

**NEC Requirements for Signs and Labels Used for Traffic Signal
and Roadway Lighting Applications
Part 1 of 2**

Many articles in the NEC require signs or labeling of equipment. The NEC has no standard on the language to be used, size or color. Signs and labels can be found with the following terminology:

- Directory
- Field Marked
- Identification
- Label/Labeled
- Legibly Marked
- Marking
- Plaque
- Posted
- Sign/Signs
- Warning Signs

The NEC requirements for signs and labels are from nonspecific to specific. For example, Article 690 Solar Photovoltaic Systems, in Section 680.41 Emergency Switch for Spas and Hot Tubs, requires:

A clearly labeled emergency shutoff or control switch for the purpose of stopping the motor(s)...

leaving the size, color and wording up to the user. A very specific requirement is given in Article 551- Recreational Vehicles and Recreational Vehicle Parks, where Section 551.46 requires a label, and gives the exact size, material and legend:

(D) Labeling at Electrical Entrance. Each recreational vehicle shall have permanently affixed to the exterior skin, at or near the point of entrance of the power-supply cord(s), a label 75 mm × 45 mm (3 in. × 1¾ in.) minimum size, made of etched, metal-stamped, or embossed brass, stainless steel, or anodized or clad aluminum not less than 0.51 mm (0.020 in.) thick, or other suitable material [e.g., 0.13 mm (0.005 in.) thick plastic laminate] that reads, as appropriate, either

**THIS CONNECTION IS FOR 110–125-VOLT AC,
60 HZ, ____ AMPERE SUPPLY.**

An appropriate standard for signs or labels would be ANSI Z535.4-1998, Product Safety Signs and Labels, which provides guidelines for the design of safety signs and labels for application to products. Only one section in the NEC [110.16-Flash Protection] references this safety standard.

This two part article will review the 2002 NEC for sign and labeling requirements that apply to Traffic Signal and Roadway Lighting applications. Proper signage can limit exposure to hazardous conditions and limit liability. Signs that do not meet the suggested standard, even though the installer may feel they are adequate, can expose the installer to a lawsuit if someone is injured or electrocuted.

Guidelines for Safety Signs and Labels

There are five basic types of signs, and each sign is composed of a signal word that states the hazard, what can result from the hazard, and how to protect from the hazard. Please refer to ANSI Z535.4-1998, Product Safety Signs and Labels for the guidelines on nomenclature, color and layout.

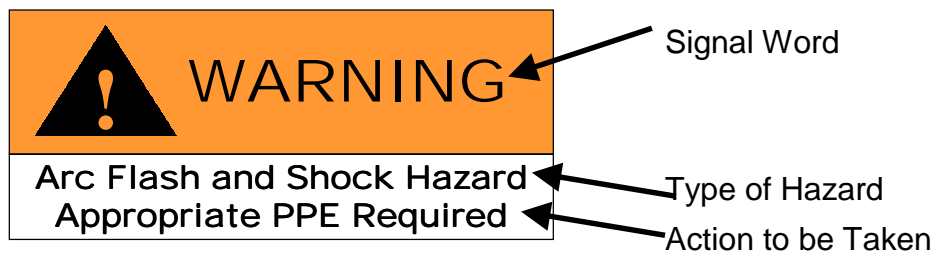
Danger Signs are used to indicate imminently hazardous situations that, if not avoided, will result in death or serious injury. Danger signs should be limited to the most extreme situations. Danger signs use white text on a red background.

Warning signs are used when a potentially hazardous situation which, if not avoided, could result in death or serious injury. Warning signs use black text on an orange background.

Caution Signs are to be used to indicate a potentially hazardous situation which, if not avoided, could result in minor or moderate injury. Caution signs use black text on a yellow background.

Notice Signs are used to indicate a statement of organization policy that relates directly or indirectly to the safety of personnel or protection of property. The signal word shall not be associated with a hazard or hazardous situation that warrants a danger, warning, or caution sign. Notice signs are white text on a blue background.

General Safety Signs are used to give general instructions, such as safe work practices, reminders of proper safety procedures, and locations of safety equipment. General safety signs may have signal words such as "Safety First," "Safety Instructions," "Be Careful," or "Think." Other signal words that convey a general safety message are allowed. General safety signs shall not be associated with a hazard or hazardous situation that warrants a danger, warning, or caution sign. General safety signs are white text on a green background.



Courtesy E.I. du Pont de Nemours & Co.

Basic Sign Showing Signal Word, Hazard and Action



Illustration of Improper Sign

This sign for a 120/240 volt traffic signal service does not have the correct wording, the color (orange on black) is incorrect for the signal word, the equipment is not “High Voltage” (the NEC considers high voltage to be systems operating at 600 volts and above) and it is missing the action to be taken.

NEC Sections Requiring Signs/Labels

Article 110 Requirements for Electrical Installations

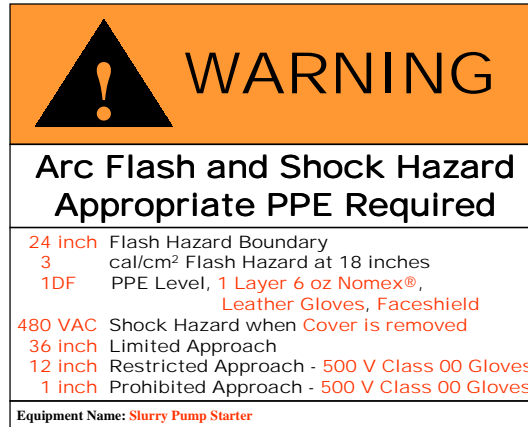
Section: 110.16 Flash Protection.

Requirement: *Switchboards, panelboards, industrial control panels, and motor control centers that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.*

FPN No. 1: NFPA 70E-2000, Electrical Safety Requirements for Employee Workplaces, provides assistance in determining severity of potential exposure, planning safe work practices, and selecting personal protective equipment.

FPN No. 2: ANSI Z535.4-1998, Product Safety Signs and Labels, provides guidelines for the design of safety signs and labels for application to products.

Application: In this case the requirement is for a “field marking” to alert qualified persons¹ of a potential arc flash hazard. In a Traffic Signal and/or Roadway Lighting (TS/RL) application, this would be the service equipment and lighting controllers. There are two types of signs that can be used, basic and advanced. For a basic sign with the requirement elements, see above. The advanced sign (below) has complete information to allow maintenance staff to select the proper safety equipment. Either sign meets the intent of 110.15



Field marking (sign) for complying with arc flash requirement

Authors Note: While 110.16 may not seem to apply to traffic signal control cabinets, the requirement is to field mark “Switchboards, panelboards, industrial control panels...”. Often the traffic signal cabinet itself (not the wiring and plugables) will be UL 508-Industrial Control Panel Listed, and the argument could be made that 110.16 would apply to traffic signal cabinets. Note that 110.16 exempts “dwelling occupancies”, as the available fault current at a dwelling occupancy is limited. For example most dwelling unit panelboards have a maximum short circuit rating of 10,000 amperes, and the typical single phase transformer has about 5,000 amperes short-circuit current available at the secondary terminals, and at the service panelboard the available short-circuit current would be much lower. A traffic signal would have similar low levels of fault current, but there is always the exception where a traffic signal may be fed from a large single phase padmount transformer close to the traffic signal cabinet. The user will have to determine the application of 110.16 to traffic signal cabinets based on the amount of fault current. Traffic signal cabinets are always worked hot, and most often by qualified personnel, and the access is often limited by being in a locked enclosure.

Section: 110.22 Identification of Disconnecting Means.

¹ **Article 100 Definition - Qualified Person.** One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training on the hazards involved.

Requirement:

- *Each disconnecting means shall be legibly marked to indicate its purpose unless located and arranged so the purpose is evident. The marking shall be of sufficient durability to withstand the environment involved.*
- *Where circuit breakers or fuses are applied in compliance with the series combination ratings marked on the equipment by the manufacturer, the equipment enclosure(s) shall be legibly marked in the field to indicate the equipment has been applied with a series combination rating. The marking shall be readily visible and state the following:*

**CAUTION — SERIES COMBINATION SYSTEM RATED ____ AMPERES.
IDENTIFIED REPLACEMENT COMPONENTS REQUIRED.**

FPN: See Section 240.86(A) for interrupting rating marking for end-use equipment.

Application:

In the first part of Section 110.22, each disconnecting means has to be “legibly” marked with its purpose. This would obviously include the service disconnect. There is no definition of “legibly marked”, but the common interpretation is suitable for the environment. The purpose of a disconnect located next to a traffic signal cabinet could be evident, but the individual branch circuits would still require a circuit directory per [408.4].

The second part of [110.22] is for marking equipment used with high levels of available fault current. The marking is to alert the user that specific replacement overcurrent protective devices are required to be able to withstand the high fault current. Most single phase 120/240 transformers have less than 10,000 amperes of short-circuit current available, and the lowest rating of listed service equipment is 10,000 amperes interrupting current. Traffic signal services are not typically subject to high levels of fault current, but roadway lighting could be, if it is supplied at a 480/277 Y voltage. The designer needs to be aware of the levels of fault current and install the appropriately rated electrical service. The user needs to be aware that using the incorrect replacement over current protective devices could result in a fire or safety hazard.

Section: 110.27 Guarding of Live Parts.

Requirement:

(A) Live Parts Guarded Against Accidental Contact. Except as elsewhere required or permitted by this Code, live parts of electrical equipment operating at 50 volts or more shall be guarded against accidental contact by approved enclosures or by any of the following means:

(1) By location in a room, vault, or similar enclosure that is accessible only to qualified persons.

(C) Warning Signs. Entrances to rooms and other guarded locations that contain exposed live parts shall be marked with conspicuous warning signs forbidding unqualified persons to enter.

FPN: For motors, see 430.132 and 430.133. For over 600 volts, see 110.34.

Application: This is the obvious requirement for guarding live parts against contact. An “Approved”² enclosure is what normally is used. Exposed live parts in a locked traffic signal cabinet or lighting cabinet would meet the requirements of Section 110.27, by being in an approved enclosure.

Article 210: Branch Circuits

Section: 210.4 (D) Identification of Ungrounded Conductors.

Requirement:

Where more than one nominal voltage system exists in a building, each ungrounded conductor of a multiwire branch circuit, where accessible, shall be identified by phase and system. This means of identification shall be permitted to be by separate color coding, marking tape, tagging, or other approved means and shall be permanently posted at each branch-circuit panelboard.

Application:

There is no requirement to identify ungrounded (hot) conductors with a specific color code, such as Black-Red-Blue for 120/208 Y and Brown-Orange-Yellow in the NEC. A color code requirement was in the NEC in the 1970’s but was removed. The requirement is if there is more than one nominal voltage system, such separate color coding must be “permanently posted”. Many proposals have been made to require the NEC to have a color code standard. The Code Making Panels have stated we don’t want the electrician to see a red wire and assume its 120 volts, we want the electricians to test and be sure. Often what is installed for a job is what is on the truck! However there is nothing wrong with a facility or agency adopting a strict color code standard in its own standards. The use of some colors is restricted for certain applications:

- Green or Green/Yellow Stripe-Equipment grounding conductor
- White or Gray-Grounded Conductor

NOTICE	
UNGROUND CONDUCTOR IDENTIFICATION <i>THIS BUILDING HAS MORE THAN ONE SYSTEM VOLTAGE</i>	
ELECTRICAL SYSTEM SERVICE, FEEDER AND BRANCH CIRCUITS ARE IDENTIFIED AS FOLLOWS:	
480/277V 3 PHASE Phase A - Brown Phase B - Orange Phase C - Yellow Neutral - Gray Ground - Green	240/120V 1 PHASE Leg A - Black Leg B - Red Neutral - White/Black stripe Ground - Green
<i>Conductors are identified at accessible locations</i>	

Example of Sign for Section 210.4(D)

² Article 100 Definition -Approved. Acceptable to the authority having jurisdiction.

Article 225: Outside Branch Circuits and Feeders
(Part II. More Than One Building or Other Structure)

Section: 225.37 Identification.

Requirement:

Where a building or structure has any combination of feeders, branch circuits, or services passing through it or supplying it, a permanent plaque or directory shall be installed at each feeder and branch-circuit disconnect location denoting all other services, feeders, or branch circuits supplying that building or structure or passing through that building or structure and the area served by each.

Exception No. 1: A plaque or directory shall not be required for large-capacity multibuilding industrial installations under single management, where it is ensured that disconnection can be accomplished by establishing and maintaining safe switching procedures.

Exception No. 2: This identification shall not be required for branch circuits installed from a dwelling unit to a second building or structure.

Part II: More Than One Building or Other Structure

Section: 225.37 Identification

Requirement:

Where a building or structure has any combination of feeders, branch circuits, or services passing through it or supplying it, a permanent plaque or directory shall be installed at each feeder and branch-circuit disconnect location denoting all other services, feeders, or branch circuits supplying that building or structure or passing through that building or structure and the area served by each.

Article: 230 Services

Section: 230.2 Number of Services.

230.2(E) Identification.

Requirement: *Where a building or structure is supplied by more than one service, or any combination of branch circuits, feeders, and services, a permanent plaque or directory shall be installed at each service disconnect location denoting all other services, feeders, and branch circuits supplying that building or structure and the area served by each. See 225.37.*

Application: The requirements above are all similar. If a building or structure is served by more than one service, branch circuit or feeder, a “permanent plaque” is required at each service, feeder or branch circuit disconnect location. This is to facilitate the shut down of all sources of power to a building or structure. An application of this requirement would be roadway lighting supplied at 277/480 volts to a luminary on a traffic signal mast arm, with the signal heads fed from a separate service at 120/240 volts. This would require a “permanent plaque or directory” at each service disconnect and feeder.

Authors Note: There is precedent in the NEC for a lighting pole to be considered a structure. In Article 225-Outside Branch Circuits and Feeders, Section 225.32 requires a disconnecting means inside or outside of the building or structure, but

exception No. 3 allows the disconnecting means to be elsewhere for “towers or poles used as lighting standards”. This exception was added to the 1996 as some AHJ’s considered lighting standards to be a structure, and required a disconnecting means for each.

Resources

ANSI Z535.4-1998, Product Safety Signs and Labels is available for \$51.00, from NEMA at www.nema.org, or Global Documents at www.his.com.

A review of safety warning signs can be found at the Lawrence Livermore National Laboratory web site, http://www.llnl.gov/es_and_h/hsm/doc_12.01/doc12-01.html#appb

Arc flash signs courtesy E.I. du Pont De Nemours & Co.

Italic text excerpted from the 2002 NEC, National Electric Code® and the NEC® are registered trademarks of the National Fire Protection Association, Inc., Quincy Massachusetts.

Byline:

IMSA Member Tom Baker has been a certified electrician for 23 years and is also an IMSA Level II Traffic Signal Technician. His business, Puget Sound Electrical Training, provides classes on the NEC, Grounding and Bonding, and other electrical subjects. He was recently appointed to the IESNA Roadway Lighting Committee by the IMSA. Contact him via email at tom@psetraining.com, or at 360-377-2492.