

## STANDARDS ORGANIZATION SUMMARY AND DIRECTORY OVERVIEW

### What's in a Rating?

As a way of standardizing enclosure performance, organizations like NEMA, UL, CSA, IEC and VDE use rating systems to identify an enclosure's ability to resist external environmental influences. Resistance to everything from dripping liquid to hose-down to total submersion is defined by the ratings systems. While these ratings are all intended to provide information to help you make a safer, more-informed product choice, there are differences among them.

### North American Standards Organizations

In North America, NEMA, UL and CSA are the commonly recognized standards organizations. Their ratings are based on similar application descriptions and expected performance. UL and CSA both require enclosure testing by qualified evaluators in their certified labs. They also send site inspectors to make sure a manufacturer adheres to prescribed manufacturing methods and material specifications. NEMA, on the other hand, does not require independent testing and leaves compliance completely up to the manufacturer.

North American enclosure rating systems also include a rating that indicates corrosion resistance. This rating is based on the enclosure's ability to withstand prolonged exposure to salt water spray.

While the corrosion resistance rating is a good indicator that an enclosure can resist corrosion, it does not provide information on how a specific corrosive agent will affect a given enclosure material. It is best to conduct a full analysis of the specific application and environment to determine the best enclosure choice.

### International Standards Organizations

Like NEMA, IEC does not require independent testing and leaves compliance completely up to the manufacturer. Nevertheless, there are differences in how enclosure performance is interpreted. For example, UL and CSA test requirements specify that an enclosure fails the water-tight test if even a single drop of water enters the enclosure. In the IEC standards for each level of ingress protection (IP), a certain amount of water is allowed to enter the enclosure.

IEC 60529 IP ratings do not specify construction requirements or degrees of protection against corrosive atmospheres, risk of explosion or conditions such as moisture or corrosive vapors. NEMA Type ratings, on the other hand, do specify construction and performance requirements for most environmental conditions. For this reason, and because the tests and evaluations for other characteristics are not identical, the IEC enclosure classification designations cannot be exactly equated with NEMA enclosure Type numbers.

**STANDARDS ORGANIZATION DIRECTORY****National Electrical Manufacturers Association**

1300 North 17th Street  
Suite 1847  
Rosslyn, VA 22209

[www.nema.org](http://www.nema.org)

NEMA Standards Publication No. 250  
Enclosures for Electrical Equipment (1000 Volts Maximum)  
NEMA Standards Publication No. ICS6  
Enclosures for Industrial Controls and Systems

**Electrical Equipment Manufacturers Association of Canada**

5800 Explorer Drive  
Suite 200

Mississauga, Ontario  
Canada L4W 5K9

[www.electrofed.com](http://www.electrofed.com)

**Underwriters Laboratories Inc.**

333 Pfingsten Road  
Northbrook, IL 60062

[www.ul.com](http://www.ul.com)

UL 50 Enclosures for Electrical Equipment, Non-Environmental Considerations (Type 1)  
UL 50E Enclosures for Electrical Equipment, Environmental Considerations (Remaining Types)  
UL 508A Industrial Control Panels  
UL 870 Wireways, Auxiliary Gutters and Associated Fittings  
UL 94 Flammability of Plastic Materials  
UL 2279 Electrical Equipment for Use in CLI Zone 1 and 2 Hazardous Locations  
UL 1863 Communication Circuit Accessories  
UL 414 Meter Sockets  
UL 497 Protectors for Paired Conductor Communication Circuits  
UL 1773 Termination Boxes  
UL 1203 Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations

**Canadian Standards Association**

178 Rexdale Boulevard  
Rexdale (Toronto), Ontario, Canada  
M9W 1R3

[www.csa.ca](http://www.csa.ca)

CSA Standard C22.2:  
No. 0 General Requirements - Canadian Electrical Code, Part II  
No. 0.4 Bonding and Grounding of Electrical Equipment (Protective Equipment)  
No. 14 Industrial Control Equipment for Use in Ordinary (Non-Hazardous) Locations  
No. 40 Cutout, Junction, and Pull Boxes  
No. 26 Construction and Test of Wireways, and Auxiliary Gutters, and Associated Fittings  
No. 94 Special Purpose Enclosures  
No. 182.4 Plugs, Receptacles, and Connections for Communications Systems  
No. 76 Splitters  
No. 25 Enclosures for Use in Class 11 Groups E, F, and G Hazardous Locations

**International Electrotechnical Commission**

3 Rue de Varembe  
CH-1211

P.O. Box 131  
Geneva 20  
Switzerland

[www.iec.ch](http://www.iec.ch)

IEC 60529 Classification of Degrees of Protection Provided by Enclosures  
IEC 60204 Safety of Machinery - Electrical Equipment of Machines  
IEC 60079 Electrical Apparatus for Explosive Gas Atmospheres  
IEC 61641 Enclosed low-voltage switchgear and controlgear assemblies - Guide for testing under conditions of arcing due to internal fault  
IEC 62208 Empty enclosures for low-voltage switch-gear and control-gear assemblies.

**STANDARDS ORGANIZATION DIRECTORY (CONTINUED)****Electronic Industries Alliance**

2500 Wilson Blvd.  
Arlington, VA 22201  
[www.eia.org](http://www.eia.org)  
EIA RS-310-D Racks, Panels, and Associated Equipment

**American National Standards Institute**

1819 L Street NW  
Washington, DC 20036  
[www.ansi.org](http://www.ansi.org)

**National Fire Protection Association**

Batterymarch Park  
Quincy, MA 02169-7471  
[www.nfpa.org](http://www.nfpa.org)  
NFPA 70 National Electrical Code  
NFPA 70e Standard for Electrical Safety Requirements for  
Employee Workplaces  
NFPA 79 Electrical Standard for Industrial Machinery  
NFPA 496 Purged and Pressurized Enclosures for Electrical  
Equipment

**International Society of Automotive Engineers**

400 Commonwealth Drive  
Warrendale, PA 15096-0001  
[www.sae.org](http://www.sae.org)  
SAE HS 1738 SAE Standard - Electrical Equipment for Automotive  
Industrial Machinery

**Institute of Electrical and Electronics Engineers**

445 Hoes Lane  
Piscataway, NJ 08854-1331  
[www.ieee.org](http://www.ieee.org)  
C37.20.7 IEEE Guide for Testing Medium-Voltage Metal-Enclosed  
Switchgear for Internal Arcing Faults  
IEEE 1584 Guide for Arc Flash Hazard Calculations

**National Sanitation Foundation**

NSF International  
789 Dixboro Road

Ann Arbor, MI 48113-0140

[www.nsf.org](http://www.nsf.org)  
NSF Criteria C-2 Special Equipment and/or Devices

**Telcordia Technologies**

8 Corporate Place  
Piscataway, NJ 08854-4157  
[www.telcordia.com](http://www.telcordia.com)  
GR 63 NEBS™ Requirements: Physical Protection  
GR487 Generic Requirements for Electronic Equipment Cabinets

**The American Society of Mechanical Engineers**

Three Park Avenue  
New York, NY 10016-5990  
[www.asme.org](http://www.asme.org)  
ASME BPE Bioprocessing Equipment

**Defense Automation and Production Service**

Building 4/D  
700 Robbins Avenue  
Philadelphia, PA 19111-5094  
<http://dodssp.daps.dla.mil>  
MIL-STD-810 Environmental Engineering Considerations and  
Laboratory Tests  
MIL-S-901 Shock Tests. H.I. (High Impact) Requirements for  
Shipboard Machinery, Equipment, and Systems

**TÜV Product Service**

Segensworth Road  
Fareham Hampshire  
PO15 5RH  
United Kingdom  
[www.tuvps.co.uk](http://www.tuvps.co.uk)

**Institute of German Electronics Engineers (VDE)**

Stresemannalle 15  
60596 Frankfurt Main  
Germany  
[www.vde.de](http://www.vde.de)

## NEMA, UL AND CSA RATINGS

## Enclosure Type Descriptions for Non-Hazardous Locations

Type	NEMA	UL	CSA
Indoor Type 1	Enclosures are intended for indoor use primarily to provide a degree of protection against contact with the enclosed equipment or locations where unusual service conditions do not exist.	Indoor use primarily to provide protection against contact with the enclosed equipment and against a limited amount of falling dirt.	General purpose enclosure. Protects against accidental contact with live parts.
Indoor Type 12	Enclosures are intended for indoor use primarily to provide a degree of protection against dust, falling dirt and dripping noncorrosive liquids.	Indoor use to provide a degree of protection against dust, dirt, fiber flyings, dripping water and external condensation of noncorrosive liquids.	Indoor use; provides a degree of protection against circulating dust, lint, fibers and flyings; dripping and light splashing of non-corrosive liquids; not provided with knockouts.
Indoor Type 12K	Enclosures with knockouts are intended for indoor use primarily to provide a degree of protection against dust, falling dirt and dripping noncorrosive liquids.	Indoor use to provide a degree of protection against dust, dirt, fiber flyings, dripping water and external condensation of noncorrosive liquids.	Indoor use; provides a degree of protection against circulating dust, lint, fibers and flyings; dripping and light splashing of noncorrosive liquids; not provided with knockouts.
Indoor Type 13	Enclosures are intended for indoor use primarily to provide a degree of protection against dust, spraying of water, oil and noncorrosive coolant.	Indoor use to provide a degree of protection against lint, dust seepage, external condensation and spraying of water, oil and noncorrosive liquids.	Indoor use; provides a degree of protection against circulating dust, lint, fibers and flyings; seepage and spraying of non-corrosive liquids, including oils and coolants.
Outdoor Type 3	Enclosures are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain and sleet; undamaged by the formation of ice on the enclosure.	Outdoor use to provide a degree of protection against windblown dust and windblown rain; undamaged by the formation of ice on the enclosure.	Indoor or outdoor use; provides a degree of protection against rain, snow and windblown dust; undamaged by the external formation of ice on the enclosure.
Outdoor Type 3R	Enclosures are intended for outdoor use primarily to provide a degree of protection against falling rain and sleet; undamaged by the formation of ice on the enclosure.	Outdoor use to provide a degree of protection against falling rain; undamaged by the formation of ice on the enclosure.	Indoor or outdoor use; provides a degree of protection against rain and snow; undamaged by the external formation of ice on the enclosure.
Outdoor Type 3RX	Enclosures are intended for outdoor use primarily to provide a degree of protection against corrosion, falling rain and sleet; undamaged by the formation of ice on the enclosure.	Not specifically defined.	Not specifically defined.
Outdoor Type 4	Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water and hose directed water; undamaged by the formation of ice on the enclosure.	Either indoor or outdoor use to provide a degree of protection against falling rain, splashing water and hose-directed water; undamaged by the formation of ice on the enclosure.	Indoor or outdoor use; provides a degree of protection against rain, snow, windblown dust, splashing and hose-directed water; undamaged by the external formation of ice on the enclosure.
Outdoor Type 4X	Enclosures are intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water and hose-directed water; undamaged by the formation of ice on the enclosure.	Either indoor or outdoor use to provide a degree of protection against falling rain, splashing water and hose-directed water; undamaged by the formation of ice on the enclosure; resists corrosion.	Indoor or outdoor use; provides a degree of protection against rain, snow, windblown dust, splashing and hose-directed water; undamaged by the external formation of ice on the enclosure; resists corrosion.
Outdoor Type 6	Enclosures are intended for use indoors or outdoors where occasional submersion is encountered; limited depth; undamaged by the formation of ice on the enclosure.	Indoor or outdoor use to provide a degree of protection against entry of water during temporary submersion at a limited depth; undamaged by the external formation of ice on the enclosure.	Indoor or outdoor use; provides a degree of protection against the entry of water during temporary submersion at a limited depth. Undamaged by the external formation of ice on the enclosure; resists corrosion.

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Some enclosures may have multiple ratings. For instance:

- 4, 12—Outdoor use; able to be used indoors with modifications
- 4X, 3RX—Outdoor use; able to be used indoors with modifications
- 4, 9—Can be used in both hazardous and non-hazardous locations

## COMPARISON OF SPECIFIC NON-HAZARDOUS APPLICATIONS IN OUTDOOR LOCATIONS

### Enclosure Type Rating

Provides a Degree of Protection Against the Following Environmental Conditions	3	3R <sup>a</sup>	3RX <sup>a</sup>	4	4X	6
Incidental contact with the enclosed equipment	•	•	•	•	•	•
Rain, snow and sleet <sup>b</sup>	•	•	•	•	•	•
Windblown dust	•			•	•	•
Hose-down				•	•	•
Corrosive agents			•		•	
Occasional temporary submersion						•

<sup>a</sup>These enclosures may be ventilated.

<sup>b</sup>External operating mechanisms are not required to be operable when the enclosure is ice covered.

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## COMPARISON OF SPECIFIC NON-HAZARDOUS APPLICATIONS IN INDOOR LOCATIONS

### Enclosure Type Rating

Provides a Degree of Protection Against the Following Environmental Conditions	1 <sup>a</sup>	4	4X	6	12	12K	13
Incidental contact with the enclosed equipment	•	•	•	•	•	•	•
Falling dirt	•	•	•	•	•	•	•
Falling liquids and light splashing		•	•	•	•	•	•
Dust, lint, fibers and flyings <sup>b</sup>		•	•	•	•	•	•
Hose-down and splashing water		•	•	•			
Oil and coolant seepage					•	•	•
Oil or coolant spraying and splashing							•
Corrosive agents			•				
Occasional temporary submersion				•			

<sup>a</sup>These enclosures may be ventilated. However, Type 1 may not provide protection against small particles of falling dirt when ventilation is provided in the enclosure top. Consult Hoffman for more information.

<sup>b</sup>These fibers and flyings are non-hazardous materials and are not considered Class II type ignitable fibers or combustible flyings. For Class III type ignitable fibers or combustible flyings see the National Electrical Code Section 505.

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## GLOSSARY TERMS SPECIFYING NON-HAZARDOUS ENVIRONMENTAL CONDITIONS

### Corrosion-Resistant

Constructed to provide a degree of protection against exposure to corrosive agents such as salt spray. Type 3RX and 4X enclosures meet this requirement.

### Damp Locations

Locations protected from weather and not subject to saturation with water or other liquids but subject to moderate degrees of moisture. Examples of such locations include partially protected locations under canopies, marquees, roofed open porches and like locations, and interior locations subject to moderate degrees of moisture, such as some basements, some barns and some cold-storage warehouses. See the indoor enclosure types and select a type rating that fits the specific application.

### Dust-tight

Constructed so that circulating or airborne dust will not enter the enclosure under specified test conditions. Type 3, 4, 4X, 12, 12K and 13 enclosures meet this requirement.

### Drip-tight

Constructed so that falling moisture or dirt does not enter the enclosure under specified test conditions. Type 3, 4, 4X, 12, 12K and 13 enclosures meet this requirement.

### Indoor

Not to be exposed to weather. Type 1, 12, 12K and 13 enclosures meet this requirement.

### Oil-Resistant

Constructed so that oil will not interfere with successful operation of equipment. Type 12 and 13 enclosures meet this requirement.

### Oil-tight

Constructed so that oil will not enter the enclosure under specified test conditions. Type 13 enclosures meet this requirement.

### Outdoor

Constructed or protected so that exposure to the weather will not interfere with successful operation of equipment. Type 3, 3R, 4, 4X and 6 enclosures meet this requirement. These ratings can also be used indoors.

### Rainproof

Constructed, protected or treated to prevent beating rain from interfering with the successful operation of the apparatus or result in wetting of live parts and wiring within the enclosure under specified test conditions. Type 3R and 3RX enclosures meet this requirement.

### Rain-tight

Constructed or protected so that exposure to beating rain will not result in water entering the enclosure under specified test conditions. Type 3, 4, 4X and 6 enclosures meet this requirement.

### Water-tight

Constructed so that moisture will not enter the enclosure when it is subjected to a stream of water under specified test conditions. Type 4, 4X and 6 enclosures meet this requirement.

### Weatherproof

Constructed or protected so that exposure to the weather will not interfere with successful operation of the equipment. Rainproof, rain-tight or water-tight equipment can fulfill the requirements for weatherproof where varying weather conditions other than wetness, such as snow, ice, dust or temperature extremes, are not a factor.

### Wet Locations

Installations underground or in concrete slabs or masonry in direct contact with the earth; in locations subject to saturation with water or other liquids, such as vehicle washing areas; and in unprotected locations exposed to weather. Use weatherproof enclosures with a type rating that fits the specific application.

## ENCLOSURE TYPE RATING VERSUS IP RATING

Electrical enclosures are rated by Type (NEMA 250 / UL 50, 50E), and/or IP rating (IEC 60529) based upon the degree of protection provided. Type ratings and IP ratings have only the following in common:

1. A degree of protection for persons from hazardous components inside the enclosure
2. A degree of protection for equipment inside the enclosure from ingress of solid foreign objects, including dust
3. A degree of protection for equipment inside the enclosure from ingress of water

NEMA 250 and UL 50, 50E Type rating documentation defines additional requirements that a Type-rated enclosure must meet. These include:

- Mechanical impact on enclosure walls
  - Gasket aging and oil resistance
  - Corrosion resistance
  - Door and cover latching requirements
  - Sheet metal gauge construction requirements (UL 50 only)
- Electrical enclosures that carry only an IP rating have not been designed or tested to the additional Type-rating requirements. For this reason, and because the tests and evaluations for other characteristics are not identical, the IP ratings cannot be exactly equated with NEMA enclosure Types.

**Electrical enclosures manufactured by Hoffman are tested for and carry both Type and IP ratings.**

## Fluid Statics and Dynamic Comparison of Ingress Water Tests

Test Type	Flow Rate (gal./min.)	Flow Rate (l/min.)	Nozzle Diameter in./mm	Nozzle Area (in. <sup>2</sup> )	Nozzle Velocity (ft./sec.)	Equivalent Head (ft.)	Equivalent Pressure (psi)	Mass Flow (lb./sec.)	Power (hp)	Total Force on Vertical Plate (lb.)
Type 3	45.00	170	1.0000 25.4	0.7854	18.38	5.25	2.274	6.256	0.060	3.5716
Type 4	65.00	246	1.000 25.4	0.7854	26.55	10.85	4.744	9.037	0.180	7.4516
IPX5	3.30	12.5	0.2480 6.3	0.0483	21.93	7.46	3.235	0.459	0.006	0.3126
IPX6	26.42	100	0.4921 12.5	0.1902	44.55	30.82	13.357	3.672	0.206	5.0815

## IP RATING DESCRIPTIONS

### Example Rating

If 1st IP number is...	and the 2nd ip number is...	Then the IP rating is
2 (protection against solid objects)	3 (protection against liquids)	IP23 An enclosure with this designation provides protection against touch with a finger, penetration of solid objects greater than 12mm, and spraying water.

### First Numeral (Solid Objects and Dust)

IP	Protection of Persons	Protection of Equipment
0	No Protection	No Protection
1	Protected against contact with large areas of the body (back of hand)	Protected against objects over 50 mm in diameter
2	Protected against contact with fingers	Protected against solid objects over 12 mm in diameter
3	Protected against tools and wires over 2.5 mm in diameter	Protected against solid objects over 2.5 mm in diameter
4	Protected against tools and wires over 1 mm in diameter	Protected against solid objects over 1 mm in diameter
5	Protected against tools and wires over 1 mm in diameter	Protected against dust (limited ingress, no harmful deposit)
6	Protected against tools and wires over 1 mm in diameter	Totally protected against dust

### Second Numeral (Liquid)

IP	Protection of Equipment
0	No Protection
1	Protected against vertically falling drops of water, e.g. condensation
2	Protected against direct sprays of water up to 15 degrees from vertical
3	Protected against sprays to 60 degrees from vertical
4	Protected against water sprayed from all directions (limited ingress permitted)
5	Protected against low-pressure jets of water from all directions (limited ingress permitted)
6	Protected against strong jets of water
7	Protected against the effects of immersion between 15 cm and 1 m
8	Protected against long periods of immersion under pressure

## CE

For industrial control equipment, the CE Mark is not intended to be applied to empty enclosures because such enclosures are inactive components of a final assembly. The responsibility of ensuring compliance with all applicable EU directives and harmonized standards belongs with the final equipment manufacturer.

## SHORT CIRCUIT CURRENT RATING FOR ENCLOSURES

The short circuit current rating is not required for an empty UL 508A enclosure. The majority of Hoffman's electrical accessories are generally used in the control circuit portion of a UL 508A Industrial Control Panel. Electrical accessories used in a control circuit are not included in determining the overall short circuit current rating of the industrial control panel. UL has not issued a requirement at the time of this publication to mark these accessories with a short circuit current rating.

For electrical accessories that are NOT located in a control circuit, and are not otherwise marked with a short circuit current rating, like Hoffman's power distribution units, then the default rating in Table SB4.1 of UL 508A would apply to the component being evaluated. If the power distribution unit is essentially receptacles or terminals, then the assumed short circuit current value from Table SB4.1 would be selected.

If the accessory contains both a load and controls, the controls would need to be assigned a short circuit current rating. An example of this would be an air conditioner that has a contactor included in the design. In this case, if the contactor is not marked, the SCCR could be assigned from Table SB4.1 in UL508A, or be tested per UL508, or the standard that applies to the component being evaluated, in this case the contactor.

## SHORT CIRCUIT CURRENT RATING FOR AIR CONDITIONERS AND HEAT EXCHANGERS

Article 409 of the 2008 National Electric Code (NFPA 70) requires industrial control panels to be marked with a short circuit current rating. As specified in the National Electric Code, UL508A-2001 Supplement SB, the Standard of Safety for Industrial Control Equipment, provides an accepted method for determining the short-circuit current rating of the control panel.

The SCCR rating for our air conditioners and heat exchangers has a default value of 5 kA.

You may use a 5 or 10 kVA isolation transformer between the customer's panel and our air conditioner and not have an effect on the customer's 65 kA rating.

You may use a fuse or circuit breaker with a 5 kA short circuit rating on the line side of the ACU and its branch circuit protective device and not have an effect on the customer's 65 kA rating.

The current limiting fuse or circuit breaker used on the line side of the branch circuit protection for the ACU must have a SCCR => that of the panel rating. Additionally for a current limiting fuse the customer would need to verify using table SB4.2 of UL 508A, that the let through current ( $I_p * 10^3$ ) of the fuse is  $\leq 5kA$ . If a circuit breaker is used as feeder protection, it **must** be marked Current Limiting type from the manufacturer, and the panel builder would need to verify based on the manufacturers published curves that it will let through  $\leq 5kA$ . Examples of these curves are included in UL 508A supplement SB.

You can run separate circuits for the panel and the air conditioner as long as each is labeled with their individual SCCR ratings.

(5 kA and 65 kA)

If the customer does not implement one of the options above, then the resulting SCCR rating would be the 5 kA rating of the ACU, if that is the lowest rated component in the panel.

Testing represents another option; however, if the customer does not implement these options, then the resulting short circuit rating of the panel is based on the lowest short circuit current rating of all power circuit components installed in the panel.