit breakers must include instructions for the installer.

Circuit Breaker Markings Ensure a Safe Electrical Installation

So why are all of these markings on circuit breakers? Without them, it would be nearly impossible to install or inspect an installation for the appropriate performance ratings and fundamental electrical connections. When designing or completing an installation, key items to review are:

1. Are the voltage, continuous current, and interrupting ratings appropriate for the application?
2. Does the application require SWD or HID ratings?
3. Is the wire type and size appropriate for the circuit breaker?
4. Is the circuit breaker suitable for the equipment in which it is installed? Have other protective functions such as GFCI or AFCI been provided as required by the *NEC*?
5. Is the temperature rating of the circuit breaker suitable for the application?

The UL Marking Guide for Molded Case Circuit Breakers is a valuable resource to understand circuit breaker markings that may further explain these and other markings in detail. If you have questions about CB markings not answered here, consult the Marking Guide or the manufacturer to assist in an *NEC*-compliant installation. ✍



Mr. Larsen, P. E., is the manager, Industry Standards for Circuit Protection for Square D Company / Schneider Electric. Mr. Larsen has served in various positions over the past 32 years. He is a member of several UL, IEEE and NEMA technical committees. His other memberships include NFPA, IAEE and CANENA.