

# Components and Systems for Global Markets



**EATON**

*Powering Business Worldwide*

# Key international markets for industrial machinery and panel builders



Many countries world-wide, as well as various shipboard classification agencies, require product certifications and rely on IEC standards.

Product certifications are a requirement for export to North America. Individual component standards and localized installation practices, in addition to specialized market conventions, need to be followed.

## Approvals and Certifications

**Approval of electrical equipment is based on the conformity and certification of components and assemblies to regional and country specific product and installation standards that are geared towards the proper application of these products in those markets.**

- Product testing conducted by nationally recognized certification agencies is often required, and product certification is also subject to periodic review and auditing by the certification agency.
- In the majority of cases, product certification is tied to the display of respective certification marks on the product themselves.
- Product certification ratings may differ from IEC based technical data and ratings.
- Product certifications are sometimes subject to additional and specific conditions of acceptability.
- Design flexibility on the part of manufacturers can sometimes be impacted by the possible need to re-certify each subsequent product modification.

## The meaning and purpose of product certification

**The issue as to whether the certification process necessarily leads to increased quality and higher degree of product safety, or whether the need to certify is motivated by purely economical interests, is generally dependent on the country involved.**

- Electrical components conforming to IEC standards are amongst the most efficient, safest and technologically advanced products available in the world today.
- IEC switching and protective devices have been installed in large volume world-wide, and have proven themselves in the most demanding of applications.
- The certification process in many instances no longer leads to an enhanced and verifiable improvement in product quality.
- North American standards place great emphasis on fire prevention. The higher requirements imposed on plastics as a consequence lead to a higher level of quality for electrical equipment in the global market place.
- North American product safety standards, particularly in the area of protective devices such as circuit breakers, are amongst the most stringent world-wide.
- In North America, the certification process achieved through neutral, nationally recognized testing laboratories is considered to provide an additional layer of product quality guarantee. (*Third party certification*).

# Globally, product certification takes on many forms.



**The export market to North America requires special focus in view of region specific product standards and market conventions which can markedly differ from those in most countries operating under the IEC mantle.**

The export of goods to North America is both economically and strategically vital for European machine manufacturers and panel builders! A viable reason to approach this market with a sound knowledge of North American requirements. The ability to export is a vital and powerful tool in today's global marketplace.

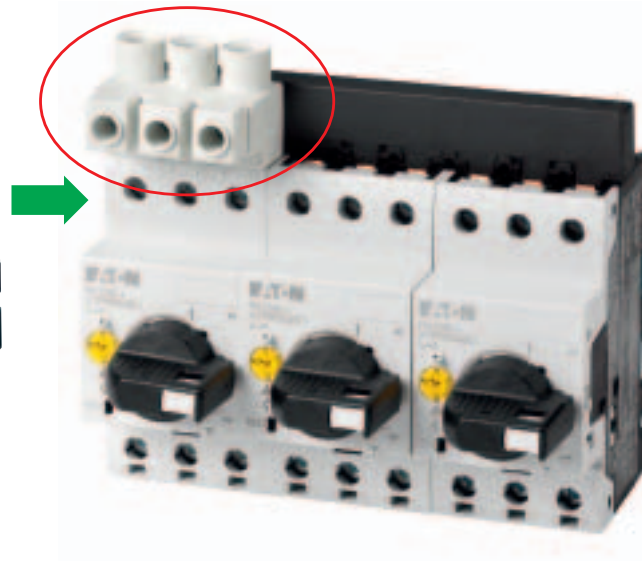
Eaton is a competent and dependable partner in helping exporters achieve the capability to access their target markets world-wide. Eaton has a viable presence in all global markets.

# What do North Americans expect from exporters?



IEC- Motor protective switch

Incoming supply terminal with large electrical clearances.



Three UL 508 Type E Self-Protected combination motor controllers.

- Awareness of key standards, particularly:
  - The NEC and CEC
  - UL 508/ CSA C22.2 No. 14
  - UL 489/CSA C22.2 No. 5-09
  - NFPA 79 (*Electrical Standard for Industrial Machinery*)
  - UL 508A (*Industrial Control Panels*)
- Understanding of North American market conventions:
  - Type rated environmental ratings (UL/CSA 4X, 12, 13 etc...)
  - Electrical data in HP, *Pilot Duty*, AWG sizes etc...
  - Certified product must also be applied per Code (NEC/CEC) requirements!

**What has proven itself world-wide for many generations doesn't necessarily make it an acceptable practice in North America.**

Example: IEC style motor protective switches require additional verification as *UL 508 Type E and F controllers* for application in North America as stand-alone protective devices in individual motor branch circuits.

# The electrical inspector in North America: Authority Having Jurisdiction



**Electrical equipment in North America, including controls and systems for industrial machinery, are subject to approvals by local electrical inspection authorities (AHJs).**

- Local city and state ordinances may also be applicable in addition to NEC/CEC guidelines and product certification to UL/CSA standards.
- In the US alone, there are literally thousands of independently governed jurisdictions which could differ in the way they interpret the requirements. There always remains a risk of a setback in the approval process at the time of commissioning.
- The approval of the local inspection authorities is an essential step in electrically connecting the installation to the local utility or power source, and allowing the premises to receive full insurance coverage.
- It is strongly recommended in all cases to demonstrate due diligence in meeting all local installation requirements.
- Third party verification e.g. in the form of a *UL listing label* applied to a component or assembly at a suitably certified manufacturing location in the country of origin, can prove particularly helpful to a local inspector since it can greatly simplify the task of verifying that the installation is in compliance with the local electrical codes.

# Special considerations, which are not readily apparent the IEC world

- Product groupings and application relevant conditions
- Product specific differences based on certification and resultant technical ratings.
- *Feeder and Branch Circuits*
- Equipment limitations based on particular supply network configurations
- Application dependent differences in product selection

These differences often lead to misunderstandings, improper component selection and assembly certification problems when dealing with local testing agencies, as well as with electrical inspection authorities in North America.

The equipment certification issue is complex, comprehensive and frequently associated with changes, which makes the process even more difficult for exporters who only occasionally busy themselves with the design and planning of installations for the North American market.



# Product groupings and application relevant conditions affecting electrical equipment in North America

## Important and fundamental differences, which are not apparent in the IEC world!

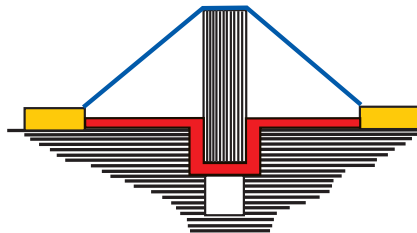
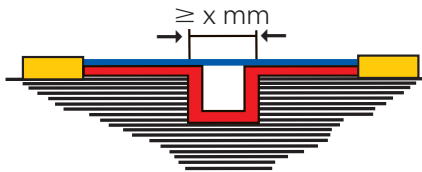
Product Groupings in North America	
Energy Distribution Equipment	Industrial Control Equipment
<p><b><i>e.g. UL 489 and CSA-C22.2 No. 5-09</i></b></p>	<p><b><i>UL 508 and CSA-C22.2 No. 14</i></b></p>
<ul style="list-style-type: none"> <li>• Molded Case Circuit Breakers (UL 489)</li> <li>• Molded Case Switches (UL 489)</li> <li>• Enclosed Switches (<i>UL 98</i>)</li> <li>• Fusible Disconnect Switches (<i>UL 98</i>)</li> <li>• Fuses (<i>UL 248</i>)</li> </ul> <p><i>Note: CSA has similar standards: UL 98 <math>\triangleq</math> CSA-C22.2 No. 4 UL 248 <math>\triangleq</math> CSA-C22.2 No. 248</i></p>	<ul style="list-style-type: none"> <li>• Contactors</li> <li>• Control Relays</li> <li>• Overload Relays</li> <li>• Manual Motor Controllers</li> <li>• Cam Switches</li> <li>• Pilot devices and Limit switches</li> <li>• Solid State relays and equipment</li> <li>• Programmable Controllers</li> </ul>

**There is a differentiation made in North America between products in Energy Distribution, e.g. molded case circuit breakers per UL 489, and those found in Industrial Control, typically falling under UL 508.**

- Standards such as UL 489 and CSA C22.2 No. 5-09 require significantly larger air and creepage clearances in component construction than do the IEC standards and their harmonized European counterparts (EN norms).
- An example of its impact would be the European motor protective switch which features a large spacings terminal on its supply side for applications in North America as a stand-alone protective device in individual motor branch circuits.

## Air and Creepage clearances, an important aspect of product certification

Example:



**■** spacing over surface, creepage distance

**■** spacing through air, clearance, air gap

**■** live parts

### Requirements for products used in Energy Distribution

- Components must be constructionally robust and feature larger electrical clearances: (for 301..600V: 1" over air, 2" over surface).



### Requirements for products used in Industrial Control

- Components are usually smaller dimensionally and the necessary clearances are not as great as the energy distribution products, and more in line with typical IEC requirements.

# Product specific differences based on scope of certification

## Example: Industrial Control Equipment

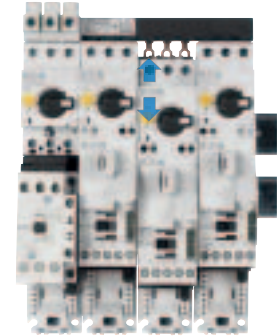




<i>Listed Industrial Control Equipment</i> <b>No restrictions when applied per its scope and ratings</b>	<i>Component Recognized Industrial Control Equipment</i> <b>Application based on Conditions of Acceptability</b>
<ul style="list-style-type: none"> <li>• Devices listed for „field wiring“</li> <li>• „factory wiring“ is covered by „field wiring“ provisions</li> <li>- Listed devices are suitable for industrial control panels when used per the guidelines of the industrial control panel standard (UL 508A). Listed devices are not subject to additional conditions of acceptability.</li> </ul>	<ul style="list-style-type: none"> <li>• As components, products are suitable for „factory wiring“ only.</li> <li>- Component selection is conducted by trained personnel and subject to Conditions of Acceptability</li> <li>- For use in control panels; designed, wired and tested by technically trained personnel in certified factories and panel shops.</li> </ul>
Certification Mark: 	Certification Mark: 

- A differentiation is made by UL between unrestricted (e.g. UL listed) and conditional (Recognized) product certifications for equipment such as industrial control (UL 508) and energy distribution.
- A distinctive certification mark denotes each type.
- All components must be properly sized, combined and applied per the requirements of the electrical codes and applicable standards, i.e. such as UL 508A.

## Example: Motor Starter

The individual components of a motor starter must be tested together as an assembly



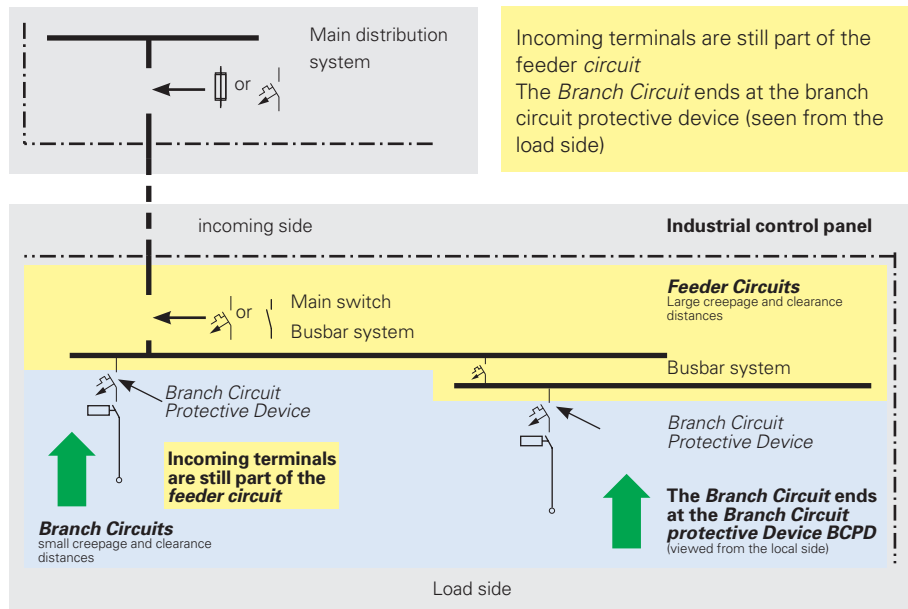
<p><i>Listed Industrial Control Equipment</i></p> <p><b>No restrictions in terms of application</b></p>	<p><i>Component Recognized Industrial Control Equipment</i></p> <p><b>Application based on Conditions of Acceptability</b></p>
	<ul style="list-style-type: none"> <li>The construction is considered incomplete and is subject to additional measures necessary in order to complete the component or assembly.</li> </ul> <p><b>Application considerations:</b>  <i>Manufacturer "Conditions of Acceptability" must be strictly followed!</i>  <i>Refer to guidelines in UL 508A SA1 in the case of industrial control panels.</i>  <i>Additional selection hints: Refer to Category Control Number Guide Information supplied by UL.</i></p>
<p>Certification Mark: </p>	<p>Certification Mark: </p>

**A listing or certification without any restrictions does not necessarily equate to the kind of engineering flexibility that a planner enjoys in the IEC world!**

- A designer does not always have the freedom to mix and match components and is seldom able to self-certify the ratings of the overall assembly.
- Components that are combined together in a listed assembly must be third-party verified and described in certification agency reports.
- Generally speaking, the process tends to promote components from a single source or manufacturer.

# Important Concepts: Feeder Circuit, Branch Circuit

It is advantageous to familiarize oneself with these specialized terms.



**The layout of feeder and branch circuits has a marked impact on component selection and needs to be considered carefully at the design stage.**

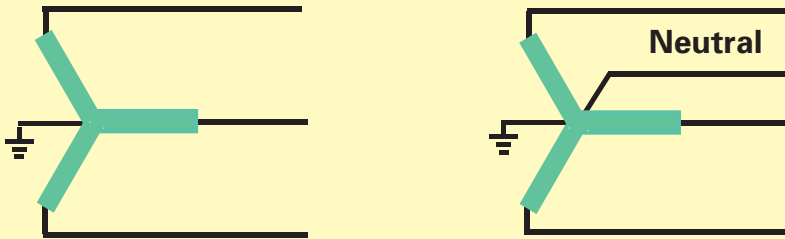
Components in *feeder circuits* and *branch circuit protective devices*, at least on their incoming supply side, must feature the larger electrical spacings at their field termination points.

# Important Concepts:

## *Slash-Rated Power Distribution Networks*



Protective devices which are slash rated are only suitable in solidly grounded power distribution networks as pictured below.



Example of a *slash* rating: 480Y/277VAC  
480V line to line; 277V line to ground or neutral

The following ratings are indicative of a solidly grounded and slash rated power distribution network:

**USA: 480Y / 277 VAC**  
**Canada: 600Y / 347 VAC**

/ = Slash

- The certification of certain product groups in North America makes them suitable for use only in solidly grounded networks (*Slash* rated supply systems). For example, *UL 508 Type E and F combination* motor starters are often "*slash-rated*" only.
- If a control panel includes a protective device which is slash rated only, then the control panel nameplate voltage rating must default to the slash rating.

# Example of a component selection peculiar to North America

**MCB = Miniature Circuit Breaker**

**MCCB = (Miniature) Molded Case Circuit Breaker**

**MCCB for  
Feeder and Branch Circuit Protection**

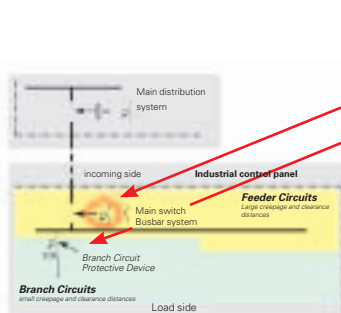
**MCB for  
Supplementary Protection**

USA: **UL 489**  
Kanada: **CSA C22.2 No. 5-09**  
Large electrical spacings  
**LISTED Component ←**

USA: **UL 1077**  
Kanada: **CSA C22.2 No. 235**  
Small electrical spacings  
**Recognized Component ←**

**The misapplication of miniature circuit breakers in North America is a significant source of design engineering errors in export related projects.**

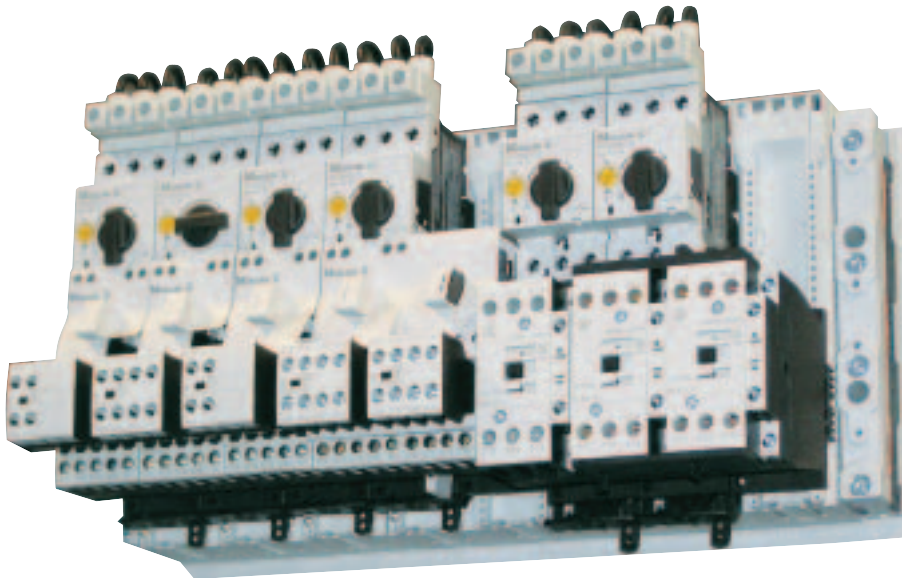
- Eaton offers the *FAZ-NA* type, certified per UL 489, featuring larger electrical spacings and suitable as a protective device in *feeder* and *branch circuits*.
- Standard IEC style miniature circuit breakers, recognized per UL 1077, are applicable for supplementary protection only (*Supplementary Protectors*) and cannot be applied as *branch circuit protective devices*.



IEC / EN 60 898

Caution!  
An improper component selection in this area counts as one of the 10 most frequently made errors flagged by inspection authorities.

## Motor Starters on busbar adapters, fed from *feeder circuits*



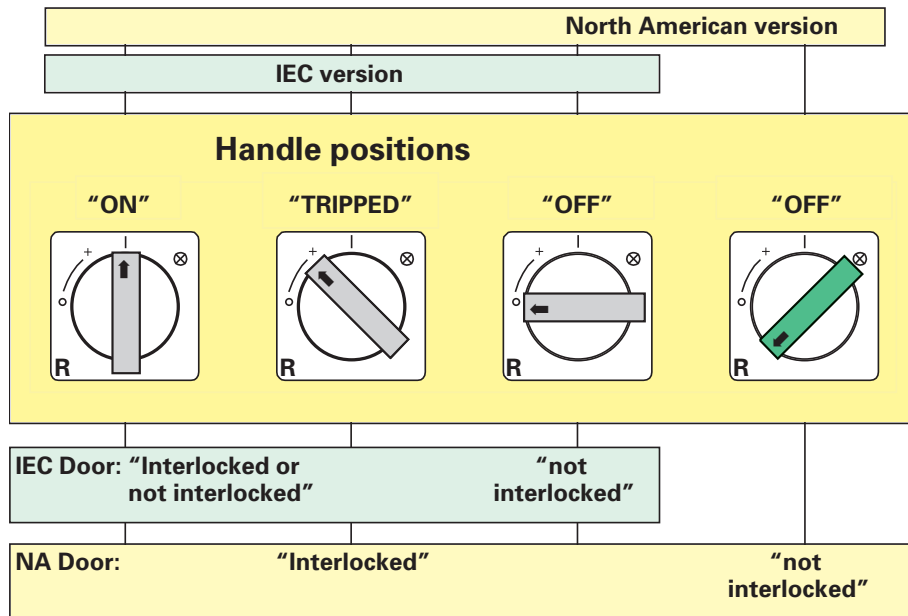
**Each *Type F combination starter* makes up an individual *branch circuit***

- A UL **508 Type F Combination Motor Starter** is provided with a large spacing terminal on its incoming side if the starter is mounted on a bus system supplied from a feeder circuit.
- Only for use with certified busbar systems and parts!
- A bottom plate is necessary for mounting to maintain proper clearances!

Note: Use locking motor-protective circuit-breakers

# Example of a component selection peculiar to North America

## Door Mounted Rotary Handles for North American applications (NA- Version)



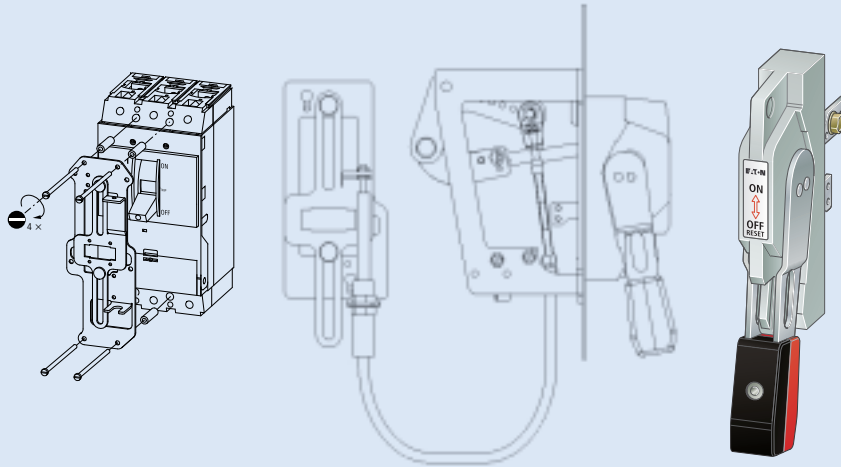
### North American market conventions

A fourth position for the door mounted rotary handles

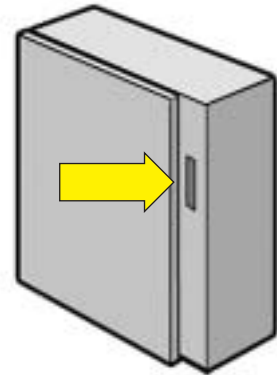
The enclosure door can only be opened in the fourth position (slight overtravel towards the RESET position). The IEC handles with 3 distinct positions are also certified (R = RESET).

## “Flange or side mounted vertical motion handle”

Typical North American version of a supply circuit disconnecting switch in accordance with NFPA 79 (*Electrical Standard for Industrial Machinery*).



Typical North American enclosure with flange mount to accommodate the supply circuit disconnect handle.



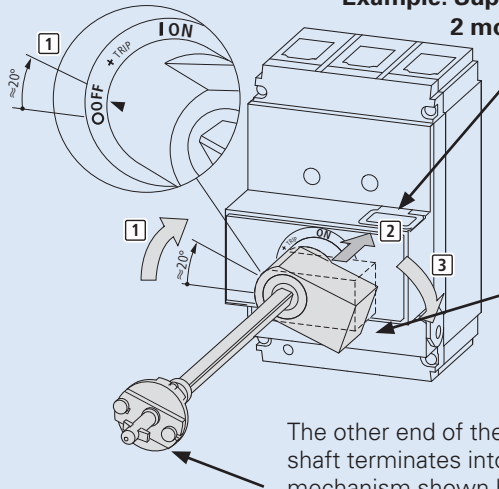
A mechanical or electrical interlocking provision for all main panel enclosure doors is mandatory.

# Example of a specialized component selection for the North American market

Operation of the main disconnect switch independent of the door position.



**Example: Supplementary handle for frame size 2 molded case breakers and switches**



The lifting clamp is a padlocking provision to allow padlocking of the switch in the OFF position when the door is open.

The supplementary handle has a switch position indication and allows operation of the switch by qualified persons when the door is open.

The other end of the supplementary handle extension shaft terminates into the door handle coupling mechanism shown here. The coupling mechanism provides the link to the rotary handle mounted on the exterior door of the panel enclosure.

## North american conventions

A supply circuit disconnecting means for industrial machinery control panels built in accordance with the requirements of NFPA 79 and UL 508A will require a specialized internal supplementary handle if the door mounted rotary handle is not directly linked to the switch at all times. The internal supplementary handle allows the switch to be operated by qualified persons through deliberate action only. (Somewhat similar to child or tamper proof locking provisions) A switch position indication is visibly maintained inside the panel at all times and the switch can also be internally padlocked in the OFF position.

# Examples of specialized engineering and planning measures necessary for compliance with relevant North American electrical equipment standards.

- Certified components must be selected, sized and combined in accordance with the requirements of the electrical codes (NEC/CEC).
- Fuses need to be certified to the UL/CSA 248 series of product standards.
- Wiring material must be certified and conductor cross-sections must be sized in accordance with the requirements of the electrical codes. Color coding of conductors must meet the requirements of NFPA 79/UL 508A for industrial machinery applications.
- Derating factors may apply and must be considered when bundling cables in wire channels. The insulation rating of conductors grouped together must be in accordance with the maximum voltage of any circuit within the the group.
- Divergent installation practices (e.g. use of conduits, cable entries through top/bottom) must be taken into consideration during the planning stages.
- Check for necessary warning and cautionary markings.
- Doors of industrial machinery control panels must be interlocked with the afore-mentioned supply circuit disconnecting means either mechanically, or electrically, or both.
- The door interlocking feature can be temporarily bypassed by qualified persons.
- Conductors of industrial machinery panels per NFPA 79 must be identified at their termination.

# Application based component selection

## Motor Starters are only suitable for switching and protecting motors!



Three UL 508 Type E Self-Protected combination motor controllers



Four UL 508 Type F combination motor controllers

**UL 508 Type E and Type F combination motor starters can only protect motors in individual branch circuits and are not suitable for the protection of:**

- Power Transformers
- Lighting
- Heaters
- Variable Frequency Drives\*

### Switching and Protection!

The regulations are more narrowly defined than IEC with respect to applications. Motor Circuit requirements are extensively described in the electrical codes.

\* Exception: It is intended to allow a Type E self-protected controller to be used as a protective device for a drive if it has been tested and certified for use with that particular drive (refer to appropriate markings on the drive for verification).

# Which fuse is the correct one to use in North America?

The proper application of fuses in power circuits is not without its share of difficulties. Fuses come in various sizes and in many classifications. Matching fuseholders can often be quite large. The emphasis is mostly placed on the very high interrupting ratings enjoyed by a great number of fuse classes. It is worth noting, however, that fuse replacement in the field would also be subject to the stringent safety guidelines outlined in the NFPA70E standard, in particular with respect to the use of appropriate protective clothing for the purpose.

Detection and application guidelines for North American power fuses used in Feeder and Branch Circuits							
Suitable for use in:	UL/CSA Standards	Characteristic	SCCR	Typical ratings in Amps	Applications	Comments	
Class F1 "Code"	Class F1 No. 50 "Code"	UL 248-6 / T C22.2 248-6-617	Fast-Acting	100A / 250VAC 100A / 600VAC	1, 800	Residential, Commercial, Industrial	Class F1, F1 and No. 50 "Code" fuses are physically interchangeable and fit in the same fuseholders. Refer to comments below under Class F1.
Class CC	Class CC	UL 248-4 / C22.2 248-4	Fast-Acting & Time Delay	200A / 100VAC	0.5, 30	Fast-Acting	Extremely compact size! Current-limiting per UL/CSA Standards!
Class G	Class G	UL 248-5 / C22.2 248-5	Fast-Acting Time Delay	300 / 480VAC 1 / 600VAC	21, 30 0.5, 20	Protection of sensitive and highly inductive loads	Compact size! Current-limiting per UL/CSA Standards! Non-interchangeable with any other fuse class.
Class J	Class J	UL 248-4 / C22.2 248-4	Fast-Acting	1 / 600VAC	1, 800	Appliances, Heaters, Lighting, Motor Loads in Feeders and Branch Circuits.	Electrical Motors, Transformers, Lighting.
Class K	Class K	UL 147-1	Fast-Acting	100A, 100A, 200A / 600VAC	1, 600		Compact size! Current-limiting per UL/CSA Standards! Non-interchangeable with any other fuse class.
Class L	Class L	UL 147-1	Fast-Acting	200A / 600VAC	801, 800B		See maximum current limiting per UL/CSA Standards! That's why Class L fuses are often substituted by smaller type Class F1 - fuses.
Class R	Class R	UL 147-1	Fast-Acting & Time Delay	100A, 100A, 200A / 600VAC	1, 800		Current-limiting per UL/CSA Standards! Types R1, R1 and R1CA1 R1 in the same regulator type fuseholders, and are non-interchangeable with any other fuse class. R1 fuses have lower let through values than R1C fuses.
Class T	Class T	UL 248-15 / C22.2 248-15	Fast-Acting	300A / 300VAC 300A / 600VAC	1, 1000		Extremely compact size! Current-limiting per UL/CSA Standards! Non-interchangeable with any other fuse class.

The characteristics and application guidelines mentioned above provide a rough overview only. For more precise information on SCCR conditions it is recommended to consult with the end user. Note fuse type 300-300V DC ratings per IEC and CSA standards.



Fuseless based designs and solutions are definitely more advantageous for export purposes. Circuit breaker type protective equipment will help you avoid export related problems and issues.

# Component applications in *Control Panels for Industrial Machinery*



There are various kinds of control panel assemblies in the US. The ones that conform to UL 508A, the US safety standard for *Industrial Control Panels*, fulfill a number of comprehensive requirements. *Control panels* which conform to the Industrial Machinery standard NFPA 79 are amongst the most specialized.

- A relatively recent requirement for all such panels involves the determination of their overall *Short Circuit Rating (SCCR)*.
- The SCCR must now appear on all nameplates of Industrial Control Panels per the requirements of the National Electrical Code (NEC).

# Discussions are part of the package!

**Successful exports are based on more than just using certified equipment.**

**Eaton: “More than Products”**



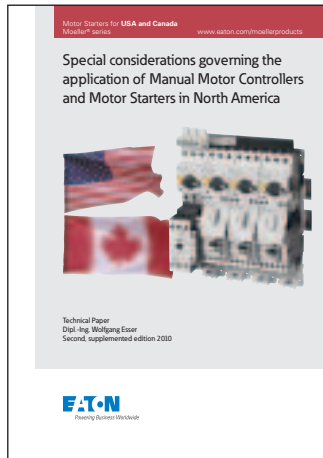
**A checklist is a useful tool to clarify important issues and minimize costs during the engineering phase. Special considerations which are overlooked during the initial stages, and remedied after the fact, will not only be costly but very time consuming as well.**

- In addition to product certifications, a firm understanding of the standards and market conventions involved is necessary to insure that electrical components and assemblies are also properly applied.
- The certification of a control panel assembly in the country of origin is highly recommended. Mistakes can be more easily remedied by the manufacturer at his production facility.

# Product and selection guidelines for World Markets



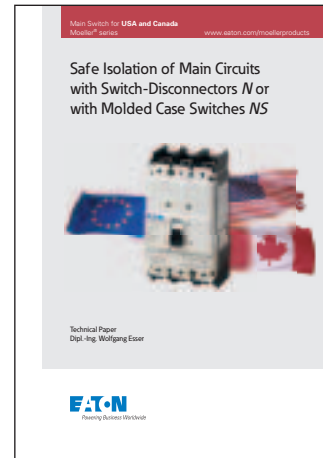
# A sampling of more extensive technical literature related to exports



VER1210+1280-928D  
VER1210+1280-928GB



VER0211-969de  
VER0211-969en



VER1230-950D  
VER1230-950GB




























VER1210-951D  
VER1210-951GB

**Selective topics on the export of low voltage system and components to North America**  
**Free Download: <http://www.moeller.net/de/support/index.jsp>**

# Shipboard certifications and classifications

Consult the current edition of the Main Catalog for further details.

														
 France	Bureau Veritas 	●	●	●	●	●	●	●	●	●	●	●	-	-
 Norway	Det Norske Veritas 	●	●	●	●	●	-	●	●	-	●	●	-	-
 Germany	Germanischer Lloyd 	●	●	●	●	●	●	●	●	●	●	●	-	-
 Great Britain	Lloyd's Register 	●	●	●	●	●	●	●	●	●	●	●	●	●
 Poland	Polski Reistr. Statkow 	●	-	●	●	●	●	●	●	-	●	-	-	-
 China	Chinese Classification Society 	-	-	-	●	●	-	●	●	●	-	●	●	-





























● Certified    ○ Under submittal    - Not currently under submittal    N No certification required

# Product certification overview

## World Markets

**Consult the current edition of the Main Catalog for further details on product certifications.**

Suitable for global markets: Availability of world market devices and certified equipment has always been an Eaton strength.

														
 Argentina		N	N	N	●	N	N	●	N	N	N	N	N	N
 Australia		●	●	●	●	●	●	●	●	●	●	●	●	●
 China		●	●	N	●	●	●	●	●	●	●	N	N	N
 Canada		●	●	●	●	●	●	●	●	●	●	●	●	●
 Russia		●	●	●	●	●	●	●	●	●	●	●	●	●
 Ukraine		●	●	●	●	●	●	●	N	●	●	N	N	●
 USA		●	●	●	●	●	●	●	●	●	●	●	●	●

● Certified    ○ Under submittal    – Not currently under submittal    **N** No certification required

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