

Short-Circuit Current Ratings

Background

The 2008 NEC® has a new definition of “short-circuit current rating”. Previously there was no definition of short-circuit current rating (sometimes referred to as “withstand rating”), although it was referenced in several sections on the marking and proper application of various types of equipment. Because the term is referenced in multiple locations of the Code, it was necessary to add a definition to Article 100 of the NEC®.

Article 100 Definitions
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.



Figure 2

What is Short-Circuit Current Rating?

Short-circuit current rating (SCCR) is the maximum short-circuit current a component or assembly can safely withstand when protected by a specific overcurrent protective device(s) or for a specified time. Adequate short-circuit current rating is required per 110.10.

Interrupting rating is the maximum short-circuit current an overcurrent protective device can safely interrupt under standard test conditions; it does not ensure protection of the circuit components or equipment. Adequate interrupting rating is required per 110.9. The fuse in Figure 2 has a UL Listed interrupting rating of 300kA at 600Vac or less.

When analyzing assemblies for short-circuit current rating, both the interrupting rating of overcurrent protective devices and the short-circuit current rating of all other components affect the overall equipment short-circuit current rating. For instance, the short-circuit current rating of an industrial control panel typically cannot be greater than the lowest interrupting rating of any fuse or circuit breaker, or the lowest short-circuit current rating of all other components in the enclosure.



Figure 1

SCCR: When using (1) gauge wire protected by a (2) ampere maximum Class J fuse. This power distribution block is rated for use on a circuit capable of delivering no more than (3) kA rms sym. or dc amperes 600V maximum. Otherwise 10kA. Other SCCR options see datasheet.

(1) Wire range	(2) Max. Ampere	(3) SCCR
2-6 AWG	400	200kA
2-14 AWG	200	50kA
2-14 AWG	175	100kA

Figure 1 illustrates a power distribution block that has a default SCCR of 10kA per UL508A SB4 Table SB4.1 However, this PDB has been combination tested and UL Listed with higher SCCRs when in combination with specific types and maximum ampere rating current-limiting fuses. The label is marked with a 200kA SCCR when protected by 400A or less Class J fuses and the conductors on the line side and load side are in the range of 2 to 6 AWG.

For more on Cooper Bussmann® High SCCR PDBs see data sheet 1049.

“Short-circuit current rating” is not the same as “interrupting rating” and the two must not be confused.

Why is Short-Circuit Current Rating Important?

Short-circuit current ratings provide the level of fault current that a component or piece of equipment can safely withstand (based on a fire and shock hazard external to the enclosure). Without knowing the available fault current and short-circuit current rating, it is impossible to determine if components or equipment can be safely installed.

Specification and installation of new equipment with higher short-circuit current ratings, such as 200,000 amperes, makes it easy to meet the requirements of the NEC®. In addition, when equipment is later moved within a facility or from plant to plant, equipment with the highest ratings can be moved without worrying about unsafe situations that might

arise from placing the equipment in a new location where the available short-circuit current is higher than the old location and now above the rating of the equipment.

How to Determine Short-Circuit Current Rating?

For components, the short-circuit current rating is typically determined by product testing. For assemblies, the marking can be determined through the equipment product listing standard or by an approved method. With the release of the UL508A, UL Standard for Safety for Industrial Control Panels, an industry-approved method is now available. UL 508A, Supplement SB, provides an analytical method to determine the short-circuit current rating of an industrial control panel. This method is based upon the weakest link approach. In other words, the assembly marked short-circuit current rating is limited to the lowest rated component short-circuit current rating or the lowest rated overcurrent protective device interrupting rating.

How to Increase Short-Circuit Current Rating?

Protection with current-limiting fuses is the easiest, lowest cost and most effective way to achieve higher short-circuit current ratings. For components, a motor controller can be used to illustrate this point very well. The Cooper Bussmann® compact, non-fused disconnect, the CDF63, is a Listed UL 508 Manual Motor Controller with a maximum horsepower rating of 40hp at 480V. It is marked with a short-circuit current rating of 5kA when protected by a 150A (or less) Class H fuse or circuit breaker. However, the short-circuit current rating for the CDF63 is marked 100kA when protected by a 100A (or less) Class J or T fuse (Cooper Bussmann LPJ-110SP or JJS-100).

When using UL 508A Supplement SB, there are significant advantages to using current-limiting fuses in industrial control panels.

1. The high interrupting rating (typically 200kA) of current-limiting fuses increases the ability to achieve higher short-circuit current ratings. If using typical circuit breakers, interrupting ratings are often only 10,000 or 14,000 amperes, which limits the short-circuit current rating of the individual control panel to 10,000 or 14,000 amperes.
2. The use of current-limiting fuses in industrial control panels can also increase component short-circuit current ratings through combination ratings (higher fault current ratings of components when a specific overcurrent protection device is provided). Currently, the only method to achieve high short-circuit current ratings with terminal and power distribution blocks is through the use of current-limiting fuses.

3. If current limiting fuses are used in the feeder circuit of an industrial control panel, the let-through values in UL508A Supplement SB can be used to raise downstream branch circuit component short-circuit current ratings.

What are the Short-Circuit Current Rating Marking Requirements?

The NEC® has requirements for certain components and equipment to be marked with their short-circuit current rating. The important sections of the Code that require the marking of the short-circuit current rating include:

Industrial Control Panels

409.110 requires that an industrial control panel be marked with its short-circuit current rating; see Figure 3.



Figure 3

Industrial Machinery Electrical Panel

670.3(A) requires the nameplate on industrial machinery to include the short-circuit current rating of the machine industrial control panel. In previous editions of the NEC® (2002 Edition) and NFPA 79 (2002 Edition), the industrial machine nameplate was required to include only the interrupting rating of the machine overcurrent protective device, if furnished. This marking was misleading as it did not represent the short-circuit current rating of the machine industrial control panel, but could be misinterpreted as such.



Air Conditioning and Refrigeration Equipment with Multimotor and Combination-Loads

440.4(B) requires the nameplate of this equipment to be marked with its short-circuit current rating. There are three exceptions for which this requirement does not apply: one and two family dwellings, cord and attachment-plug connected equipment, or equipment on a 60A or less branch circuit. So for most commercial and industrial applications, air conditioning and refrigeration equipment with multimotor and combination loads must have the short-circuit current rating marked on the nameplate.

Meter Disconnect Switches (rated up to 600V)

230.82(3) permits a meter disconnect switch ahead of the service disconnecting means, provided the meter disconnect switch has a short-circuit current rating adequate for the available short-circuit current.

Motor Controllers

430.8 requires that motor controllers be marked with their short-circuit current rating. There are three exceptions for fractional horsepower motor controllers, 2 horsepower or less general-purpose motor controllers, and where the short-circuit current rating is marked on the assembly.

How to Assure Compliance?

To assure proper application, the designer, installer, and inspector must assure that the marked short-circuit current rating of a component or equipment is not exceeded by the calculated available fault current.

In order to assure compliance it is necessary to:

- Determine the available short-circuit current or fault current at the point of installation of the component or equipment.
- Assure the component or equipment marked short-circuit current rating is equal to or greater than the available fault current. (See Figure 4 for example).

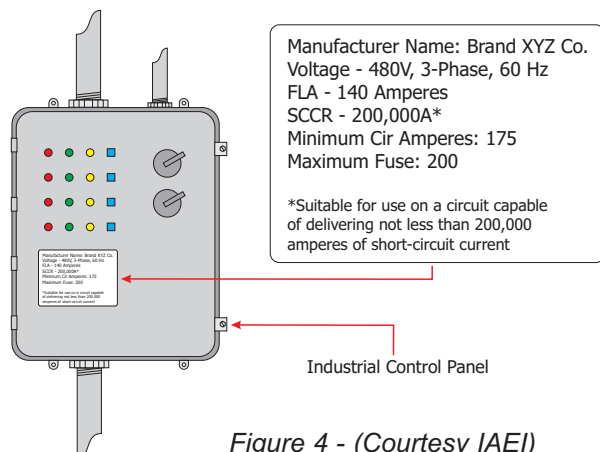


Figure 4 - (Courtesy IAEI)

Any installation where the component or equipment marked short-circuit current rating is less than the available fault current is a lack of compliance and violation of 110.10. In these cases, the equipment cannot be installed until the component or equipment short-circuit current rating is sufficient or the fault current is reduced by an acceptable method.

What Resources are Available?

Cooper Bussmann offers tools to assist with the proper application of short-circuit current ratings including:

Simplified Guide to SCCR – Basic Understanding of short-circuit current ratings and tools to determine the “weakest-link” for industrial control panels.

Advanced Guide to SCCR – In depth discussion of short-circuit current ratings, UL 508A Supplement SB, and how to fix weak-links of industrial control panels.

High SCCR Products

- Current-limiting fuses – high interrupting rating does not limit assembly SCCR and can increase other component ratings within industrial control panels.
- High SCCR Power Distribution and Terminal Blocks – high SCCR is available for feeder circuits (with UL 508A required feeder circuit spacings) and branch circuits. Open and enclosed (IP-20) power distribution blocks.
- Fuse holders, fused disconnects and non-fused disconnects with high SCCR

OSCAR™ (On-Line Short-circuit Current per UL508A Rating Calculator Software) – On-line calculator used to determine and document the short-circuit current rating of industrial control panels.

SPD (Selecting Protective Devices) – Details how to understand, determine and comply with short-circuit current ratings and other overcurrent protection issues.

Short-Circuit Calculator Program – free software download to calculate the available fault current at different points within the electrical distribution system.

For more information on the above see:

<http://www.bussmann.com/2/IndustrialMachineryandControl.html>

Short-Circuit Current Ratings

Note: There are other companion ratings that must be verified for compliance when installing or inspecting assemblies. These include:

1. Voltage Rating: be sure the voltage rating for an assembly is equal to or greater than the system voltage. When devices such as slash rated circuit breakers or motor controllers (ie 480/277) are used, the entire assembly is also limited. Per 240.85 and 430.83(E), a device, which is slash voltage rated, limits the application of that device to only solidly grounded wye systems where the voltage of any conductor to ground does not exceed the lower value and the voltage between any two conductors does not exceed the higher value. Similarly, an entire assembly would have the same limitation, if one or more devices in the assembly were slash voltage rated devices. For instance, if equipment is marked 480/277V due to the use of slash rated motor controllers, it can only be applied on 480/277V (or less) solidly grounded systems. It cannot be applied on 480V ungrounded, impedance grounded, or corner grounded systems. More information can be found on Voltage Rating on the Cooper Bussmann® website at www.cooperbussmann.com/2/ProtectiveDeviceRatings.html.

Article 240 VII. Circuit Breakers

240.85 Applications.

A circuit breaker with a slash voltage rating, such as 120/240V or 480Y/277V, shall be permitted to be applied in a solidly grounded circuit where the nominal voltage of any conductor to ground does not exceed the lower of the two values of the circuit breaker's voltage rating and the nominal voltage between any two conductors does not exceed the higher value of the circuit breaker's voltage rating.

Article 430 VII. Motor Controllers

430.83 Ratings

(E) Voltage Rating.

A controller with slash rating, for example, 120/240 volts or 480Y/277 volts, shall only be applied in a solidly grounded circuit in which the nominal voltage to ground from any conductor does not exceed the lower of the two values of the controller's voltage rating and the nominal voltage between any two conductors does not exceed the higher value of the controller's voltage rating.

2. Single Pole Interrupting Capability: Where higher fault currents are present, the single pole interrupting capability of circuit breakers and self-protected combination controllers can be of concern as indicated in the fine print notes of 240.85 and 430.52(C)(6). This is because the single pole interrupting capability is not always equal to the

three-pole rating. For instance, a 480V, 100A circuit breaker may have a three pole interrupting rating of 65,000A, but its single pole interrupting capability, based on UL 489 testing requirements, is only 8,660A. This single-pole interrupting capability becomes very critical for ungrounded, corner-grounded, and impedance grounded systems where full voltage can be seen by only one pole of the device. More information can be found on Single-Pole Interrupting Capability on the Cooper Bussmann® website at www.cooperbussmann.com/2/ProtectiveDeviceRatings.html.

240.85 (added in 2002 NEC®)

FPN: Proper application of molded case circuit breakers on 3-phase systems, other than solidly grounded wye, particularly on corner, grounded delta systems, considers the circuit breakers' individual pole-interrupting capability.

430.52(C)(6) (added in 2005 NEC®)

FPN: Proper application of self-protected combination controllers on 3-phase systems, other than solidly grounded wye, particularly on corner grounded delta systems, considers the self-protected combination controllers' individual pole-interrupting capability.

Other Considerations

Applying components or equipment within their short-circuit current rating does not mean the components can not sustain damage. UL Standards have evaluation criteria for acceptance to SCCR testing. Components and assemblies are tested in an enclosure with the bolted short-circuits external to the enclosure and door closed or cover fastened. The typical evaluation acceptance criteria by UL is

- The enclosure cannot become energized (shock hazard)
- The door or cover cannot blow open and there cannot be any large holes in the enclosure (fire hazard external to the enclosure). However, extensive damage may be permitted to the internal components.

Applying components or equipment within their short-circuit current rating, does not mean the equipment does not pose an arc flash hazard. Equipment certification tests are not run with arcing faults inside the enclosure. An arcing fault within a closed enclosure is a potentially serious hazard with the doors closed or open; incidents have been reported of doors being blown open, or off, due to arcing faults. A marked short-circuit current rating for an assembly does not signify that someone working on or near energized equipment will be uninjured if an arcing fault occurs with the doors either open or closed and latched.