Overcurrent and Overvoltage Protection Changes in the 2008 NEC® Code

Ferraz Shawmut

Overcurrent and Overvoltage Protection Changes in the 2008 Code

Contents

The recommendations by Ferraz Shawmut in this publication are intended to be in compliance with the 2008 NEC, however jurisdictions that adopt the code are solely responsible for any modifications and interpretations to be enforced by their jurisdictions.

The user of the code should identify what regulatory authority has responsibility for the installation approval and always comply with any regulatory authority modifications to the N.E.C. Ferraz Shawmut cannot be responsible for errors and omissions.

1. Short Circuit Current Ratings are Clarified

Previous 2005 Code Requirements

In the 2005 Code for the first time industrial control machinery and panels, air conditioning equipment, refrigeration equipment, meter disconnect switches, and motor controllers had to be marked with their SCCR (Short Circuit Current Rating). This rating has to be equal to or greater than the available fault current at their point of use as outlined in NEC 110.10. If the equipment or device is applied on a circuit where the available fault current exceeded the SCCR, it could become a safety hazard.

Prior editions of the Code considered that the downstream equipment was automatically protected if the overcurrent device feeding it had an adequate interrupting current rating. The 2005 code in harmony with Underwriters Laboratories (UL) required that equipment operate more safely. This included panels supplied by a high interrupting overcurrent device which would permit the downstream equipment to be a hazard due to the high available fault current level. This resulted in a new type of equipment rating, called the Short Circuit Current Rating (SCCR).

100-Short Circuit Current Rating The prospective symmetrical fault current at a nominal voltage to which an apparatus or system is able to be connected without sustaining damage exceeding defined acceptance criteria.

409.2 Modified Industrial Control Panel Definitions

Control Circuit. The circuit of a control apparatus or system that carries the electric signals directing the performance of the controller but does not carry the main power current.

Industrial Control Panel. An assembly of two or more components consisting of one of the following:
(1) Power circuit components only, such as motor controllers, overload relays, fused disconnect switches, and circuit breakers
(2) Control circuit components only, such as pushbuttons, pilot lights, selector switches, timers, switches, control relays
(3) A combination of power and control circuit components
These components, with associated wiring and terminals, are mounted on or contained within an enclosure or mounted on a subpanel. The industrial control panel does not include the controlled equipment.

409.110 Exception to (3) Marking. Short circuit current rating markings are not required for industrial control panels containing only control circuit components.

670.3(A) Additional Nameplate Marking. The number of phases shall be marked on the permanent nameplate.

Finger-Safe Power Distribution Blocks

Reasons for Changes

SCCR was not defined in the previous 2005 code. It relied only upon a note referring people to UL 508A Standard for more information. Many questions were raised about the exact type of panels covered by SCCR requirements. One change clarifies which panels need to have SCCR ratings. Another change requires additional voltage information on the nameplate to avoid misapplication.

How to Comply

Industrial control panels must be marked with their SCCR. The manufacturers or designers of the panel must do an analysis to establish panel SCCR as described in UL 508A, even if the panel is not built to the UL 508A Standard specifications.

Then the installer must insure that the panel's SCCR is not less than the available fault current at the terminals of the panel. The electrical inspector must verify that the SCCR is on the panel nameplate and have some evidence that the SCCR is not exceeded. Compliance is easy if the panel has a high SCCR and the maximum available fault current from the supply conductors is less than the SCCR.

Compliance can be costly if the installer who is responsible for code compliance ignores this code issue until the equipment is installed. Much time and money can be consumed in resolving the problem and achieving compliance. The fix often requires return of the panel to the manufacturer for upgrading.

Industrial control panels are now exempt from this SCCR requirement if they only contain control circuit components, not devices carrying the main power.

Helpful Products

The Ferraz Shawmut AmpTrap® Family of fuses delivers current limitation that can enhance the SCCR of industrial control panels. Products such as the USFM™ fuse holder directly replace circuit breakers having the same width as type IEC starters. The Surge Trap®, protecting against surge voltage, has a built-in rating of 200kA SCCR. The finger-safe power distribution blocks have a 100kA rating.

2. Series Ratings

Previous 2005 Code Requirements

Series combination ratings can be a lower cost method to comply with 110.9 than with a fully rated system. Most manufacturers recommend a fully rated system, but the code allows installation of a series combination rated system.

The series combination ratings consider the effects of both the upstream overcurrent device working in tandem with the downstream overcurrent device to establish a combined interrupting rating. For example, an apartment building could have a 50kA available fault current from the utility transformer. A fully rated system would require 50kA interrupting ratings on the load panels for each apartment.

Using a series combination rating could allow a 10kA interrupting rating on the load panels to be used with an upstream fully rated 50kA circuit breaker or fuse that has been tested or calculated to safely open when a fault occurs. This testing or calculation has identified specific fuse and circuit breaker combinations that are safe.

If during maintenance a circuit breaker or fuse is substituted different from the originally installed series combination, it might cause a hazard when a fault or short circuit occurs. The previous 2005 code section 110.22 already required field marking on the panels to alert the maintenance people that it was a series combination rated system.

In section 240.86 series combination ratings are required to be tested before they are permitted in new installations. The downstream devices are typically load panels with circuit breakers. The upstream devices can be either fuses or circuit breakers. Passing the UL tests of the combinations is considered adequate protection by the code. There are some restrictions in section 240.86(C) prohibiting using the combination rating when motor loads are significant.

If a building electrical system is altered, it can result in inadequate interrupting current rating. Rather than replacing the entire electrical system, the code allows a licensed professional engineer to make calculations to find a safe combination permitting much of the existing system to remain. In the prior 2005 code, the caution labels were the same for tested and calculated series rated systems.

110.22 Identification of Disconnecting Means.
(B) Engineered Series Combination Systems. Where circuit breakers or fuses are applied in compliance with series combination ratings selected under engineering supervision and marked on the equipment as directed by the engineer, 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 — ENGINEERED SERIES COMBINATION SYSTEM RATED _______ AMPERES. IDENTIFIED REPLACEMENT COMPONENTS REQUIRED.

FPN: See 240.86(A) for engineered series combination systems.
(C) Tested Series Combination Systems

240.86 Series Ratings.
(A) Selected Under Engineering Supervision in Existing Installations.
For calculated applications, the engineer shall ensure that the downstream circuit breaker(s) that are part of the series combination remain passive during the interruption period of the line side fully rated, current-limiting device.

Reasons for Changes

The new 2008 code requires a different warning label for series combination ratings. The warning labels have to indicate if it is an “Engineered Series Combination System” or a “Tested Series Combination System.” The rearrangement of the text makes it clearer that the engineered series combination system also requires a warning label, not just the tested series combination system.

Although the prior 2005 code in 240.86(A) was specific about the qualifications of the engineers permitted to do the calculations for the engineered series combination rating, there was still concern about possible errors. The new 2008 code reminds the engineers to be cautious when using upstream current limiting devices to protect the downstream devices, typically circuit breakers with low interrupting ratings. The dynamic impedance of some circuit breakers can cause them to self-destruct if the upstream current limiting device is not fast enough.

How to Comply

Use field installed warning labels for series rated combination systems, even for “Calculated” systems. Use the specific labels that identify “Tested” or “Engineered.” This will ensure that the maintenance personnel are informed of the requirement to replace fuses and circuit breakers with the correct replacements.

With fuses, the UL Class, voltage and ampere rating are sufficient information for replacement, independent of brand. That is because UL listed fuses of all fuse manufacturers are tested to meet minimum performance requirements by UL Class, voltage, and ampere rating.

However, with circuit breakers, the exact brand and model number must be used. If the manufacturer has discontinued that exact model, it can cause replacement headaches.

Helpful Products

The Ferraz Shawmut AmpTrap family of fuses is often used because of its effective current limiting actions to protect downstream circuit breakers with low interrupting current safety ratings. Ferraz Shawmut publishes fuse let-through curves and tables to help aid qualified engineers to calculate series ratings. There is a free software tool called Select-A-Fuse® (SAF) that contains the fuse let-through values. SAF is available for downloading on the **us.ferrazshawmut.com** website.

3. Selective Coordination is Modified

Previous 2005 Code Requirements

The original code requirement for selective coordination was inserted in 1993 referencing elevators. In the 2005 Code this selective coordination requirement was expanded to cover heath care facilities, emergency systems and legally required standby systems. The affects of this expansion were well discussed during the 2008 code cycle, resulting in some clarification. The code making community discussed the basics of selective coordination at length.

Selective coordination is a description of how an electrical systems acts under overcurrents. Most users expect that a single overcurrent in the system would de-energize the affected part of the system and the rest of the system would continue to operate. If the electrical system was not engineered to behave as a selectively coordinated system, a downstream overcurrent can result in shutting off substantially more of the system than necessary to isolate the problem

An example of such a non-selectively coordinated system is a branch circuit shorting out causing the feeder and maybe even the main to de-energize. This condition can occur in a typical building that was not designed with selective coordination as a goal. Then why is it uncommon to see entire buildings lose power due to a branch overcurrent?

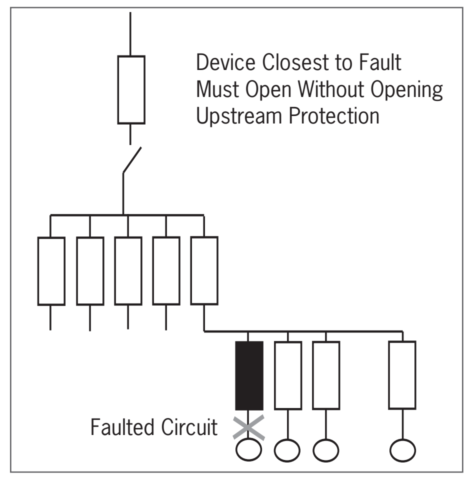
Overcurrents can be broken into two types—overloads and short circuits. Typically an overload is less than 10 times the rated circuit current and the short circuit is over 10 times. Overloads are the most common electrical problem. These common overloads are relatively easy to selectively coordinate because most fuses and circuit breakers are designed for this performance. As long as the upstream overcurrent device has a higher trip rating or a longer opening time, the downstream device will open first leaving the rest of the system operating normally.

The less common overcurrent, the short circuit, is the condition selective coordination becomes an engineering task. Unfortunately, short circuits are more likely during a fire, explosion, or other accident and that is the exact time that elevators and emergency electrical systems are most needed. Short circuits result in high currents and the overcurrent protective devices respond very rapidly (less than 100msec). The rapid response times of the overcurrent devices have to be coordinated so that only the smallest portion of the electrical system closest to the short circuit is taken out of service. If this is accomplished for all levels of overcurrents possible in an electrical system, that system is selectively coordinated.

The 2005 code change was based on the success of the elevator requirement for selective coordination in section 620.62. This section requires selective coordination where more than one elevator or driving device is fed from the same feeder. The intent is to prevent loss of use of multiple elevators when the electrical outage could be confined to one elevator.

Code sections 700.27 and 701.18 were added in 2005 requiring selective coordination. These sections affected emergency systems, legally required standby systems and by reference of 517.26, the essential electrical systems of health care facilities. These systems are considered important enough to require selective coordination to prevent unnecessary power outages.

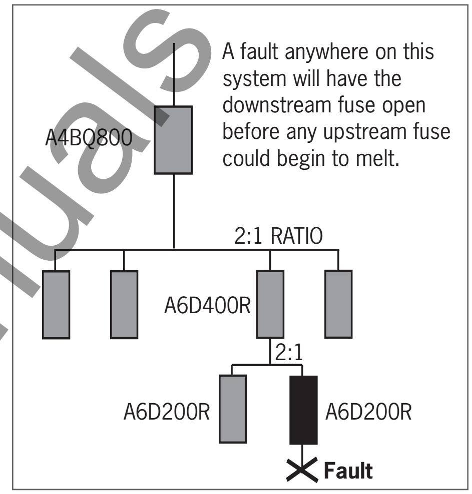
To make these systems selectively coordinated, engineers have to spend more time on their design. Fuses, circuit breakers, and combinations of both can be selectively coordinated in new system designs. The code requirements cover only new installations. Typically existing systems prove challenging for economical redesign.



System Selectivity

700.27 Coordination.
Emergency system(s) overcurrent devices shall be selectively coordinated with all supply side overcurrent protective devices.
Exception: Selective coordination shall not be required in (1) or (2):
(1) Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exists on the transformer secondary,
(2) Between overcurrent protective devices of the same size (ampere rating) in series.

701.18 Coordination.
Legally required standby system(s) overcurrent devices shall be selectively coordinated with all supply side overcurrent protective devices.
Exception: Selective coordination shall not be required in (1) or (2):
(1) Between transformer primary and secondary overcurrent protective devices, where only one overcurrent protective device or set of overcurrent protective devices exists on the transformer secondary,
(2) Between overcurrent protective devices of the same size (ampere rating) in series.



Example of a Coordinated System

Reasons for Changes

When the electrical community instituted the new selective coordination requirements, many discussions occurred. Two new clarifications, sections 700.27 and 701.18 were added in the form of exceptions. These exceptions don't alter the impact of requiring selective coordination, but give technical direction to the design engineer.

How to Comply

In designing a new electrical system the sections of the system needing selective coordination should be identified first. Although circuit breakers can be selectively coordinated for a given system, the use of the AmpTrap 2000 family of fuses is generally more economical.

Within the AmpTrap 2000 family of fuses at least a simple 2:1 ratio of the upstream vs downstream fuse size ensures selective coordination. This is due to the current limiting action of the fuses which are faster acting than circuit breakers. The reduction of time and complexity from using circuit breaker systems can significantly reduce the engineering effort to comply with the code selective coordination requirements.

Helpful Products

The selective coordination requirement can be easily met in new system design using the AmpTrap 2000 family of fuses. This family enables meeting the requirements even if future electrical system modifications change the available fault currents. This family can also reduce the arc flash hazard exposure because of their high degree of current limitation and speed of operation.

4. Engineering Analysis Permitted for Feeder Tap Adequacy

Previous 2005 Code Requirements

Article 240 Section VIII of Overcurrent Protection permits some more lenient requirements for supervised industrial installations. Some of these lenient requirements are longer cable lengths permitted ahead of an overcurrent protection devices, use of differential relay protection, and cables terminating in up to six devices to provide overload protection.

As part of these requirements, a list of options considered suitable for short circuit protection were given in the 2005 code in 240.92(B)(1). Section 240.92(B)(1)(3) permitted engineering calculations to determine suitability of overcurrent with specific cable.

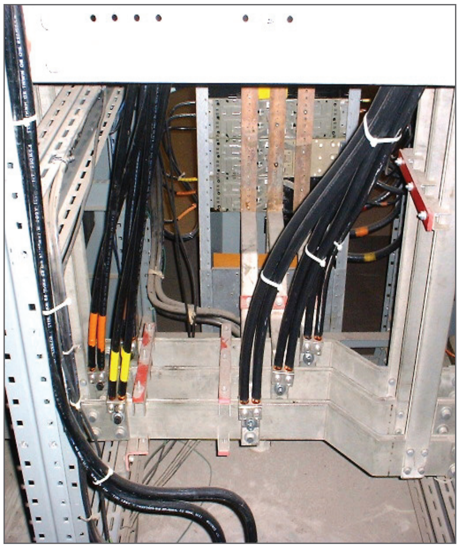
VIII Supervised Industrial Installations
240.92 Location in Circuit.
An overcurrent device shall be connected in each ungrounded circuit conductor as required in 240.92(A) through (E).
(B) Feeder Taps. For feeder taps specified in 240.21(B)(2), (B)(3), and (B)(4), the tap conductors shall be permitted to be sized in accordance with **Table 240.92(B)**.

Tap conductors are considered to be protected under short-circuit conditions when their short-circuit temperature limit is not exceeded. Conductor heating under short-circuit conditions is determined by (1) or (2):

(1) Short-Circuit Formula for Copper Conductors
$(I^2/A^2)t \leq 0.0297 \log_{10} [(T_2 + 234)/(T_1 + 234)]$

(2) Short-Circuit Formula for Aluminum Conductors
$(I^2/A^2)t \leq 0.0125 \log_{10} [(T_2 + 228)/(T_1 + 228)]$

Where:
I=short circuit current maximum in amperes
A=conductor area in circular mils
t=time of short circuit in seconds (for times less than or equal to 10 seconds)
T_1= initial conductor temperature in degrees Celsius
T_2= final conductor temperature in degrees Celsius
Copper or aluminum conductor with paper, rubber, varnished cloth insulation,
T_2 = 200 maximum
Copper or aluminum conductor with thermoplastic insulation,
T_2 = 150 maximum
Copper or aluminum conductor with cross-linked polyethylene insulation,
T_2 = 250 maximum
Copper conductor or aluminum with ethylene propylene rubber insulation,
T_2 = 250 maximum



Reasons for Changes

Section 240.92(B)(1)(3) did not give guidance for the engineering criteria to be used to achieve compliance. It was very subjective. The 2008 code inserts a table requiring that the cables not be heated beyond their specific established insulation damage limit. An additional paragraph was inserted moving the 2005 code 240.92 "B" and the following ones down the alphabet.

Cable has to be protected from overheating so that the insulation is not damaged. One consideration is the overheating occurring when the cable dissipates some of the heat. Heat is generated inside the cable by its resistance to the current passing through. This heat travels to the outside of the cable and dissipates in the air. As long as the temperature doesn't reach levels high enough to damage the insulation, it's fine.

When a short circuit occurs, high current flows for a short duration. The heat generated in the cable conductors builds up rapidly and doesn't have enough time to dissipate. The temperature rise caused by a high short circuit current can damage the insulation in a fraction of a second. The faster that an overcurrent device operates under a short circuit condition, the less heat is released into the cable thus avoiding insulation damage.

The new "B" permits the tap conductors of section 240.21(B)(2), (B)(3), and (B)(4), to be sized based on Table 240.92(B). This simplifies the engineering task and makes for uniformity for installations.

How to Comply

When applying cable taps in supervised industrial locations, now Table 240.92(B) can be implemented which can be more lenient than the requirements of section 240.21(B)(2), (B)(3), and (B)(4).

The correct formula is chosen based upon the conductor material. Then the initial and final temperatures are chosen based upon the insulation rating and the ambient temperature. Use the available fault current and obtain the overcurrent protective device operating time. Fuses in their current limiting range have a maximum opening time of 0.0083 seconds (1/2 cycle). Circuit breakers typically have many times that duration depending upon the model and type selected. The minimum conductor size in circular mils must make the term $(I^2/A^2)t$ equal to, or less than the right side of the formula.

Helpful Products

All branch circuit rated current limiting fuses can reduce the heating affect of cables tremendously primarily because of their short opening time. The technical data for opening time of Ferraz Shawmut fuses is available through the **us.ferrazshawmut.com** website or by contacting the Technical Services Department.

5. Field Marking Required for Delta Mid-Point Grounded Systems

Previous 2005 Code Requirements

Section 408 had a fine print note referring back to 110.15 for correct labeling of the high leg conductors. But other articles such as 240.83(E), 240.85, 430.52(C)(6), and 430.83(E) have been warning against applying devices with inadequate voltage ratings labeled with "slash-ratings."

> **408 Switchboards and Panelboards**
> **408.3(F) High-Leg Identification.** A switchboard or panelboard containing a 4-wire, delta-connected system where the midpoint of one phase winding is grounded shall be legibly and permanently field marked as follows:
>
> "Caution ___ Phase Has _____ Volts to Ground"

Reasons for Changes

Many times circuit breakers or motor controllers are replaced or added to existing switchboards and panelboards during maintenance. Without labeling on the switchboard or panelboard it's not obvious these replacement devices need a full voltage rating. Use of less expensive slash-rated devices is not code compliant if the phase to ground voltage is exceeded. Many self-protected combination motor starters are also slash-rated which causes possible concern regarding inadequate voltage ratings.

Slash-rated devices have limited voltage capability compared to the full unrestricted rating. For example, a circuit breaker can have a 480Y/277 voltage rating. This is acceptable for a 480 volt 3-phase grounded wye system in which the maximum voltage from a phase to ground is 277. It is not permitted with a mid-phase grounded delta supply because the voltage phase to ground on one phase can be over 277 volts. Similarly with a 240V mid-phase grounded delta the circuit protection requires a fully rated 240V device, not a 240/120 one.

Devices that have a full voltage rating can be used at their maximum voltage from phase to ground. Fuses have full voltage ratings so they can be used in grounded, resistance grounded, ungrounded, corner grounded, and mid-phase grounded 3-phase systems.

Some devices have a dual rating and the applicable one depends upon the application. One example is a self-protected combination motor starter. Typically it has a full voltage rating for stopping and starting the motor. But when it comes to self-protection, it may only have a slash-voltage rating.

How to Comply

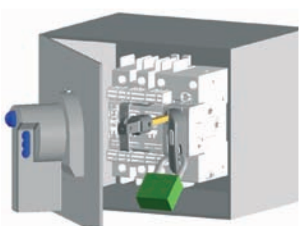
Switchboards and panelboards should be field marked: "Caution ___ phase has _____ volts to ground." This will permit proper selection of added or replacement devices based upon the maximum phase to ground voltage.

Branch circuit rated fuses are tested with full voltage to ground and are not application limited by the type of grounding. Many circuit breakers and self-protected starters have slash-voltage ratings instead of full voltage ratings.

Helpful Products

If equipment has been misapplied in the past, retrofitting with fuses is often the most economical solution. The Ferraz Shawmut USFM fuse holder is the same size as common small circuit breakers, but has a full voltage rating as well as a high interrupting rating and high degree of current limitation when used with Ferraz Shawmut ATDR, ATQR or ATMR Class CC fuses.

New NFPA 79 Requirements and Solutions



As defined in the NFPA 79 Standard 2007 edition section 5.3.3.1 and 6.2.3.2, our disconnecting devices fully comply with all of the following requirements:
1. Isolate the electrical equipment from the supply circuit and have one off (open) and one on (closed) position only.
2. Have an external operating means (e.g., handle).
3. Be provided with a permanent means permitting it to be locked in the off (open) position only (e.g., by padlocks) independent of the door position. When so locked, remote as well as local closing shall be prevented.
4. Be operable, by qualified persons, independent of the door position without the use of accessory tools or devices.

However the closing of the disconnecting means while door is open is not permitted unless an interlock is operated by deliberate action.
Flange and side operation:

Our side operated switches used with flange handles meet the requirements of the NFPA 79 without any additional parts being added.

6. Disconnect Requirement for Non-Removable Locking Hardware

Previous 2005 Code Requirements

Previously the NEC allowed the use of portable locking hardware for use in Lock-Out Tag-Out safety operations. In some sections the hardware is not required to be permanently mounted to the disconnect. NFPA 79 has consistently required permanent means for locking out the switches, but this is an optional standard which applies to machinery.

> **440.14 Location. Air Conditioning and Refrigeration Equipment**
> Exception No. 1: (Where ... disconnecting means within sight from the equipment shall not be required) The provision for locking or adding a lock to the disconnecting means shall be installed on or at the switch or circuit breaker and shall remain in place with or without the lock installed.
>
> **620.51 Disconnecting Means. -Elevators**
> **(A) Type.**
> Portable means for adding a lock to the switch or circuit breaker shall not be permitted as the means required to be installed at and remain with the equipment.

Reasons for Changes

Unfortunately portable lock-out hardware pieces have a tendency to be misplaced. Frequently an outside contracting service is used for HVAC and elevator maintenance. When there is missing hardware for locking out the disconnect, the missing hardware can encourage an unsafe work condition.

How to Comply

Use disconnect switches that have permanently installed locking hardware. This means that a basic lock is sufficient to lock out the disconnect and there are no loose hardware pieces to become lost.

Helpful Products

Ferraz Shawmut offers Socomec disconnect switches ranging from 16 to 1200 amps. Disconnect switches are available separately or mounted within various NEMA rated enclosures.

7. Stationary Batteries Now Require Disconnects

Previous 2005 Code Requirements

Previously, there were no specific requirements for storage batteries to have disconnects. The prior code permitted storage batteries to be disconnected by undoing the cable terminals.

> **480.5 Disconnecting Means.**
> A disconnecting means shall be provided for all ungrounded conductors derived from a stationary battery system over 30 volts. A disconnecting means shall be readily accessible and located within sight of the battery system.

Reasons for Changes

There is a possibility of drawing an arc when conductors are disconnected from storage batteries. The OSHA lock-out and tag-out requirements are in effect for maintenance people exposed to the energy of a storage battery. By requiring a disconnecting means the maintenance people can safely work on de-energized DC battery circuits such as in UPS systems and transfer switches.

How to Comply

Storage battery systems operating over 30 volts should have a disconnect properly rated for the voltage and current. DC voltage ratings are often different from AC voltage ratings, so care should be taken to select switch with the appropriate DC ratiing.

Helpful Products

Ferraz Shawmut offers an extensive range of disconnects as well as fuses that are DC rated. Ferraz Shawmut offers its Sirco line of disconnects rated 250 VDC and a wde line of special high voltage and high current disconnects specifically for DC applications.

8. Surge Suppressors Have Been Re-Defined

Previous 2005 Code Requirements

Articles 280 and 285 permit surge arresters and transient voltage surge suppressors to reduce the surge voltage in electrical systems. The surge arresters were permitted to be installed into both above and below 600 volts.

280.1 Scope.
This article covers general requirements, installation requirements, and connection requirements for surge arresters installed on premises wiring systems over 1kV.

285.1 Scope.
This article covers general requirements, installation requirements, and connection requirements for SPDs [surge arresters and transient voltage surge suppressors (TVSSs)] permanently installed on premises wiring systems 1kV or less.

FPN No. 1: Surge arresters less than 1kV are also known as Type 1 SPDs.
FPN No. 2: Transient voltage surge suppressors (TVSSs) are also known as Type 2 and Type 3 SPDs.

285.5 Listing.
An SPD (surge arrester or TVSS) shall be a listed device.

285.6 Short-Circuit Current Rating.
The SPD (surge arrester or TVSS) shall be marked with a short-circuit current rating and shall not be installed at a point on the system where the available fault current is in excess of that rating. This marking requirement shall not apply to receptacles.

285.23 Type 1 SPDs (Surge Arresters).

Type 1 SPDs shall be installed in accordance with 285.23(A) and (B).
(A) Installation. Type 1 SPDs (surge arresters) shall be installed as follows:
(1) Type 1 SPDs (surge arresters) shall be permitted to be connected to the supply side of the service disconnect as permitted in 230.82(4) or
(2) Type 1 SPDs (surge arresters) shall be permitted to be connected as specified in 285.24.
(B) At the Service. When installed at services, the grounding conductor of a Type 1 SPD shall be connected to one of the following:
(1) Grounded service conductor
(2) Grounding electrode conductor
(3) Grounding electrode for the service
(4) Equipment grounding terminal in the service equipment

285.24 Type 2 SPDs (TVSSs).
Type 2 SPDs (TVSSs) shall be installed in accordance with 285.24(A) through (C).
(A) Service-Supplied Building or Structure. Type 2 SPDs (TVSSs) shall be connected anywhere on the load side of a service disconnect overcurrent device required in 230.91, unless installed in accordance with 230.82(8).
(B) Feeder-Supplied Building or Structure. Type 2 SPDs (TVSSs) shall be connected at the building or structure anywhere on the load side of the first overcurrent device at the building or structure.
(C) Separately Derived System. The SPD (TVSS) shall be connected on the load side of the first overcurrent device in a separately derived system.

285.25 Type 3 SPDs.
Type 3 SPDs (TVSSs) shall be permitted to be installed anywhere on the load side of branch-circuit overcurrent protection up to the equipment served, provided the connection is a minimum 10 m (30 ft) of conductor distance from the service or separately derived system disconnect.

Reasons for Changes

The UL 1449 Standard was rewritten changing terminology and testing requirements for safety. The previous 2005 code was incompatible with the new UL standard. With more electronic loads that are easily damaged by surge voltages, more surge protective devices are being used; hence, changes were needed.

UL 1449, Standard for Safety of Surge Protective Devices, has re-defined the common terms for surge protective devices. The third edition of this standard doesn't go into effect until October of 2009. The code was revised to bridge the two very different terminologies, aiding the industry to migrate from the Second Edition of UL 1449 to the Third Edition.

How to Comply

A key requirement of the new code is to use a listed product. It is also important to have the product meet the latest UL standard. The UL procedure is to have effective dates for compliance with changed standards. If a company manufactures to the standard in effect at the time of manufacture, they can legitimately store that product and offer it for distribution long after the effective date for a revised standard.

For example, UL 1449 Second Edition was significantly revised for safety issues with a compliance date effective February, 2007. The increased safety tests required most manufacturers to redesign their products or stop making them altogether. Some manufacturers stocked up with the older design and are still supplying them to customers with a valid UL mark because they were manufactured prior to the compliance date of February 2007. Look for products that specifically meet "UL 1449 Second Edition Revised" or meet "Third Edition" to avoid safety liability and compliance issues.

The 2008 code requires that surge protective devices have a "Short Circuit Current Rating" (SCCR) marked on them. This makes it easy to apply a surge protective device with at least the capacity of the available short circuit current as required by code section 285.6.

The 2008 code also explains the application of various types of surge protective devices more completely. They are listed as Types 1, 2 and 3. Type 1 is used at or near the service entrance. Type 2 is used on the load side of the service entrance overcurrent protection. Types 1 and 2 are permanently connected into the electrical system. The Type 3 can only be applied at least 30 feet downstream from the service entrance.

Helpful Products

The Ferraz Shawmut SurgeTrap meets the latest safety standards and is designed for use in industrial control panels. It complies with UL 1449 Second Edition Revised, and the forthcoming UL 1449 Third Edition, for the latest safety requirements. The SurgeTrap has a rating of 200kA for Short Circuit Current Rating (SCCR) without external or auxiliary overcurrent protection. It has optional contacts to communicate to a PLC when it needs replacing. Details are available on the **us.ferrazshawmut.com** website.

9. Modified Arc Flash Requirements

Previous 2005 Code Requirements

The code is an installation document, not a safe work standard such as NFPA 70E. But the NEC does reference some key safety requirements pertaining to arc flash.

Since 2002 the code has had a requirement for labeling switchboards and some other equipment with a caution label. This label warns against potential arc flash hazards.

100. 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 **to recognize and avoid** the hazards involved.

110.16 Flash Protection.
Electrical **equipment, such as** switchboards, panelboards, industrial control panels, meter socket enclosures, 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.

Reasons for Changes

The definition of a qualified person in the prior NEC was vague regarding what kind of safety training a person needed to be considered a qualified person within the context of the code. The electrical inspector now has a basis for determining if a worker is a qualified person.

The previous requirement for labeling had a specific list of electrical equipment which didn't include disconnects. The revision is now expanding the list of equipment that is subject to the warning labels. The equipment listed in 110.16 are just examples instead of a complete list.

How to Comply

Workers should receive enough safety training to recognize and avoid electrical hazards. This is also a requirement of OSHA and NFPA 70E. In addition, OSHA requires the training to be documented.

The warning labels about arc flash hazards should be field applied to any electrical equipment operating at 50 volts or more and likely to be examined, inspected or maintained.

Helpful Products

The **us.ferrazshawmut.com** website offers extensive help on arc flash safety and compliance with safety standards. The site has an arc flash calculator for fuses, as well as technical papers based on research and testing performed at the Ferraz Shawmut High Current Test Lab in Newburyport, MA.

The AmpTrap 2000 family of fuses with their high degree of current limitation can be useful in reducing the arc flash hazard categories for a safer workplace.

Modified Arc Flash Requirements

10. Branch Circuit Overcurrent Devices Defined

Previous 2005 Code Requirements

The 2005 code in Article 100 added the definition of a supplementary overcurrent protective device. A supplementary overcurrent device is different from a branch circuit overcurrent device, and is applied down stream of and in addition to the branch circuit overcurrent device. This prior change was to offer guidance and to avoid individuals applying supplementary devices in place of the branch circuit overcurrent devices.

The code requires branch circuit rated overcurrent protective devices in most applications. Supplementary protectors can only be used in a few restricted applications. When supplementary protectors are used, they are required to be protected by an upstream branch circuit rated overcurrent protective device.

Supplementary protectors are normally listed to UL 1077 that has less rigorous requirements than UL 248 and UL 489 for branch circuit overcurrent devices. The supplementary devices are lower cost and often smaller than the branch circuit rated ones. As a result, there is a tendency to use the supplementary overcurrent devices in place of a branch circuit device creating a safety hazard.

> **100. Branch-Circuit Overcurrent Device.** A device capable of providing protection for service, feeder, and branch circuits and equipment over the full range of overcurrents between its rated current and its interrupting rating. Branch-circuit overcurrent protective devices are provided with interrupting ratings appropriate for the intended use but no less than 5,000 amperes.

Reasons for Changes

There were continuing misunderstandings regarding the use of supplementary protectors. The 2005 definition of a supplementary protector used the term, "Branch circuit overcurrent device", but that term wasn't defined in the code. The new added definition will clarify the applications of branch circuit overcurrent devices versus supplemental overcurrent devices.

How to Comply

When selecting branch overcurrent protection, use devices that are rated for branch circuit protection, not supplemental protection. The UL 1077 standard for supplemental protectors makes it clear that they are different from branch rated devices.

For instance, supplemental protectors have 480 volt conductor spacing of 3/8 inch in air and ½ inch over the surface. The branch circuit rated devices in UL 489 are required to have 1 inch in air and 2 inches over the surface. The supplemental devices can have low interrupting ratings, as low as 32 amps. The minimum branch circuit protective device interrupting current rating is 5,000 amps. The branch circuit rated devices meet a more rigorous short circuit and protective characteristic UL test program.

The proper application is to have branch circuit overcurrent rated devices with additional supplemental protectors for additional protection. Supplemental protectors can not be used as a substitute for required branch rated devices.

Helpful Products

The Ferraz Shawmut AJT, ATDR, and ATQR in particular are commonly applied to provide branch circuit overcurrent protection. The AJT, which is a Class J time delay fuse, may be applied with Ferraz Shawmut Socomec disconnect switch. The ATDR and ATQR are both Class CC fuses with the additional advantage of extremely small size.

The Ferraz Shawmut USFM is a three pole Class CC fuse holder with the same width as an IEC starter. Many times it can be directly substituted in the same space as a non-code compliant supplementary protector to provide simple code compliance.

A relentless pursuit of protection for electrical components, systems—and the people who use them.

Ferraz Shawmut is an international company manufacturing the widest range of circuit protection solutions in the electrical industry. Drawing on a century of experience—and an ongoing commitment to critical research in electrical safety—we provide industrial, commercial, and OEM customers with innovative products and technical support teams to increase effectiveness, simplify applications, and enhance productivity. Learn more about our circuit protection solutions at us.ferrazshawmut.com.

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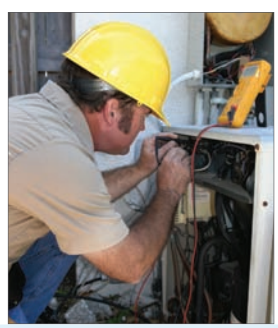
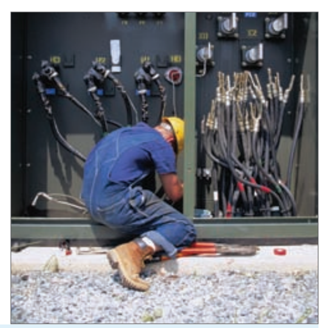

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