



The 10 most common challenges when building industrial control panels

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Abbreviations:

AHJ = Authority Having Jurisdiction

BCP = Branch Circuit Protection

CAN/ULC = Canadian Standard

CCN = Category Control Number

CEC = Canadian Electrical Code

IEC = International Electrotechnical Commission

EN = European Standards

IEC/EN = see above

IP = Ingress Protection

NEC = National Electric Code

NFPA = National Fire Protection Association

R/C = UL Recognized

SCCR = Short Circuit Current Rating

Introduction

The construction of an industrial control panel (ICP) for the international market may be associated with several challenges. This is often the case when it comes to questions about the application or interpretation of guidelines and standards for specific markets such as North America. Essentially, these are questions relating to the North American Standard, UL 508A, the Standard for Industrial Control Panels, and CSA C22.2 No. 286-17. However, this can also be useful for other markets to help avoid

additional costs and extra work. With the ever-increasing pressure of cutting project times and costs, these challenges can have a significant impact on your project success.

Based on frequently asked questions from panel builders and our many years of experience in the testing and certification of industrial control panels, we have compiled a list of the 10 most common challenges as well as some useful advice on how to overcome these.



1. Applying the incorrect standard

During the code authority inspection or certification (listing or field evaluation) of your panel, it could be identified that an incorrect standard has been used which is not valid for the intended application. This can lead to significant delays, which may require additional steps and extra work. This results in an extension of the project time, as well as additional costs, and reduced customer satisfaction. While IEC/EN guidelines and standards for panels are applied in many countries, other codes and standards exist for the North American market (NEC, CEC, UL 508A, CSA C22.2 No. 286-17, NFPA 79). ⚠️ **You should also note that UL 508A is not intended for the following types of applications:**

- Fire pump controllers, covered under UL 218, the Standard for Fire Pump Controllers
- Panelboards, covered under UL 67, the Standard for Panelboards
- Panels in hazardous locations, covered under e.g. UL 1203, the Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations
- Industrial control panels with intrinsically safe (IS) barriers, covered under UL 698A, the Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations
- Motor control centers, covered under UL 845, the Standard for Motor Control Centers
- Fire protective signaling systems, covered under CAN/ULC S561, Installation and Services for Fire Signal Receiving Centres and Systems
- Dead-front switchboards, covered under UL 891, the Standard for Switchboards

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2. Selection and dimensioning of components

One of the main challenges in panel construction is the selection and dimensioning of components. The selection of the correct components can be difficult due to the large number of existing components that are similar, the desired application area and the required specification according to the applicable standard. Incorrect selection of one or more components can lead to rejection or delay in the acceptance or certification of the panel.

UL Product iQ™ online database makes it easy to find the right UL Certified component. To facilitate the search, similar products are grouped together using a Category Control Number (CCN). In addition to the general information, the data sheet also contains the most important specifications that are required in connection with the planned application/required standard.

Get help with selecting components in accordance with the standard and to find the CCN:
www.ul.com/resources/ul-508a-supplement-sa-specific-component-requirements

UL Product iQ™ online database: iq.ulprospector.com/info/

3. Supplementary protection instead of branch circuit protection

Where can supplementary protectors be used and where must a branch circuit protection (BCP) be used? In general, supplementary protectors, covered under UL 1077, the Standard for Supplementary Protectors for Use in Electrical Equipment, can be used where UL 489, the Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures, protection is not required.

💡 **When a BCP is to be applied, protection is provided by a UL489 rated circuit breaker or a UL248 listed fuse.** The dimensioning of the BCP is based on the characteristics of the BCP and the rated motor current, restricted by information on nameplates, such as soft starters and operating instructions of frequency drives.

Scope of

- [UL 489 Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures](#)
- [UL 1077 Standard for Supplementary Protectors for Use in Electrical Equipment](#)
- [UL248 Low-Voltage Fuses](#)





4. Enclosures

In Europe, enclosures are classified according to IP Rating and in North America according to Type Rating (protection class required by the NEC). 💡 **The IP Rating is not a substitute for the Type Rating and therefore cannot be adopted interchangeably for enclosures in the North American market.** In this market, these enclosures must be UL Listed (protection class according to the environmental conditions). A list of the Type Ratings, their applications, and the environmental conditions for which they are designed to protect against can be found in section 5.8 of UL 50, the Standard For Safety For Enclosures for Electrical Equipment, Non-Environmental Considerations.

A further challenge for enclosures are the openings for components, e.g. for wireways or ventilation. In order to keep a given Type Rating (other than 1), all component openings must be equipped or covered with UL Listed/ Recognized parts that maintain the desired Type Rating. 💡 **Tables 19.2 and 19.3 of UL 508A helps to identify the correct markings that these components must have for your application.**



5. Power supplies (R/C versus listed, industrial device instead of Class 2)

Switched mode power supplies are used frequently and in many variants in control cabinets. This results in a range of different approvals. UL 508 or UL 61010-2-201, the Standard for Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 2-201: Particular Requirements for Control Equipment, Listed power supplies can be used without restrictions. Those that are R/C to UL 60950-1, the Standard for Information Technology Equipment – Safety – Part 1: General Requirements and without an enclosure, must

have an additional fuse protection at the output sized at a maximum of 50% of the rated power supply output current.

💡 If the output voltage of the power supply is 60 volts or less, it is possible to use one with an NEC Class 2 approval, UL 1310, the Standard for Class 2 Power Units. This allows the following wiring to be carried out simpler.

6. Nameplate, circuit diagram and warnings

Often questions arise regarding nameplate placement, what information it must contain and which warnings must be provided. For some standard signs, on-site purchase is possible if necessary. In the case of special designs or the nameplate, this is only possible to a limited extent and can therefore lead to the loss of valuable time and money.

💡 **Table 52.1 in UL 508A provides an overview of the labeling.** In addition, there are other markings inside the switch cabinet, e.g., on the fuse holders and in areas where external components are connected. In most cases there must be a circuit diagram inside the control panel.

General information about the labelling requirements:

- Nameplate
 - Manufacturer's name
 - Complete electrical rating of each input
 - Field wiring diagram number
 - Factory identification (if needed)
 - Enclosure type rating per Section 19 requirements
 - Short circuit current rating (SCCR, see UL 508A - SB5.1.1)
- External load ratings

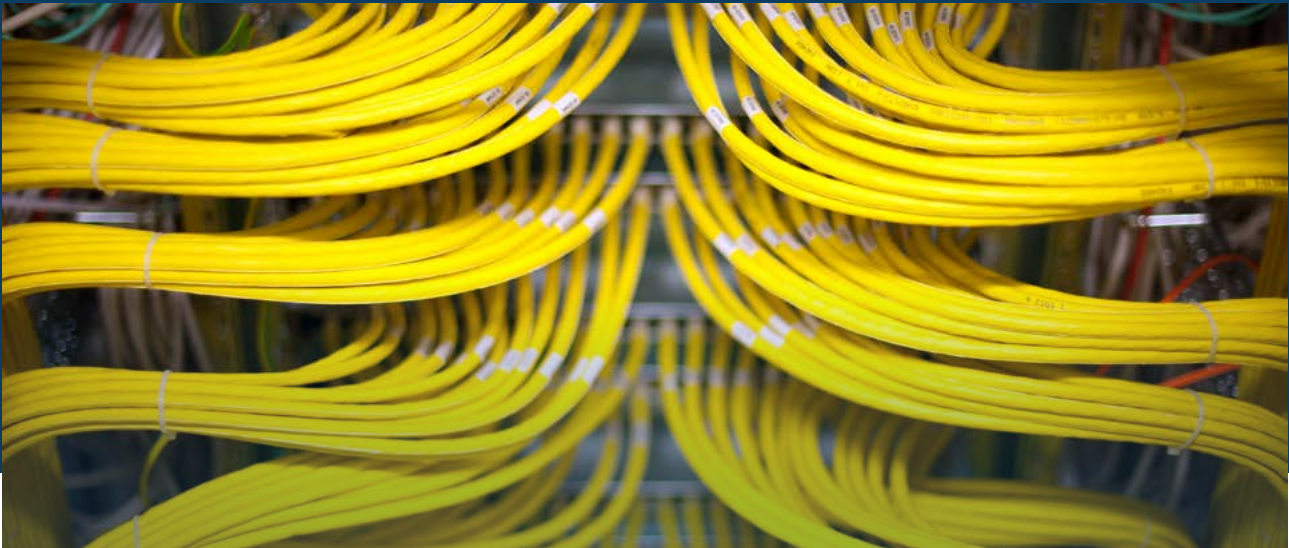


7. Traceability of the certification, e.g., for cables

The components used must have UL certification. For cables used for internal wiring, this is typically the UL Mark or the sticker on the drum. This shows a consecutive number together with the cable length. This proof must be kept and presented to an inspector on request.

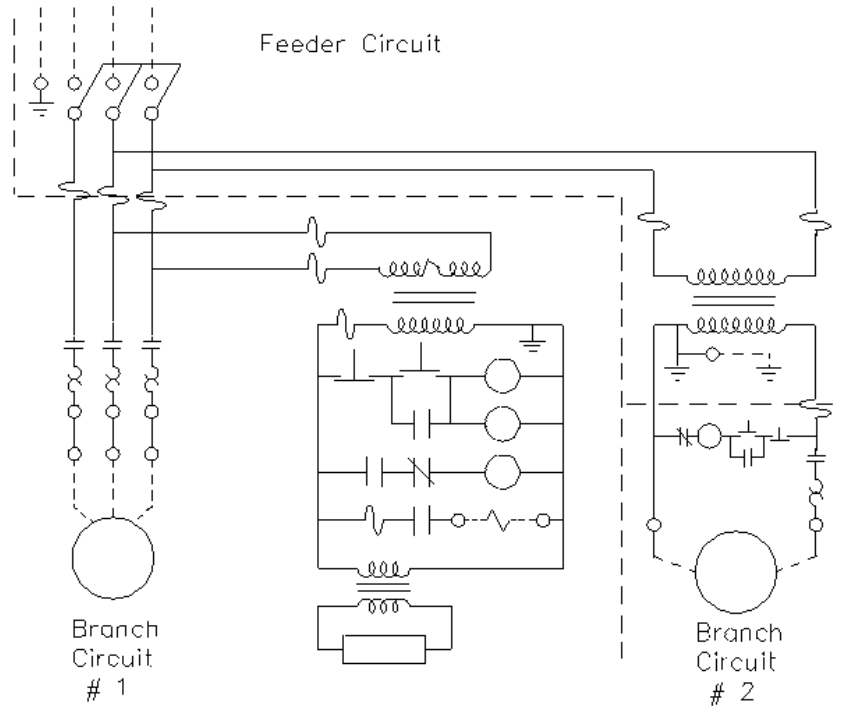
8. Frequency drives are incorrectly protected

Frequency drives are often a challenge in terms of protection. Typically, the manufacturer provides special protection specifications for North America in their manuals. These specifications must be implemented, as they were determined during inspection as part of the drive approval process.



9. Feeder and branch mix up

The question often arises which components inside a panel belong to the feeder and which to the branch circuit. A branch circuit is defined as a circuit that follows the last overcurrent protection device. ⚡ **A feeder is defined as everything between the feeding side of the building and the last overcurrent protection devices.** This distinction is important because the requirements regarding clearance and creepage spacings are higher in the feeder than in the branch circuit. This leads to a restriction in the selection of components in the feeder.



S3774

Example circuit to illustrate feeder and branch
(from UL 508A, Figure 6.3)

10. Short circuit current rating incorrect or missing

During an inspection of the industrial control panel, it is discovered that the short circuit current rating (SCCR) information is missing on the nameplate. This rating is required in the NEC®, for example, and is verified by the code authority.

SCCR is a value that indicates the maximum short circuit current that the component or assembly can withstand, also known as the short circuit resistance. This mainly concerns the power circuit. It is recommended to select UL Certified components, as the SCCR has already been tested and is indicated on the component. This reduces the effort required to determine the SCCR for the panel.

Early assessment at the beginning of the panel project is recommended so that any necessary adjustments can be made at an early stage. Changes made at a later stage can cause additional costs and lead to a delay in completion.

💡 **A list of tested combinations is available under the following link:**

www.ul.com/resources/short-circuit-current-ratings-combination-motor-controller-components

💡 **When determining the SCCR, it is important to take local conditions and requirements into account and not just assume general standard requirements.**

The SCCR can be determined as follows:

- Step 1: Analyze Components
 - in power circuits
 - BCP of Control Circuits
 - Markings on Components (High-Fault rating)
 - Exempted Components
- Step 2: Determine overall SCCR using:
 - Weakest link
 - Limiting Components in feeder: Transformer, Fuses, Current limiting breakers
 - Combination Testing
- Step 3: Marking on nameplate of panel per NEC 409





Additional resources

- [Common Misapplications of Components in Industrial Control Panels \(ICP\)](#)
- [Frequently Asked Questions on Common Misapplications in ICP](#)
- [Determining SCCR for Industrial Control Panels and Industrial Machinery](#)
- [Top 10 Questions on Determining SCCR of Industrial Control Panels ...](#)
- [Industrial Automation and Control System Cybersecurity](#)

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