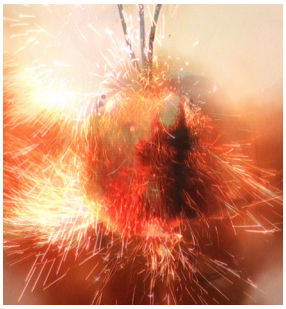
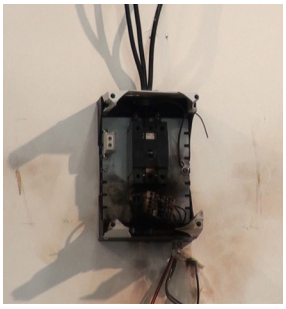
# CRITICAL SAFETY TIPS ON SHORT-CIRCUIT CURRENT RATING FOR INDUSTRIAL CONTROL PANELS AND INDUSTRIAL MACHINERY

## Determining SCCR, avoiding misapplications and how it relates to arc flash



**SCCR represents the maximum amount of current that the assembly can safely withstand under short-circuit conditions.**

A short-circuit current rating (SCCR) for equipment is required by NEC® 409.110(4) and 670.3(A). SCCR represents the maximum amount of current that the assembly can safely withstand under short-circuit conditions. Additionally, the following general statement related to SCCR is included in NEC 110.10:

"The overcurrent protective devices, the total impedance, the equipment short-circuit current ratings, and other characteristics of the circuit to be protected shall be selected and coordinated to permit the circuit protective devices used to clear a fault to do so without extensive damage to the electrical equipment of the circuit."

Understanding how the SCCR of an industrial control panel is determined and what the markings on the product signify will help ensure that the industrial control panel is adequate for the available fault current at the point of installation.

Industrial control panels are defined by the NEC section 409.2 as an assembly of two or more power circuit components, control circuit components, or any combination of power and control circuit components. Industrial control panels are listed in accordance with ANSI/UL 508A, the Standard for Industrial Control Panels, and covered by UL product category NITW (Industrial Control Panels) as factory-wired assemblies of industrial control equipment, such as motor controllers, switches, relays, and auxiliary devices. The panels may include disconnecting means, power distribution blocks, motor controllers, and branch-circuit protective devices. UL Listed products installed and used in accordance with their listing are considered by the NEC to meet these requirements. Short-circuit current ratings marked on the equipment provide the information needed to help ensure a safe, code-compliant installation.

For UL 508A panel manufacturers, two options are available to obtain the needed SCCR for a given panel:

1. Apply the method described in UL 508A, Supplement SB (determining SCCR based on the components in the power circuit). If the industrial control panel contains only control circuit components, marking the SCCR is not required (also noted in NEC section 409.110(4) Exception).
2. Test a panel to achieve ratings higher than the value determined using Supplement SB.

UL 508A Supplement SB is the preferred option for nearly all industrial control panels. The overall process of this is to:

1. Identify the lowest component SCCR and/or component combination SCCR rating with an overcurrent protective device (OCPD).
2. Increase the branch component SCCR and/or component combination SCCR rating with a feeder current-limiting OCPD.
3. Identify the lowest interrupting rating of overcurrent protective devices in the industrial control panel.

The lowest component SCCR (steps 1 and 2) and the lowest interrupting rating of the overcurrent protective device (step 3) results in the overall assembly SCCR.

For step 1, power circuit components (components that supply power to external loads such as motors, lighting, heating, appliances, or convenience receptacles), the SCCR is determined by either the product markings or the instruction sheets. If there are no product markings, a default value can be used as indicated in UL 508A, Supplement SB, Table SB4.1.

As mentioned previously, the SCCR of the industrial control panel must be adequate for the available fault current at the point of installation. In most applications, a default SCCR of 5 kA is not adequate.

For these installations, UL 508A Supplement SB allows the manufacturer of the industrial control panel to achieve the required SCCR by using power circuit components that have been tested by the component manufacturer for a high fault rating and incorporating them into the industrial control panel manufacturer's UL report (Procedure).

For step 2, it's possible to raise the ratings of branch power circuit components – those on the loadside of the branch-circuit overcurrent device (the overcurrent device closest to the load). Any component or overcurrent device on the lineside of the branch-circuit overcurrent device is in the feeder circuit. When a current-limiting device (fuse or circuit breaker marked current-limiting or a transformer) is located in the feeder circuit, it can be investigated to determine if it can increase branch circuit component SCCR ratings. When transformers are used, both the branch-circuit overcurrent device interrupting rating and the component SCCR are able to be increased.

However, when current-limiting overcurrent devices are used, only the component SCCR can be increased. It is not permitted to increase the branch-circuit overcurrent device interrupting rating.

The final step is verifying the lowest interrupting rating of the overcurrent devices in the industrial control panel. If this is lower than any power circuit component after the steps above, the assembly SCCR is lowered to this value.

Although the overall process may seem simple and straightforward, understanding the rules of UL 508A Supplement SB and the proper application of devices is a complex and challenging concept. This is especially true with regards to the use of current-limiting devices as noted in step 2.

## Common misapplications in industrial control panels

Each component in an industrial control panel must be properly applied for safe and reliable operation. The application requirements for each component are often quite complex and unique to the component, resulting in erroneous interpretation, leading to improper use of the component. We will review some of the most common misapplications of components within the panel.

**UL 508 Listed control components used as a main feeder**

- UL 508 switches Listed as a "manual motor controller" are designed to be used for the on/off or manual motor controller function to meet NEC requirements in Article 430, Part VII. Their testing requirements and creepage and clearance distances are less than those required by UL 98. They are not suitable for use as main, feeder or branch circuit disconnects.
- UL 98, the Standard for Enclosed and Dead-Front Switches, Listed disconnects switches have more robust testing and creepage and clearance distance requirements and can be applied on mains, feeders and branch circuits of service entrance equipment, panelboards, switchboards, motor control panels, industrial machinery and control panels.

**Manual motor starters or manual motor protectors as branch circuit overcurrent protection**

- UL 508 manual motor starters (or manual motor protectors) are permitted to provide motor control (on/off) and motor overload protection as required per NEC 430.32. For proper application they require a motor branch-circuit OCPD, and a motor branch-circuit and controller disconnect on the lineside. These devices are not Listed nor permitted to provide branch circuit overcurrent protection for any load.
- UL 98 disconnect or UL 489, the Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures, circuit breakers meet the requirements for branch circuit overcurrent protection. UL 508 Type E/F combination motor controllers are only suitable for protection of a single motor load, they are not suitable for protection of group motor applications or other types of loads.

**Fuse holders used as a disconnecting means**

- UL 4248, the Standard for Fuseholders, fuseholders are not intended for use as a load-break rated device. They cannot be used alone as a motor branch-circuit and controller disconnect, or as an "at-the-motor" disconnect to meet NEC 430.109, nor can they be used alone as a motor controller (on/off function) to meet NEC Article 430, Part VII.
- Use a load-break rated device, such as a UL 98 disconnect switch, as the disconnecting means for main, feeder and branch circuits.

**Supplementary protectors (mini-breakers) or supplemental fuses used as branch-circuit protection**

- Supplementary protectors, such as UL 1077, the Standard for Supplementary Protectors for Use in Electrical Equipment, recognized minibreakers or supplemental fuses, offer limited protection and performance, and are only intended for use in circuits where branch circuit protection is already provided. They cannot be used in place of a branch circuit OCPD and should generally be limited to use in control circuits.
- UL 489 circuit breakers and UL 248, the Standard for Low-Voltage Fuses, "Class" fuses are suitable for use as branch-circuit protection and can be safely applied in main, feeder or branch circuits.

**Improper or insufficient OCPD interrupting ratings**

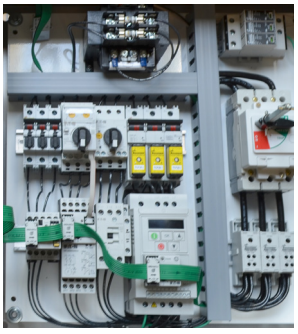
- NEC 110.9 requires equipment intended to interrupt current at fault levels to have an interrupting rating sufficient for the available fault current at the point of application. Low interrupting ratings are a limiting factor in overall assembly SCCR, as the panel SCCR can never be higher than the lowest OCPD interrupting rating.
- Use OCPDs with interrupting ratings adequate for the available fault current and desired SCCR of the panel.

**UL Recognized terminal blocks in feeder circuits**

- UL 1059, the Standard for Terminal Blocks, UL Recognized terminal blocks do not meet the required creepage and clearance distances in UL 508A. These terminal blocks are typically suitable for use in branch circuits only. Additionally, they may not have been evaluated for high SCCRs.
- UL 1953, Outline of Investigation for Power Distribution Blocks, Listed power distribution blocks meet the creepage and clearance requirements for feeder circuits and should be used for proper power distribution to multiple branches. Multi-wire terminals with shrouds used on fused switches or circuit breakers can often meet the creepage and clearance requirements as well.

**A slash rated device in any system other than solidly grounded wye**

- Slash voltage (such as 480Y/277V) rated OCPDs can only be applied where the system's line-to-ground system voltage does not exceed the lower of the two numbers. This limits slash voltage rated devices to solidly grounded wye applications, and when any slash rated devices are used in a panel or assembly, the equipment's voltage rating must reflect this limitation that restricts the equipment's installation in only solidly grounded wye systems.
- A straight voltage (such as 480V) rated OCPD can be installed in any electrical system regardless of the type of grounding employed.



**Each component in an industrial control panel must be properly applied for safe and reliable operation. The requirements for each component are unique and often misunderstood.**

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**Determining SCCR of industrial control panels per the 3rd Edition of UL 508A**
*with John Kovacik (UL) and Dan Neeser (Bussmann)*

**November 20, 2019**
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**How to avoid common misapplications in industrial control panels**
*with John Kovacik (UL) and Christy Rosati (Bussmann)*

**December 3, 2019**
**10:00 a.m. CT**
**How is arc flash different from SCCR?**
*with John Kovacik (UL) and Joe Pavia (Bussmann)*

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## SCCR versus arc flash

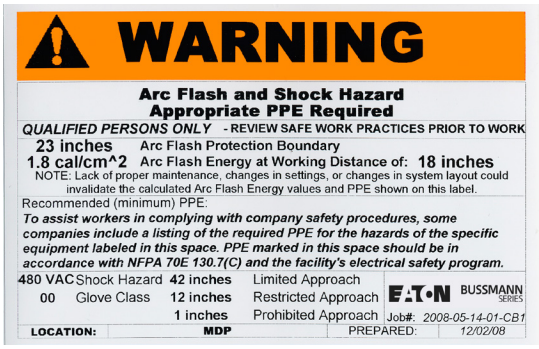
**How does arc flash relate to SCCR?**

Equipment SCCR represents the maximum amount of short-circuit (fault) current that the assembly can safely withstand under short-circuit conditions. When the industrial control panel or industrial machinery does not have an adequate SCCR for the available short-circuit (fault) current an electrical hazard exists.

The IEEE 1584 standard is the method in calculating arcing currents and incident energy level. When the upstream OCPD is the only device considered when calculating the industrial control panel incident energy and, i.e., the industrial control panel SCCR is not included in the calculation, a major hazard exists. OSHA section 1910.303(b), requires equipment (new and existing) to be rated to handle the available fault current without causing a hazard. For example; a fuse or circuit breaker is feeding an industrial control panel that has a 5kA SCCR. The available fault current on the line-side of the industrial control panel is calculated to be 15kA. If the industrial control panel SCCR is not considered in the calculation, the incident energy is based only on the magnitude of the arcing fault and the time to clear the fault by the fuse or circuit breaker. A label will be generated based on the incident energy calculated and placed on the inadequate SCCR industrial control panel. In other words, the industrial control panel is not rated for the available fault current, which could result in extensive damage creating a dangerous situation for anybody working on or near the panel.

In the above example, the arc flash warning label should state "DANGER," no one should be allowed to work on or near the panel when energized until the proper industrial control panel SCCR is achieved.

The NEC and UL recognize the need to provide adequate protection against short-circuit events. This can only be achieved by understanding available fault current, communicating protection requirements to personnel and equipment suppliers, and properly applying components in the industrial control panel. Execution of a proper equipment SCCR plan will help provide adequate protection for employees and equipment.

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