

Understanding Short Circuit Current Rating (SCCR)

Meeting NEC 2005, Article 409 for Industrial Control Panels.

“Standard for Electrical Safety in the Workplace”, NFPA70E, was recently updated by the National Fire Protection Association. It primarily addresses fire and explosion hazards caused by arc flash in electrical equipment. The ultimate goal of this important initiative is to eliminate these events, thereby mitigating risk to facilities and – most importantly – injury to humans.

OSHA (Occupational Safety and Health Standards) 29-CFR, Part 1910.333, Sub-part S (Electrical), specifically addresses Standards for Work Practices and also references NFPA70E. The National Electric Code NEC 2005, Article 409 (NEC409, for short) was also amended to align with NFPA70E. Subsequently, in April of 2006, UL 508A Supplement SB was released as the guideline for panel fabricators to meet the requirements of NEC409. At the municipal, county and state levels, electrical codes are being amended at an increasing rate to include the requirement for SCCR labeling of industrial control panels per NEC409.

Often, industrial control panels used in electrical heating applications house power controllers. As an industry leader in this field, Control Concepts is keenly interested in the safe application of our SCR Power Controllers. Our goal is to heighten the awareness of the designers, fabricators and end-users of these panels as to the interplay between NEC409, UL508A Supplement SB and SCCR.

These materials should not be interpreted as an electrical design guide for industrial control panels intended to meet NEC409. Rather, as a roadmap to key terms, design / installation considerations and other available reference resources.

Key Definitions:

SCCR: “The maximum short circuit current a component, assembly, or equipment can safely withstand when protected by a specific overcurrent protective device, or for a specified time interval.”

Interrupt Rating (IR): “The highest current, at rated voltage, that a device is intended to interrupt under standard test conditions.”

The maximum SCCR of an industrial control panel must always be equal to or greater than the Fault Current available from the electrical feeders from which it draws power. Otherwise, a catastrophic and violent equipment component and enclosure failure can occur during a short circuit event. Note that arc flash hazards can still exist in electrical control panels regardless of the assigned SCCR. Safe electrical work practices should always be heeded, and are not covered within this scope.



What is SCCR and why the recent attention?
It's all about safety.

NEC409 covers industrial control panels intended for general use, operating at 600V or less. Typically, these house power circuit components which supply main line power to loads such as motors, heaters, lighting, appliances or receptacles. Compliance requires that the exterior of all industrial control panels be marked with the SCCR, as calculated or tested per the procedures outlined by UL 508A SB and stipulated by NEC409.22 as: “An Industrial Control Panel shall not be installed where the available Fault Current exceeds its SCCR as marked in accordance with NEC409.110, paragraph 4.”

Therefore, selecting overcurrent protection devices (circuit breakers or fuses) with the appropriate IR specification is a safety essential and a required step in meeting NEC409.

Determining SCCR

Three basic methods exist for determining the SCCR for industrial control panels:

1) Test each unique panel construction.

- This is usually financially impractical, unless numerous panels of identical design are involved.
 - o Testing must be witnessed by a UL project engineer – a paid service.
 - o Record the construction in a follow-up procedure, which must also be reviewed by UL - a paid service.
 - o Given the numerous possible component combinations within a panel, this requires a tremendous investment in testing and record-keeping.

2) Purchase previously tested combinations from a major manufacturer.

- Also known as “coordinated selection”.
 - o Major component manufacturers – typically of breakers, fuses, VF drive/starters - provide software tools for panel designs using common combinations, to which a documented SCCR is assigned for the grouping.
 - o Deviations from these standard groupings will invalidate this approach.

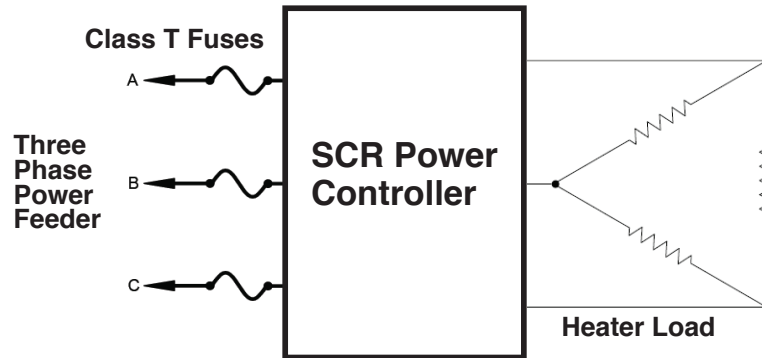
3) Utilize the method described in UL508A, Supplement SB.

- This is the best approach in most cases, but requires care in selecting panel devices with adequate SCCR.
 - o The procedure is basically a “weakest-link-in-the-chain” evaluation, where the installed device with the lowest SCCR will dictate the overall SCCR of the entire panel.

Many manufacturers do not invest in actual SCCR testing, instead relying on the default SCCR values assigned by UL based on device category. For SCR power controllers this value is 5,000 Amps (5 KA), if UL certified testing is not performed. Many installations require industrial control panel SCCR to be 35, 65 or 100KA, so designing an industrial control panel which includes devices with low SCCR can be a major challenge.

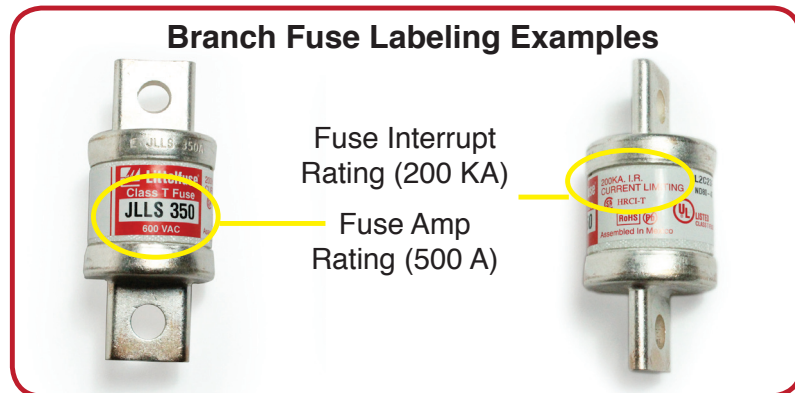
An example design scenario will help to illustrate this.

An electric heating load panel housing a 400 Amp SCR power controller will be directly connected to a 480 V feeder circuit with a predetermined Fault Current of 100 KA. In order to protect the branch circuit from exceeding its rated current, a current-limiting circuit breaker or fuse should be included; in this case a fuse is selected.



Fuse Specifications:

- Class: T, 600V
- Rating: 500A
- IR = 200 KA



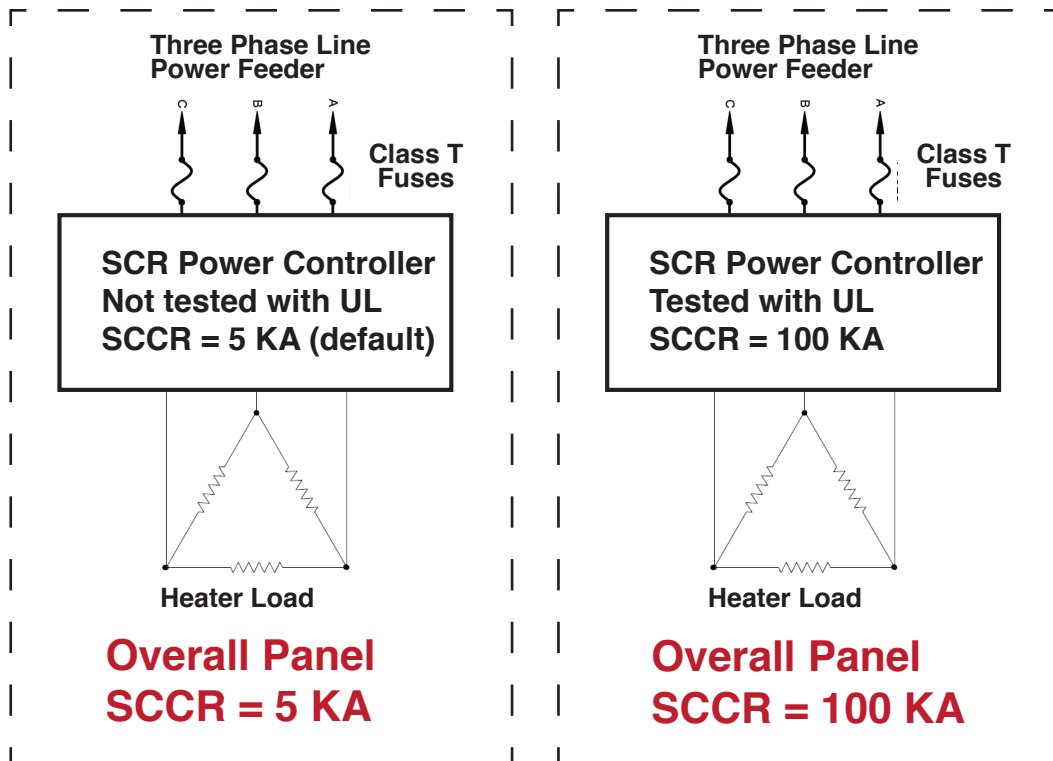
In accordance with NEC409, in order to safely connect directly to the feeder circuit, the panel must be designed for a minimum SCCR of 100 KA. So far, the design appears sound. The feeder circuit Fault Current is 100 KA and the fuse IR of 200 KA exceeds that value, as required. At this point, an erroneous assumption is often made: The panel SCCR = fuse IR = 200 KA. This is not necessarily true!

UL508A, Supplement SB, Section 4.3.3 outlines the method for determining how other branch devices – even if protected by current-limiting fuses – impact overall panel SCCR. It is a “weakest-link-in-the-chain” evaluation, meaning that the lowest SCCR circuit within the panel will ultimately determine the overall SCCR of the entire control panel. It specifically addresses the above erroneous assumption (that the panel SCCR = fuse IR) which is only valid if the remaining devices in the branch circuit have an SCCR not less than the I_p (peak let-through current) of the fuse. Referring to the manufacturer’s data sheet or UL508A Supplement SB, Table SB 4.2, for the fuse selected, $I_p = 42$ KA.

Consider the branch circuit, namely the SCR power controller. If the manufacturer has not tested and certified the device with UL to achieve an elevated SCCR for the device, then an SCCR default value of 5 KA is assigned, per UL508A Supplement SB, Table SB 4.1. Since the SCR power controller SCCR of 5 KA is less than the fuse I_p of 42 KA, the overall control panel SCCR will be only 5 KA. The panel will not meet NEC409 and if local electrical code requires this compliance - it cannot be directly connected to the feeder circuit. Now what?

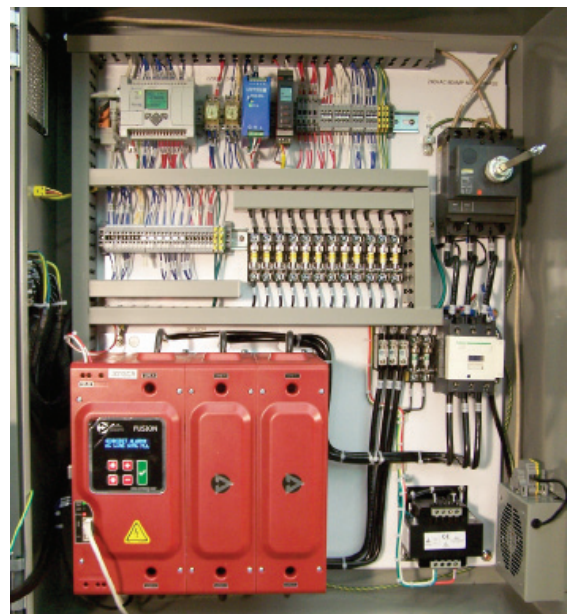
One possible workaround is to install a current limiting reactor (transformer) between the feeder circuit and the control panel. This approach would incur significant additional cost and require additional space, which might not be available for a given installation. But there is a much better solution!

Leading electrical component manufacturers have made the investment to test their devices at UL, in order to achieve SCCR certification much higher than the UL default values. Specifying these superior devices often eliminates the need for additional branch circuit breakers / fuses and intermediate feeder reactors. The overall benefit realized by selecting an SCR power controller certified to high SCCR is evident in our design example:



Control Concepts FUSION / Compact FUSION series of SCR Power Controllers are UL certified to 100 KA SCCR - much above the 5 KA default value.

Surprisingly, the cost of these best-in-class devices is about the same as other untested devices in their category. Any cost differential will be more than offset by the savings realized through the elimination of unneeded circuit breakers / fuses, reactors, excess panel wiring and engineering manpower.



References and further reading:

UL 508A Standard for Safety
Electrical Control Panels, Supplement SB ©
Underwriters Laboratories Inc.

[http://www.ul.com/global/eng/pages/offerings/industries/powerandcontrols/
industrialcontrolequipment/shortcircuit/](http://www.ul.com/global/eng/pages/offerings/industries/powerandcontrols/industrialcontrolequipment/shortcircuit/)

UL 508A eLearning Courses

<http://lms.ulknowledgeservices.com/catalog/display.resource.aspx?resourceid=421897>

National Fire Protection Association

NFPA 70 2002- National Electrical Code®

NFPA 70E 2000- Standard for Electrical Safety Requirements for Employee Workplaces

www.nfpa.org

Occupational Safety and Health Administration

OSHA Standards 29-CFR, Part 1910.333, sub part S (electrical)

www.osha.gov

IEEE Guide for Performing Arc-Flash Hazard Calculations

IEEE standard No. 1584-2002

www.ieee.org

“ELECTRICAL SAFETY HAZARDS HANDBOOK”

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