

Standards Organization Summary and Directory

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 organizations. Their ratings are based on similar application descriptions and expected performance. UL and CSA both require enclosure testing by qualified evaluators in their 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 4X rating that indicates resistance to corrosion. This rating is based on the enclosure's ability to withstand prolonged exposure to salt water spray.

While a 4X 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

International Standards Organization (IEC) ratings are based on performance criteria similar to NEMA. Nevertheless, there are differences in how enclosure performance is interpreted. For example, UL and CSA test requirements specify that an enclosure fails the watertight 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 IP ratings do not specify degrees of protection against risk of explosion or conditions such as moisture or corrosive vapors. NEMA Type ratings, on the other hand, do specify 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

- 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

Underwriters Laboratories Inc.

333 Pfingsten Road
Northbrook, IL 60062

www.ul.com

- UL 50 Cabinets and Boxes
- 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

Joint Industry Council

c/o AMT - The Association for Manufacturing Technology

7901 Westpark Drive
McLean, VA 22102-4206

www.amtonline.org

- EMP-I Electrical Standards for Mass Production Equipment
- EGP-I Electrical Standards for General Purpose Machine Tools
- These standards have been replaced by NFPA-79*

Standards Organization Directory

Canadian Standards Association

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

- 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

TÜV Product Service

Segensworth Road
Fareham Hampshire
PO15 5RH
United Kingdom
www.tuvps.co.uk

Institute of German Electronics Engineers (VDE)

Stresemannalle 15
60596 Frankfurt Main
Germany
www.vde.de

Electronic Industries Alliance

2500 Wilson Blvd.
Arlington, VA 22201
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

National Fire Protection Association

Batterymarch Park
Quincy, MA 02169-7471
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

- 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

- 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

- NSF Criteria C-2 Special Equipment and/or Devices

Telcordia Technologies

8 Corporate Place
Piscataway, NJ 08854-4157
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

- 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

Industry Standards

Comparison of Specific Non-Hazardous Applications in Outdoor Locations

Provides a Degree of Protection Against the Following Environmental Conditions	Type of Enclosure					
	3	3Ra	3RXa	4	4X	6
Incidental contact with the enclosed equipment	•	•	•	•	•	•
Rain, snow, and sleet ^b	•	•	•	•	•	•
Sleet ^c						
Windblown dust	•			•	•	•
Hose-down				•	•	•
Corrosive agents			•		•	
Occasional temporary submersion						•

^a These enclosures may be ventilated.

^b External operating mechanisms are not required to be operable when the enclosure is ice covered.

^c External operating mechanisms are operable when the enclosure is ice covered.

Comparison of Specific Non-Hazardous Applications in Indoor Locations

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

^a 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.

^b 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.

The preceding tables are reproduced by permission of the National Electrical Manufacturers Association from NEMA Standards Publication 250 "Enclosures for Electrical Equipment (1000 Volts Maximum)".

Enclosure Type Rating vs. IP Rating

Electrical enclosures are rated by type (NEMA 250 / UL 50), and/or IP rated (IEC 60529) based on 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 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 to the additional type-rating requirements. Therefore, a type rating cannot be assigned to an enclosure that has been only IP rated.

Electrical enclosures manufactured by Hoffman are tested for both type and IP rating and carry both ratings.

Fluid Statistics and Dynamic Comparison of Ingress Water Tests

Test Type	Flow Rate (gal/min)	Flow Rate (l/min)	Nozzle Diameter (In)	Nozzle Diameter (mm)	Nozzle Area (sq in)	Nozzle Velocity (ft/sec)	Equivalent Head (ft)	Equivalent Pressure (psi)	Mass Flow (lbs/sec)	Power (hp)	Total Force on Vertical Plate (lbs)
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	1.0000	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

Industry Standards

Rev. A 7/07

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, I2, I2K, and I3 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, I2, I2K, and I3 enclosures meet this requirement.

Indoor

Not to be exposed to weather. Type I, I2, I2K, and I3 enclosures meet this requirement.

Oil-Resistant

Constructed so that oil will not interfere with successful operation of equipment. Type I2 and I3 enclosures meet this requirement.

Oil-tight

Constructed so that oil will not enter the enclosure under specified test conditions. Type I3 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.

NEMA, UL, and CSA Ratings

NEMA, UL, and CSA Ratings

NEMA, UL, and CSA are standard-writing organizations commonly recognized in North America. Their ratings are based on similar application descriptions and expected performance. UL and CSA both require enclosure testing by qualified evaluators. 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.

Enclosure Types Non-Hazardous Locations

	Enclosure Type	National Electrical Manufacturers Association (NEMA Standard 250) and Electrical and Electronic Mfg. Association of Canada (EEMAC)	Underwriters Laboratories Inc. (UL 50 and UL 508A)	Canadian Standards Association (Standard C22.2 No. 94)
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.
	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.
	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.
	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.
	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.
	Type 3RX ^a	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.
	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.
	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.
	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.

^a Underwriter's Laboratories Inc. anticipates issuing revisions to the UL50 and UL508A standards to include Type 3RX.

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CE and IEC Classifications

CE

The CE Mark is a European Union (EU) compliance symbol and acronym for Conformité Européenne. The CE Mark indicates that a product complies with all European directives and essential harmonized standards for health, safety, environment, and consumer protection that may apply to that product. In addition, the CE Mark promotes free trade movement from outside and within the EU.

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.

Hoffman enclosures are designed in compliance with European standards and are eligible to receive a Manufacturer's Declaration of Conformity. The certificate assists the final equipment manufacturer in obtaining the CE Mark. Contact Applications Engineering at 763 422-2175 for further information.

Hoffman enclosures meet the requirements of the applicable European standards specified below.

Applicable European Directives

73/23/EEC, amended by 93/68/EEC - Low Voltage Directive for Electrical Equipment within Certain Voltage Limits
89/336/EEC, amended by 92/31/EEC and 93/68/EEC - EMC Directive Relating to Electromagnetic Compatibility
98/37/EC - Machinery Directive

Note: The EMC Directive is only secondarily applicable since an empty enclosure does not produce electromagnetic interference.

Applicable International Standards

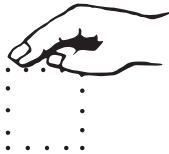









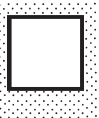
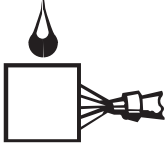
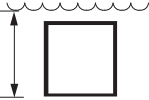

IEC 60529 (IEC529) Degrees of Protection Provided by Enclosures
IEC 60204 (IEC204) Electrical Equipment of Industrial Machines

International Standards IP Protection Classification

IEC Publication 60529 Classification of Degrees of Protection by Enclosures provides a system for specifying enclosures of electrical equipment on the basis of the degree of protection required. IEC 60529 does not specify degrees of protection against risk of explosions or conditions such as moisture (produced, for example, by condensation), corrosive vapors, fungus, or vermin. NEMA Standards Publication 250 does test for environmental conditions such as corrosion, rust, icing, oil, and coolants. 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.

CE and IEC Classifications

IP Rating Categories

First Numeral		Second Numeral	
IP	Protection of Persons	Protection of Equipment	Protection of Equipment
0	No Protection	No Protection	0 No Protection
1	 Protected against contact with large areas of the body (back of hand)	Protected against objects over 50mm in diameter	1  Protected against vertically falling drops of water, e.g. condensation
2	 Protected against contact with fingers	Protected against solid objects over 12mm in diameter	2  Protected against direct sprays of water up to 15° from vertical
3	 Protected against tools and wires over 2.5 mm in diameter	Protected against solid objects over 2.5mm in diameter	3  Protected against sprays to 60° from vertical
4	 Protected against tools and wires over 1 mm in diameter	Protected against solid objects over 1mm in diameter	4  Protected against water sprayed from all directions (limited ingress permitted)
5	 Protected against tools and wires over 1mm in diameter	Protected against dust (limited ingress, no harmful deposit)	5  Protected against low pressure jets of water from all directions (limited ingress permitted)
6	 Protected against tools and wires over 1mm in diameter	Totally protected against dust	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 IEC SYMBOLS

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)	IP 2 3 (An enclosure with this designation provides protection against touch with a finger, penetration of solid objects greater than 12mm, and spraying water.)

Short Circuit Current Rating and Metric System Conversions

Short Circuit Current Rating

The short circuit current rating is not required for an empty UL 508A enclosure, and 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.

Metric System Conversions

Enclosures

Length

To convert

Inches to millimeters – multiply by 25.4

Millimeters to inches – multiply by .03937

Weight

To convert

Pounds to kilograms – multiply by .4536

Kilograms to pounds – multiply by 2.2046

Thermal Management

Temperature

To convert

Degrees Fahrenheit to Degrees Celsius – subtract 32, then multiply by 5/9ths

Degrees Celsius to Degrees Fahrenheit – multiply by 9/5ths, then add 32

Air Flow

To convert

Cubic feet per minute to cubic meters per hour – multiply by 1.6992

Cubic meters per hour to cubic feet per minute – multiply by .5885

Pressure

To convert

Pounds per square inch to mega pascals – multiply by .006894757

Mega pascals to pounds per square inch – multiply by 145.0377

Energy

To convert

BTUs per hour to Watts – multiply by .2932

Watts to BTUs per hour – multiply by 3.4129

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