

A photograph of two men in a server room. The man on the left is wearing a white shirt and holding a smartphone, gesturing with his hand. The man on the right is wearing a blue and white checkered shirt and glasses, holding a stack of papers. They are standing in front of server racks with blue lighting. In the top left corner, there is a white box containing the Siemens logo and tagline.

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# Industrial control panels for North America

Recent changes in the relevant standards in the USA and Canada

## White Paper | December 2017

Standards are regularly supplemented or revised to keep pace with the rapidly changing state of the art. This is also the case in the North American market, where a lot has happened in the last year or two: two completely new Canadian standards for control panel and machine building have been published since 2016, and electrical designers also have revised standards to take into consideration for the US market. This white paper summarizes the currently applicable North American standards and the most important changes.

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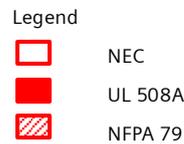
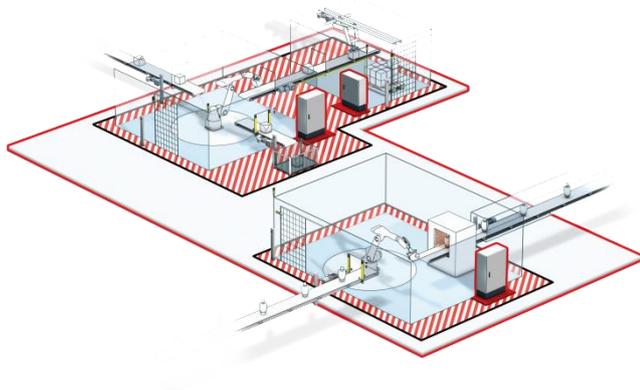
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# Summary of US standards

## The three key US regulations

The following standards are of major significance to control panel and machine builders:

- NEC (National Electrical Code, NFPA 70) as the highest-level regulation for installation
- UL 508A for industrial control panels
- NFPA 79 for industrial machinery (Electrical Standard for Industrial Machinery)



## Current standards

The following table summarizes the currently applicable versions of the standards (as of: December 2017)

Standard	Last revised	Expected revision
NEC 2017	August 2016	2019 (NEC 2020)
UL 508A, 2nd Edition, 2nd Revision	July 2017	2018 (UL 508A, 3rd Edition)
NFPA 79, Edition 2015	May 2014	2018 (NFPA 79, Edition 2018)

The following pages outline details of the individual standards and their most important revisions.

# National Electrical Code (NEC)

## General information on the NEC

The National Electrical Code (NEC) is the only code for electrical installations recognized by national law in the USA, making it **the** electrical installation regulation for the USA. It is published by the NFPA (National Fire Protection Association) as NFPA 70. The NEC is revised and reissued every three years. The most recent version is NEC 2017. However, it does not apply automatically in the whole of the United States upon publication, as it has to be adopted and accepted by each individual state.

**Tip:** Check which code is accepted in which state! An up-to-date map can be found on the NFPA website ([www.nfpa.org/NEC/NEC-adoption-and-use/NEC-adoption-maps](http://www.nfpa.org/NEC/NEC-adoption-and-use/NEC-adoption-maps)).

The NEC makes reference to the standards for the application in question in the form of an "Informational Note".

- UL 508A (Article 409): Industrial Control Panels
- NFPA 79 (Article 670): Industrial Machinery

## Important changes in NEC 2017

Compared to the previous version, NEC 2014, there are three places with changes concerning Short-Circuit Current Rating (SCCR):

- Article 409.22 (B) Short-Circuit Current Rating - Documentation  
The maximum available short-circuit current at the industrial control panel now has to be documented together with the date the short-circuit current calculation was performed and, upon request, shall be made available to the "Authorities Having Jurisdiction".
- Article 670.5 Short-Circuit Current Rating  
Industrial machinery shall be marked in the field with the maximum available short-circuit current. The field marking(s) shall include the date the short-circuit current calculation was performed.

The revisions mentioned here are directed at owners and not at control panel or machine builders. The control panel or machine builder only has to design the electrical equipment according to the available short-circuit at the terminal for the incoming supply circuit specified by the owner. If we assume that owners will prefer to "play safe" when calculating the "available short-circuit current", we expect that higher SCCR values will tend to be stated for industrial control panels and industrial machinery in future.

# UL 508A

## General information on UL 508A

The UL 508A application standard for industrial control panels is issued by UL (Underwriters Laboratories Inc.®), a US testing and certification organization in the field of product safety. According to NEC Article 100, an industrial control panel is an arrangement of two or more components in the power circuit, control circuit or hybrid circuits.

UL 508A (the standard relevant to industrial control panels) covers industrial control panels with a voltage up to 1,000 V for normal ambient conditions. The entire electrical installation between the electrical infeed and the outgoing terminals to the field is included in the scope. Outside of the control panel, only the interfaces (e.g. field wiring terminals) to the field not wired up by the machinery manufacturer are covered by the standard.

The first edition of UL 508A was published in 2001. The 2nd Revision of the 2nd Edition has been available since July 2017. Further revisions are expected to be published in the form of UL 508 A, 3rd Edition in spring 2018.

## Important changes in UL 508A, 2nd Edition, 2nd Revision

The current 2nd Revision of the 2nd Edition of UL 508A from July 2017 replaced the 1st Revision of the 2nd Edition from January 2013. Many of the changes merely give a more precise rendition of existing formulations in the standard and therefore have no impact on its practical application. However, in the following areas there are new content and technology-related changes that need to be noted:

- Adaptation of the definition of low voltage to the NEC: now every industrial control panel can be connected to a maximum voltage of 1000 V if its components are also approved for this voltage.
- Wiring ferrules have now been included in Chapter 29.3.5A (Wiring methods):  
Wiring ferrules may only be used under the following conditions:
  1. Used with stranded AWG copper wire(s) only.
  2. Terminated in a connector rated for copper wire and rated for the number and size of wire(s) crimped to the ferrule. (Note information provided by the manufacturer!)
  3. Crimped with an appropriate tool as recommended by the ferrule manufacturer only.
  4. Sized in diameter appropriate for the number of wires and wire size(s) as recommended by the ferrule manufacturer.
- Crimped to the wires such that the length of the uninsulated portion of the wires does not result in the reduction of electrical spacings when the ferrule is installed. This means that there may be no uninsulated copper wire between the ferrule and the insulation.
- Marking the setting values of overload relays:  
All overload relays without exception must be marked in close proximity to the installation location with the setting values. This also applies to devices with integrated overload relays (e.g. soft starters, type E/F motor circuit breakers, converters).
- Single and multipole Connectors with the Category Control Number "ECBT2" are permitted if they have been tested in accordance with UL 1977 and meet the requirements in Table SA 1.2.
- Calculating the SCCR in the power circuit:  
Exceptions regarding components not included in the overall SCCR calculation have been revised:  
Exception 3: Now only air conditioners that are cord-and-attachment-plug connected.  
Exception 4 (NEW!): Wiring ferrules are not required to have a SCCR rating.
- High fault SCCR of industrial control panel components achieved by means of combination tests:  
If the protection device being tested is a "non-current limiting overcurrent device", it can be replaced by a fuse from Table SB4.2 with the same or lower rated current if the interrupting rating is the same as or greater than the tested SCCR level of the combination.
- Excepted circuits:  
Previously, circuits could only be branched upstream of the disconnecting means for lighting in the industrial control panel and for data backup. Now, Section 66.6.1 Exceptions A through I defines twelve further circuits that shall be permitted to be connected to the supply side of each disconnecting means. Chapter 66.6.4 is completely new and sets out rules for marking excepted circuits.
- The low-voltage limited energy circuit was raised from 41.4 V DC to 60 V DC. Now it can be generated by a 60 V battery voltage if it is protected with max. 1.6 A according to the 100 W rule.

# NFPA 79

## General information on NFPA 79

NFPA 79 is the relevant standard for electronic components of industrial machinery and equipment up to 600 V for normal ambient conditions. Its scope ranges from the electrical infeed through to the individual machine assemblies. The objective of the standard is to protect people and equipment.

Like the NEC, NFPA 79 is also published by the NFPA (National Fire Protection Association). NFPA 79 2015 has applied since May 2014, but a new edition, NFPA 79 2018, is expected soon.

## Important changes in NFPA 79 2015

As it is now several years since NFPA 79 was last revised, this section only draws attention to places in the standard where relevant changes were made as a result of the changeover from NFPA 79 2012 to NFPA 79 2015.

- Chapter 5.3 Supply circuit disconnecting (isolating) means:  
Industrial control panels with control circuits for communication, remote control and signaling of less than 50 volts shall not be required to be provided with a supply circuit disconnecting means.
- Chapter 6.2 Protection by enclosures:  
6.2.4.2 (3) specifies when a door interlocking means coupled with a supply circuit disconnecting means is necessary.
- Chapter 19.1 Branch-Circuit Overcurrent Protection for Drives and Motors:  
Clearer formulation of the fact that short circuit protection for branch circuits with converters for servo drives shall correspond to the manufacturer's specifications.

## Outlook: NFPA 79 2018

Further steps for alignment and harmonization with the international IEC 60204-1 standard are planned with the new edition of NFPA 79 expected at the beginning of 2018. This will involve restructuring and adjustment of the wording. There are likely to be relevant changes to the content in the following areas:

- A new Chapter 4 stipulates that only listed and labeled components may now be used.
- The electromagnetic compatibility shall be examined.
- Change relating to door interlocking/main disconnecting means
- Additional uses of excepted circuits
- Some changes in Chapter 7 Protection of Equipment, for example regarding protection of branch circuit protection devices.
- Some changes in Chapter 8 Grounding

# Summary of Canadian standards

## Changes in Canadian standards

Until recently, the standards to be considered when building industrial control panels and machinery for Canada were quite straightforward. To be accepted by the ESA Inspector, an industrial control panel had to consist of components approved for the Canadian market and meet the relevant requirements from Part 1 of the Canadian Electrical Code (CEC) and the CSA C22.2 No. 14 (Industrial Control Equipment) standard, which is nothing more than a normal product standard.

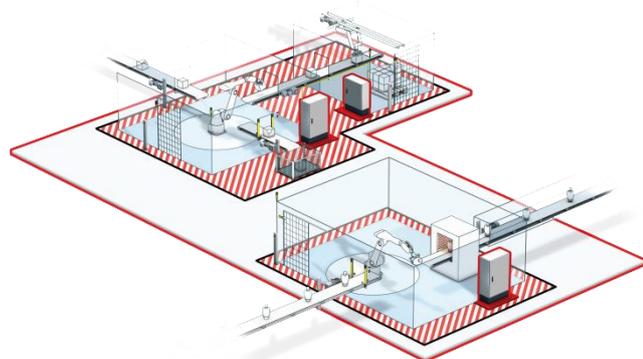
In practice, this often led to uncertainty, as there were no statements to be found in the applicable standards regarding the implementation of many industrial control panel and machinery applications. Canada's standards and inspection organization, the Canadian Standard Association (CSA), remedied this situation with the publication of two new standards:

- February 2015: Publication of the standard CSA C22.2 No. 286-15 Industrial control panels and assemblies (updated 2017, now standard CSA C22.2 No. 286-17)
- January 2016: Publication of the standard CSA C22.2 – No. 301-16 Industrial electrical machinery

As the currently applicable CEC 2015 has yet makes no reference to the two new standards, they are not yet regarded as recognized by the CEC. The references are likely to be inserted into the next edition of the CEC, whereupon the standards will be recognized.

In future, the following standards will therefore be of major significance in Canada to control panel and machine builders:

- CEC (Canadian Electrical Code) for electrical installation on site
- CSA C22.2 No. 286 for industrial control panels and assemblies



## Current standards

The following table summarizes the currently applicable versions of the standards (as of: December 2017)

Standard	Last revised	Expected revision
CEC Part I (CSA C22.1)	2015	2018
CEC Part II (CSA C22.2 No. 0)	2010	Not known
CSA C22.2 No. 286	2017	Not known
CSA C22.2 No. 301	January 2016	Not known

You will find details of the individual standards on the following pages and in February 2018 in a further Siemens white paper.

### Legend:

-  CEC
-  CSA C22.2 No. 286
-  CSA C22.2 No. 301

- CSA C22.2 – No. 301 for industrial electrical machinery

# Canadian Electrical Code (CEC)

## General information on the CEC

The Canadian Electrical Code (CEC) is the most important set of regulations for electrical installations in Canada. As with its US counterpart, the NEC, it is the only legally binding, recognized standard for electrical installations on private, public and industrial premises.

The CEC is published by the CSA and is currently available in its 23rd Edition. It is important to note that two parts are published:

Part 1 is designated C22.1 and was last updated in 2015. Appendix A of the CEC lists other product testing and application standards whose application is mandatory in their respective field. It is expected that the new edition of CEC 2018 will make reference to C22.2 No. 286 and C22.2 No. 301 in Appendix A. The CEC still makes reference to the Industrial Control Equipment C22.2 No. 14 product standard.

Part 2 is known as C22.2 No. 0. CEC Part 2 was last updated in 2010. It is intended to complement Part 1 and contains guidelines for installing, for marking and for performing voltage and insulation tests on electrical devices and equipment with the aim of preventing injury and damage. As a supplement to CEC Part 1, this safety standard provides requirements in terms of design and engineering whose primary objective is to ensure protection against fire and electrical hazards.

# CSA C22.2 No. 286

## General information on CSA C22.2 No. 286

The CSA C22.2 No. 286 user standard for "Industrial Control Panels and Assemblies" is published by the CSA (Canadian Standards Association).

It is defined as a user standard for the design of industrial control panels with a maximum voltage of 1,500 V AC or DC, but is not to be applied to the rest of the equipment. The scope excludes hazardous locations and is restricted to ambient temperatures of 0°C to 40°C. Chapter 4 is particularly important as it describes design requirements.

CSA C22.2 No. 286 first appeared in 2015 as C22.2 No.286-15. A new edition of the standard, C22.2 No. 286-17, appeared in 2017.

Although C22.2 No. 286 currently applies as the Canadian standard for industrial control panels, the CEC still refers to C22.2 No. 14-13 with respect to industrial control panels. Industrial control panels are therefore currently regarded as industrial control equipment. There are no detailed guidelines on electrical installation for the industrial control panel to be found in the standard. It is almost certain that the new 2018 edition of the CEC will refer to CSA C22.2 No. 286. C22.2 No. 286 is therefore not yet recognized by CEC 2015, but this will probably change in the next edition of the CEC. However, we recommend already observing the requirements of C22.2 No. 286 as they specify a necessary and useful framework for the design of industrial control panels.

# CSA C22.2 No. 301

## General information on CSA C22.2 No. 301

Since 2016, the CSA C22.2 No. 301 user standard has been Canada's relevant standard for electronic components of industrial machinery and equipment up to 1,000 V for normal ambient conditions.

The content is mainly based on the IEC 60204-1 (Electrical equipment of machines) international safety standard. However, there are some differences and specific features to ensure compatibility with the CEC. It is also similar to its US counterpart, the NFPA 79 (Electrical Standard for Industrial Machinery), to avoid conflicts with Canada's important neighboring market.

The CSA has published CSA C22.2 No. 301 since January 2016, and the standard is still in its 1st Edition. As with C22.2 No. 286, Appendix A of the currently applicable CEC from 2015 does not yet refer to the standard.

C22.2 No. 301 will not be recognized by the CEC until such a reference appears. This is expected in the 2018 edition of the CEC. However, we recommend already observing the requirements of the standard as they specify a necessary and useful framework for the design of industrial control panels.

# Further information from Siemens!

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Whether you are looking for reference works, web-based training courses, helpful engineering tools or useful information on panel building, you will find comprehensive information on "expert know-how", "tools and data for digitalization in engineering" and "aligned product and system portfolio" on our market portal for panel building:

[usa.siemens.com/controlpanels](http://usa.siemens.com/controlpanels)

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