



Standards Sources .....	454
Industry Definitions (per NEMA) .....	455
Industry Definitions (NEMA Standards) .....	456
Enclosure Type - NEMA, UL, CSA Cross Reference .....	459
Definition of Protection Grades IEC 529 .....	460
Corrosion Information .....	462
Information Specific to Hammond Enclosures .....	463
Instructions for Repainting Hammond Enclosures .....	464
Decimal and Millimeter Equivalents .....	465
Metric Conversion Information .....	466
Corrosion Resistance Table .....	467

## Standards Sources



www.nema.org

### **NEMA National Electrical Manufacturers' Association**

- 1300 North 17th Street Rosslyn, VA 22209
- NEMA Standards Publication No. 250 enclosures for Electrical Equipment (1000 Maximum)
- NEMA Standards Publication No. ICS6 enclosures for Industrial Controls and Systems



www.ul.com

### **UL Underwriters' Laboratories Inc.**

- 333 Pfingsten Road, Northbrook, IL 60062
- UL 50 Cabinets and Boxes
- UL 508 Industrial Control Equipment
- UL 870 Wireways, Auxiliary Gutter, and Associated Fittings



www.csa.ca

### **CSA CSA International**

- 178 Rexdale Boulevard, Etobicoke (Toronto), Ontario, Canada M9W 1R3
- CSA Standard C22.2, No 0 General Requirements - Canadian Electrical Code, Part II
- CSA Standard C22.2, No 0.4 Bonding and Grounding of Electrical Equipment (Protective Equipment)
- CSA Standard C22.2, No. 14 Industrial Control Equipment for Use in Ordinary (Non-Hazardous) Locations
- CSA Standard C22.2, No. 40 Cutout, Junction, and Pull Boxes
- CSA Standard C22.2, No. 26 Construction and Test of Wireways, and Auxiliary Gutters, and Associated Fittings.
- CSA Standard C22.2, No. 94-M91 Special Purpose Enclosures



www.amtonline.org

### **JIC Joint Industry Council c/o AMT - The Association for Manufacturing Engineering**

- 7901 Westpark Drive, McLean, VA 22101
- EMP-1 Electrical Standards for Mass Production Equipment
- EGP-1 Electrical Standards for General Purpose Machine Tools
- These standards have been replaced by NFPA-79



Electronic Industries Alliance  
www.eia.org

### **EIA Electronic Industries Association**

- 2500 Wilson Blvd, Arlington, VA 22201
- EIA RS-310-D Cabinets, Racks, Panels, and Associated Equipment



www.iec.ch

### **IEC International Electrotechnical Commission**

- 3 Rue de Varemb, Geneva, Switzerland
- IEC 60529 Classification of Degrees of Protection Provided by Enclosures



www.cemarking.net

### **CE Conformite Europeene**

- European Commission



American National Standards Institute  
www.ansi.org

### **ANSI American National Standards Institute**

- 1819 L Street NW Washington, DC 20036

# Industry Definitions (per NEMA)

## Introduction

An enclosure is a surrounding case constructed to provide a degree of protection to personnel against incidental contact with the enclosed equipment and to provide a degree of protection to the enclosed equipment against specified environmental conditions. NEMA 250-2003.

## General Definitions Pertaining To Enclosures

**Cover:** An unhinged portion of an enclosure that covers an opening.

**Degree of Protection:** The extent of protection provided by an enclosure against access to hazardous parts, against ingress of foreign solid objects and/or against ingress of water and verified by standardized test methods.

**Design Tests:** Tests to demonstrate performance of a product designed to applicable standards. (Note: Design tests are not intended to be production tests.) NEMA 250-2003.

**Door:** A hinged portion of an enclosure that covers an opening. NEMA 250-2003.

**Hazardous (Classified) Locations** are those areas, which may contain hazardous (classified) materials in sufficient quantity to create an explosion. See Article 500 of the National Electrical Code. NEMA 250-2003.

**Hazardous (Classified) Materials** are those gases, vapors, combustible dusts, fibers, or flyings, which are explosive under certain conditions. NEMA 250-2003.

**Hazardous Parts** are parts that are hazardous to approach or touch.

**Indoor Locations** are those areas, which are protected from exposure to the weather. NEMA 250-2003.

**Knockout** is a portion of the wall of an enclosure so fashioned that it may be removed readily by a hammer, screwdriver, and pliers at the time of installation in order to provide a hole for the attachment of an auxiliary device or raceway, cable, or fitting. NEMA 250-2003.

**Non-Hazardous Locations:** Areas, which do not contain hazardous (classified) materials in sufficient quantity to create an explosion. NEMA 250-2003.

**Non-Ventilated** means constructed so as to provide no intentional circulation of external air through the enclosure. NEMA 250-2003.

**Oil-Resistant Gaskets** are those made of material, which is resistant to oil, or oil fumes. NEMA 250-2003.

**Outdoor Locations** are those areas, which are exposed to the weather. NEMA 250-2003.

**Ventilated** means constructed so as to provide for the circulation of external air through the enclosure to remove excess heat, fumes, or vapors. NEMA 250-2003.

## Industry Definitions (NEMA Standards)

### Definitions Pertaining to Non-Hazardous Locations

**Type 1 Enclosures** are constructed for indoor use to provide a degree of protection to personnel against access to hazardous parts and to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt)

**Type 2 Enclosures** are constructed for indoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt), and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing).

**Type 3 Enclosures** are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt) and windblown dusty, to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow), and that will be undamaged by the external formation of ice on the enclosure.

**Type 3R Enclosures** are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt) to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow), and that will be undamaged by the external formation of ice on the enclosure.

**Type 3S Enclosures** are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and windblown dust) to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow), red for which the external mechanisms) remain operable when ice laden.

**Type 3X Enclosures** are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt) and windblown dusty, to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow), that provides an additional level of protection against corrosion and that will be undamaged by the external formation of ice on the enclosure.

**Type 3XR Enclosures** are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt), to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow), that will be undamaged by the external formation of ice on the enclosure that provides an additional level of protection against corrosion, and that will be undamaged by the external formation of ice on the enclosure.

**Type 3SX Enclosures** are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and windblown dusty, to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snowy, that provides an additional level of protection against corrosion, and for which the external mechanisms) remain operable when ice laden.

**Type 4 Enclosures** are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and windblown dusty, to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water), and that will be undamaged by the external formation of ice on the enclosure.

**Type 4X Enclosures** are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (windblown dusty, to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (rain, sleet, snow, splashing water, and hose directed water), that provides an additional level of protection against corrosion, and that will be undamaged by the external formation of ice on the enclosure.

**Type 5 Enclosures** are constructed for indoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and settling airborne dust, lint, fibers, and flyings), and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing).

**Type 6 Enclosures** are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt), to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (hose directed water and the entry of water during occasional temporary submersion at a limited depths), and that will be undamaged by the external formation of ice on the enclosure.

**Type 6P Enclosures** are constructed for either indoor or outdoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt), to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (hose directed water and the entry of water during prolonged submersion at a limited depths), that provides an additional level of protection against corrosion and that will be undamaged by the external formation of ice on the enclosure.

## NEMA Enclosure Classifications

### Definitions Pertaining to Non-Hazardous Locations - Cont'd

**Type 12 Enclosures** are constructed (without knockouts) for indoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and circulating dust, lint, fibers, and flyings), and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing).

**Type 12K Enclosures** are constructed (with knockouts) for indoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and circulating dust, lint, fibers, and flyings), and to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing).

**Type 13 Enclosures** are constructed for indoor use to provide a degree of protection to personnel against access to hazardous parts, to provide a degree of protection of the equipment inside the enclosure against ingress of solid foreign objects (falling dirt and circulating dust, lint, fibers, and flyings), to provide a degree of protection with respect to harmful effects on the equipment due to the ingress of water (dripping and light splashing), and to provide a degree of protection against the spraying, splashing, and seepage of oil and non-corrosive coolants.

### Definitions Pertaining to Hazardous (Classified) Locations

**Type 7 Enclosures** constructed for indoor use in hazardous locations classified as Class I, Division 1, Groups A, B, C, or D, as defined in NFPA70. NEMA 250-2003.

**Type 8 Enclosures** constructed for either indoor or outdoor use in hazardous locations classified as Class I, Division 1, Groups A, B, C, or D, as defined in NFPA70. NEMA 250-2003.

**Type 9 Enclosures** constructed for indoor use in hazardous locations classified as Class II, Division 1, Groups E, F, or G, as defined in NFPA70. NEMA 250-2003.

**Type 10 Enclosures** constructed to meet the requirements of the Mine Safety and Health Administration, 30 CFR, Part 18. NEMA 250-2003. NEMA 250-2003.

### Application for Enclosure Types

**Type 1** general-purpose enclosures are suitable for general-purpose application indoors, where atmospheric conditions are normal. These enclosures serve as protection against falling dirt but are not dust tight.

**Type 2** drip-tight (indoor) enclosures are similar to Type 1 enclosures, suitable for application where condensation may be severe, such as that encountered in cooling rooms or laundries.

**Type 3** enclosures provide proper protection against windblown dust and weather hazards such as dirt, rain, sleet, or snow. They are suitable for application outdoors on ship docks, canal locks, construction work, and for application in subways and tunnels, use indoors where dripping water is a problem.

**Type 3R** enclosures provide proper protection falling dirt, rain, sleet, snow, undamaged by external formation of ice. They are suitable for application outdoors, they will not withstand wind blown dust.

**Type 4** watertight enclosures are suitable for dairies, breweries, etc., where the enclosure may be subjected to large amounts of water from any angle. (They are not submersible).

**Type 4X** corrosion resistant enclosures satisfy the same requirements of Type 4, in addition, they are suitable for food processing plants, dairies, refineries, and other industries where corrosion is prominent.

**Type 6** submersible enclosures are suitable for application where the equipment may be subject to occasional temporary submersion, such as quarries, mines, and manholes. The enclosure design will depend upon the specified conditions of pressure and time.

**Type 9** hazardous location enclosures—Class II, Group E, F, or G. These enclosures are designed to meet the requirements of the “Canadian Electrical Code” Part I for Class II hazardous locations, and CSA codes section 18, Class II, Group E, F, and G.  
**Class II, Group E** — atmospheres containing metal dust

**Class II, Group F** — atmospheres containing carbon black, coal, or coke dust

**Class II, Group G** — atmospheres containing flour, starch, or grain dust

**Type 12** industrial use enclosures protect against dripping and light splashing of liquids. Hammond Type 12 enclosures meet JIC standard and also satisfy requirements of NEMA.

**Type 12K** industrial use enclosure same as type 12 but includes knockouts in the top and bottom end walls only.

**Type 13** industrial use enclosures, protection against dust, spraying of water, oil, and non-corrosive coolant. These enclosures are suitable for application to machine tools and other industrial processing machines.

## Industry Definitions (NEMA Standards) (continued)

### Comparison of Specific Applications of Enclosures for Indoor Non Hazardous Locations

Provides a Degree of Protection Against The Following Environment Conditions	Enclosure Type				
	1 <sup>1</sup>	4	4X	12	13
Incidental contact with enclosed equipment	•	•	•	•	•
Falling dirt	•	•	•	•	•
Falling liquids and lightly splashing		•	•	•	•
Circulating dust, lint and fiber flyings <sup>2</sup>		•	•	•	•
Settling airborne dust, lint and fiber flyings <sup>2</sup>		•	•	•	•
Hosedown and splashing water		•	•		
Oil and coolant seepage				•	•
Oil and coolant spraying and splashing					•
Corrosive agents			•		

<sup>1</sup> These enclosures may be ventilated

<sup>2</sup> These fibers and flyings are nonhazardous materials and are not considered Class III type ignitable fibers or combustible flyings. For Class III type ignitable fibers or combustible flyings see the National Electrical Code, article 500.

### Comparison of Specific Applications of Enclosures for Outdoor Non Hazardous Locations

Provides a Degree of Protection Against The Following Environment Conditions	Enclosure Type		
	3R <sup>1</sup>	4	4X
Incidental contact with enclosed equipment	•	•	•
Rain, snow, and sleet <sup>2</sup>	•	•	•
Windblown dust, lint and fiber flyings		•	•
Hosedown		•	•
Corrosive agents			•

<sup>1</sup> These enclosures may be ventilated

<sup>2</sup> External operating mechanisms are not required to be operable when the enclosure is ice covered.

# Enclosure Type - NEMA, UL, CSA Cross Reference

## Non-Hazardous Enclosures

Type	National Electrical Manufacturers' Association	Underwriters' Laboratories Inc.	Canadian Standards Association
<b>1</b>	Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment to provide a degree of protection against falling dirt.	Indoor use primarily to provide a degree of protection against limited amount of falling dirt.	General purpose enclosure in ordinary locations.
<b>2</b>	Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment, to provide a degree of protection against falling dirt, and to provide a degree of protection against dripping and light splashing of liquids.	Indoor use primarily to provide a degree of protection against limited amounts of falling water and dirt.	An enclosure for Indoor use, constructed so as to provide a degree of protection against dripping and light splashing of non-corrosive liquids, and falling dirt.
<b>3</b>	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with enclosed equipment to provide a degree of protection against falling dirt, rain, sleet, snow and windblown dust and that will be undamaged by the external formation of ice on the enclosure.	Outdoor use primarily to provide a degree of protection against rain, sleet, windblown dust, and damage from external ice formation.	An enclosure for either indoor or outdoor use, constructed so as to provide a degree of protection against rain, snow, and windblown dust, undamaged by the external formation of ice on the enclosure.
<b>3R</b>	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with enclosed equipment to provide a degree of protection against falling dirt, rain, sleet, snow and that will be undamaged by the external formation of ice on the enclosure.	Outdoor use primarily to provide a degree of protection against rain, sleet; and damage from external ice formation.	An enclosure for either indoor or outdoor use, constructed so as to provide a degree of protection against rain, and snow, undamaged by the external formation of ice on the enclosure.
<b>4</b>	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment: to provide a degree of protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, hose directed water, and hose-directed water, and that will be undamaged by the external formation of ice on the enclosure.	Indoor or outdoor use primarily to provide a degree of protection against windblown dust, and rain, splashing water, hose-directed water, and damage from external ice formation.	An enclosure for either indoor or outdoor use, constructed so as to provide a degree of protection against rain, snow, windblown dust, splashing and hose-directed water, undamaged by the external formation of ice on the enclosure.
<b>4X</b>	Enclosures constructed for either indoor or outdoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment, to provide a degree of protection against falling dirt, rain, sleet, snow, windblown dust, splashing water, hose-directed water, and corrosion, and that will be undamaged by the external formation of ice on the enclosure.	Indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, hose-directed water, and damage from external ice formation.	An enclosure for either indoor or outdoor use, constructed so as to provide 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.
<b>12</b>	Enclosures constructed (without knockouts) for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment, to provide a degree of protection against falling dirt, against circulating dust, lint and fiber flyings, and against dripping and light splashing of liquids.	Indoor use primarily to provide a degree of protection against circulating dust, falling dirt, and dripping non-corrosive liquids.	An enclosure for indoor use, constructed so as to provide a degree of protection against circulating and settling dust and lint, fibre flyings; dripping and light splashing of non-corrosive liquids; not provided with knockouts.
<b>13</b>	Enclosures constructed for indoor use to provide a degree of protection to personnel against incidental contact with the enclosed equipment, to provide a degree of protection against falling dirt, against circulating dust, lint and fiber flyings, and against the spraying, splashing, and seepage of water, oil, and non-corrosive coolants.	Indoor use primarily to provide a degree of protection against dust, spraying of water, oil, and non-corrosive coolant.	An enclosure for indoor use, constructed so as to provide a degree of protection against circulating and settling dust, lint and fibre flyings, seepage and spraying of non-corrosive liquids including oils and coolants.

Note: The specifications on this page are for comparative reference only and are not intended to provide the complete requirements or test qualifications published by various associations and agencies. Complete information may be obtained by contacting the appropriate organization as shown in the "Standards Sources" listing.

## Definition of Protection Grades IEC 529 IEC (International Electrotechnical Commission)

The IEC has established an enclosure grading system that produces an IP rating. (For example, IP 54 - "5" is the first character - refer to tables I & II. "4" is the second character - refer to table III - following page).

### Table I Degrees of Protection against Hazardous Parts

Degree of protection is indicated by the first characteristic numeral

First Characteristic Numeral	Brief Description	Definition
0	Non Protected	
1	Protected against access to hazardous parts with the back of a hand.	The Access probe, sphere of 50 mm $\varnothing$ , shall have adequate clearance from hazardous parts.
2	Protected against access to hazardous parts with a finger.	The jointed test finger of 12mm $\varnothing$ , 80 mm length, shall have adequate clearance from hazardous parts.
3	Protected against access to hazardous parts with a tool.	The access probe of 2.5 mm $\varnothing$ shall not penetrate.
4	Protected against access to hazardous parts with a wire.	The access probe of 1.0 mm $\varnothing$ shall not penetrate.
5	Protected against access to hazardous parts with a wire.	The access probe of 1.0 mm $\varnothing$ shall not penetrate.
6	Protected against access to hazardous parts with a wire.	The access probe of 1.0 mm $\varnothing$ shall not penetrate.

Note: In the case of the first characteristic numerals 3, 4, 5 and 6, protection against access to hazardous parts is satisfied if adequate clearance is kept. Due to the simultaneous requirement specified in Table II the definition "shall not penetrate" is given in Table I.

### Table II Degrees of Protection against Solid Foreign Objects

Degree of protection is indicated by the first characteristic numeral

First Characteristic Numeral	Brief Description	Definition
0	Non Protected	
1	Protected against solid foreign objects of 50 mm $\varnothing$ and greater.	The object probe, sphere of 50 mm $\varnothing$ , shall not fully penetrate. <sup>1</sup>
2	Protected against solid foreign objects of 12.5 mm $\varnothing$ and greater.	The object probe, sphere of 12.5 mm $\varnothing$ , shall not fully penetrate. <sup>1</sup>
3	Protected against solid foreign objects of 2.5 mm $\varnothing$ and greater.	The object probe of 2.5 mm $\varnothing$ shall not penetrate at all. <sup>1</sup>
4	Protected against solid foreign objects of 1.0 mm $\varnothing$ and greater.	The object probe of 1.0 mm $\varnothing$ shall not penetrate at all. <sup>1</sup>
5	Dust-protected	Ingress of dust is not totally prevented, but dust shall not penetrate in a quantity to interfere with satisfactory operation of the apparatus or to impair safety.
6	Dust-tight	No ingress of dust

<sup>1</sup> The full diameter of the object probe shall not pass through an opening of the enclosure.

# Definition of Protection Grades IEC 529

## IEC (International Electrotechnical Commission)

**Table III**  
**Degrees of Protection against Water**

Degree of protection is indicated by the second characteristic numeral

Second Characteristic Numeral	Brief Description	Definition
0	Non Protected	
1	Protected against vertically falling water drops	Vertically falling drops shall have no harmful effects.
2	Protected against vertically falling water drops when enclosure tilted up to 15°.	Vertically falling drops shall have no harmful effects when the enclosure is tilted at any angle up to 15° on either side of the vertical.
3	Protected against spraying water.	Water sprayed at any angle up to 60° on either side of the vertical shall have no harmful effects.
4	Protected against splashing water	Water splashed against the enclosure from any direction shall have no harmful effects.
5	Protected against water jets	Water projected in jets against the enclosure from any direction shall have no harmful effects.
6	Protected against powerful water jets	Water projected in powerful jets against the enclosure from any direction shall have no harmful effects.
7	Protected against the effects of temporary immersion in water.	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is temporarily immersed in water under standardized conditions of pressure and time.
8	Protected against the effects of continuous immersion in water.	Ingress of water in quantities causing harmful effects shall not be possible when the enclosure is continuously immersed in water under conditions which shall be agreed between manufacturer and user but which are more severe than for numeral 7.

## NEMA TO IEC

### Enclosure Rating Cross-Reference<sup>1</sup>

(CANNOT be used to convert IEC Classification designations to NEMA Type Ratings)

NEMA TYPE	IP20	IP22	IP24	IP54	IP55	IP66	IP67
1	☐						
2		☐					
3					☐		
3R			☐				
4						☐	
4X						☐	
6							☐
12, 12K				☐			
13				☐			

<sup>1</sup> This cross reference is an approximation of NEMA and IEC classifications for reference only. Please consult the appropriate agencies for requirements and test qualifications for complete information.

## Corrosion Information

### Corrosion Resistance of Various Enclosure Materials

- Hammond offers many different material types in its broad product offering. Deciding on the appropriate material depends on various factors with a major consideration being resistance properties of the material to various chemical laden environments. Below is a general summary of the suitability of the materials offered in Hammond's product lines. Please consult Hammond for specific questions you may have for a particular environment.

<b>Suitability</b>	High	Stainless Steel Type 316 Stainless Steel Type 304	Stainless Steel Type 316 Stainless Steel Type 304	Stainless Steel Type 316 Stainless Steel Type 304 Fibreglass Aluminum Steel - Powder Painted
	Satisfactory	Fiberglass Steel - Powder Painted	Fiberglass	
	Limited	Aluminum	Aluminum Steel - Powder Painted	
		Acids	Alkalies	Solvents

**Material Type**

### Suggested Applications for Corrosion Resistant Materials

Material Type	Hammond NEMA Rating	Suggested Application
<b>Stainless Steel Type 304</b>	4X	Indoor/outdoor applications. Ideal for hose-down and wet areas (e.g. food processing, water treatment, dairies, breweries, etc.)
<b>Stainless Steel Type 316</b>	4X	Indoor/outdoor applications. Ideal for most all environments especially marine uses.
<b>Aluminum</b>	4	Indoor/outdoor applications. Ideal for marine uses as well as environments containing solvents, petrochemicals, some acids and most sulfates and nitrates.
<b>Fiberglass Reinforced Polyester</b>	4X	Indoor/outdoor applications. Ideal for continually wet, cold or salty environments. Also useful in solvent or chemical laden areas. Strong resistance to heat, dilute acids and bases, impact, fire and outdoor exposure.

## Information Specific to Hammond Enclosures

### Intended Use of Hammond Enclosures

Hammond electrical enclosures shown in this catalog are designed for industrial electrical applications and as such should be selected, transported, handled, installed, and re-fabricated by qualified professional electricians. These products are not intended for resale or repackaging for household applications or use by the general public. All applications of these products should be in accordance with proper inspections, test approvals, warnings, notices, and instructions as indicated by Consumer Product Safety Regulations and all other applicable local, state, provincial, and federal laws.

Hammond Manufacturing supplies enclosures built to the 3rd party specifications (i.e. UL, CSA) as noted in this catalog. Hammond offers no guarantee or warranty as to the applicability of our products outside these specifications. If you have any concerns about the appropriate enclosure selection for your application, please contact Hammond for advice regarding the variables in your particular situation.

### Hammond Paint Finish

#### NEMA Type 12

Hammond Type 12 industrial enclosures are finished with recoatable powder coating.

#### NEMA Type 4

Hammond Type 4 industrial enclosures are finished with recoatable powder coating.

#### NEMA Type 4X for Painted Mild Steel Enclosures

Users of previous Hammond Manufacturing catalogs may have noticed a change to the ratings noted for Type 4 painted mild steel enclosures. Previously, Hammond catalog's have shown that these enclosures also carried the Type 4X designation, but this is no longer the case. There has been NO CHANGE WHATSOEVER to the quality of the Hammond paint finish. Hammond has removed the 4X approval from this catalog only to avoid misapplication of painted steel enclosures. The testing criteria for Type 4X is not as rigorous as many users may assume.

It is important for users to understand the NEMA 4/4X rating. In response to concern about the costs of corrosion, the Underwriters' Laboratory (UL) and the National Electrical Manufacturers' Association (NEMA) have developed a rating system for electrical enclosures, stipulating that certain minimum conditions of corrosion resistance be met.

Material tested to UL1332 (type 4 protective coating) is prerequisite to a type 4X salt spray test. The NEMA 4X rating is applied to material that has met, under laboratory conditions, a two hundred hour salt spray with no worse pitting than that exhibited on a Type 304 Stainless sample run at the same time. This rating, however, does not test for corrosion resistance beyond this, or with chemicals other than salt.

## Information Specific to Hammond Enclosures

### Repainting Hammond Enclosures

### Instructions For Repainting Hammond Standard Paints & Powders

**IMPORTANT:** Check with your paint manufacturer to insure the paint you are applying is compatible with the paint on the Hammond product.

Hammond paints are re-paintable with most baking enamels, alkyd air dry enamels, industrial acrylic enamels, two component urethanes & two component epoxy's by following the instructions below.

**Note:** Automotive type paint finishes usually require additional surface preparation when applied over polyester powder finishes. Contact the paint supplier for more information.

**IMPORTANT:** For best adhesion results, correct surface preparation before painting is essential.

### Type 12 and Type 4 Enclosures

#### INSTRUCTIONS FOR REPAINTING HAMMOND POWDER COATED PRODUCTS

- All Hammond standard powder coated products can be repainted.
  - Check with your paint manufacturer to insure that the paint you are applying is compatible with the paint on the Hammond product.
  - (Hammond uses Polyester and Hybrid powder coatings on standard catalogue products) - Always test the repainting process in an inconspicuous area prior to use.
  - This painting instruction applies to ANSI 61 (Gray) and RAL7035 (Light Gray).
  - All other Hammond powder paints can be repainted by following step 5.
1. **IMPORTANT** - This step is mandatory and must be done carefully.  
Wipe down the entire area to be repainted with lacquer thinner or acetone. Use a clean cloth and change cloth frequently.
  2. Apply finish coats as per your paint manufacturers instructions.
  3. Allow paint to cure properly for best adhesion and hardness. Consult your paint manufacturer for proper cure time and temperature.
  4. The above procedure promotes good inter-coat adhesion. To enhance this process sanding with a 220 grit sandpaper is recommended. Remove all sanding dust using clean rags and a tack cloth.
  5. All Hammond standard powders can be repainted after a light sanding with a 240 grit sandpaper and cleaning.

**Note:** Always test the repainting process in an inconspicuous area prior to use.

#### Hammond Touch-up (Spray Cans)

Part Number	Color Match
1413LRS	Gray (ANSI 61)
1413NS	White
1413CGRALS	Beige (RAL7032)
1413BKS	Black
1413LGS	Light Gray (RAL 7035)

# Decimal and Millimeter Equivalents

4ths	8ths	Fractions of an Inch			Decimal (to 3 places)	Millimeters (to 1 place)
		16ths	32nds	64ths		
				1/64	0.016	0.4
			1/32		0.031	0.8
				3/64	0.047	1.2
		1/16		5/64	0.063	1.6
			3/32		0.078	2.0
				7/64	0.094	2.4
	1/8			9/64	0.109	2.8
			5/32		0.125	3.2
				11/64	0.141	3.6
		3/16			0.156	4.0
			7/32		0.172	4.4
				13/64	0.188	4.8
			9/32		0.203	5.2
				15/64	0.219	5.6
1/4			11/32		0.234	6.0
				17/64	0.250	6.4
			13/32		0.266	6.7
				19/64	0.281	7.1
		5/16			0.297	7.5
			11/32		0.313	7.9
				21/64	0.328	8.3
			13/32		0.344	8.7
	3/8			23/64	0.359	9.1
				25/64	0.375	9.5
			15/32		0.391	9.9
				27/64	0.406	10.3
		7/16			0.422	10.7
			17/32		0.438	11.1
				29/64	0.453	11.5
			19/32		0.469	11.9
				31/64	0.484	12.3
1/2			21/32		0.500	12.7
				33/64	0.516	13.1
			23/32		0.531	13.5
				35/64	0.547	13.9
		9/16			0.563	14.3
			25/32		0.578	14.7
				37/64	0.594	15.1
			27/32		0.609	15.5
	5/8			39/64	0.625	15.9
			29/32		0.641	16.3
				41/64	0.656	16.7
			31/32		0.672	17.1
		11/16			0.688	17.5
			33/32		0.703	17.9
				43/64	0.719	18.3
			35/32		0.734	18.7
3/4				47/64	0.750	19.1
			37/32		0.766	19.4
				49/64	0.781	19.8
			39/32		0.797	20.2
		13/16			0.813	20.6
			41/32		0.828	21.0
				53/64	0.844	21.4
			43/32		0.859	21.8
	7/8			55/64	0.875	22.2
			45/32		0.891	22.6
				57/64	0.906	23.0
			47/32		0.922	23.4
		15/16			0.938	23.8
			49/32		0.953	24.2
				61/64	0.969	24.6
			51/32		0.984	25.0
				63/64	0.984	25.0
1					1.000	25.4

Technical Information

## Metric Conversion Information

### LENGTH

1 mm = 0.039 in.	8 mm = 0.315 in.	60 mm = 2.362 in.	400 mm = 15.748 in.
2 mm = 0.079 in.	9 mm = 0.354 in.	70 mm = 2.756 in.	500 mm = 19.685 in.
3 mm = 0.118 in.	10 mm = 0.394 in.	80 mm = 3.150 in.	600 mm = 23.622 in.
4 mm = 0.157 in.	20 mm = 0.787 in.	90 mm = 3.543 in.	700 mm = 27.559 in.
5 mm = 0.197 in.	30 mm = 1.181 in.	100 mm = 3.937 in.	800 mm = 31.496 in.
6 mm = 0.236 in.	40 mm = 1.575 in.	200 mm = 7.874 in.	900 mm = 35.433 in.
7 mm = 0.276 in.	50 mm = 1.969 in.	300 mm = 11.811 in.	1000 mm = 39.370 in.

#### Imperial to Metric

1 inch = 25.40 mm	1 foot = 0.3048 m
1 inch = 2.54 cm	1 yard = 91.44 cm
1 foot = 30.48 cm	1 yard = 0.9144 m

#### Imperial to Metric

1 mm = 0.03937 in.	1 m = 3.281 feet
1 cm = 0.3937 in.	1 m = 1.0936 yards
1 m = 39.37 in.	

### AREA

#### Imperial to Metric

1 sq. inch = 645.16 sq. millimeters
1 sq. inch = 6.4516 sq. centimeters
1 sq. foot = 929.03 sq. centimeters
1 sq. foot = 0.0929 sq. meter
1 sq. yard = 0.836 sq. meter

#### Imperial to Metric

1 sq. millimeter (mm <sup>2</sup> ) = 0.00155 sq. inch
1 sq. centimeter (cm <sup>2</sup> ) = 0.1550 sq. inch
1 sq. meter (m <sup>2</sup> ) = 10.7640 sq. feet
1 sq. meter (m <sup>2</sup> ) = 1.196 sq. yards

### TEMPERATURE

#### Imperial to Metric

##### Absolute Units

1° Fahrenheit = 0.555° Celsius

##### Thermometer Reading

To convert a °F temperature reading, use the following equation:

$$(^{\circ}\text{F} - 32) \times 0.555 = ^{\circ}\text{C}$$

#### Metric to Imperial

##### Absolute Units

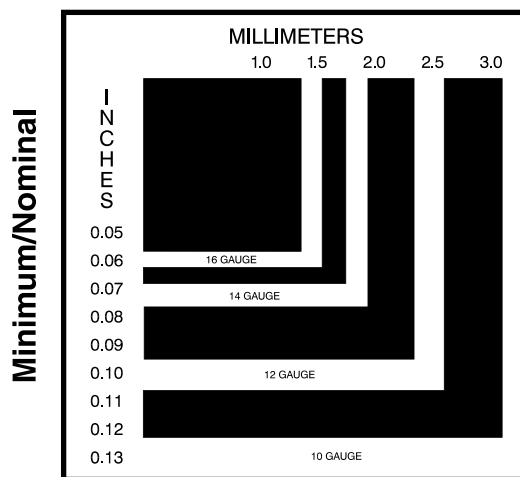
1° Celsius = 1.8° Fahrenheit

##### Thermometer Reading

To convert a °C temperature reading, use the following equation:

$$(^{\circ}\text{C} \times 1.8) + 32 = ^{\circ}\text{F}$$

### Material Thickness Cross Reference Chart



3.0 mm = 0.118 ins.	10 gauge = 0.1345/0.1225 ins. = 3.416/3.112 mm
2.5 mm = 0.098 ins.	12 gauge = 0.1046/0.0926 ins. = 2.657/2.352 mm
2.0 mm = 0.079 ins.	14 gauge = 0.0747/0.0667 ins. = 1.897/1.694 mm
1.5 mm = 0.059 ins.	16 gauge = 0.0598/0.0528 ins. = 1.519/1.341 mm

# Corrosion Resistance Table

## Non-Metallic Enclosures

Chemical and Concentration	Polyester SMC +25% FV Resistance	Chemical and Concentration	Polycarbonate (Trans. Door) Resistance
Acetone 100%	None	Acetone 100%	None
Acetone 100%	None	Acetone 100%	None
Ammonia 5%	High	Ammonia 5%	High*
Aniline purera	Average*	Aniline purera	None
Benzene pure	None	Benzene pure	None
Carbontetrachloride pure	Average	Carbontetrachloride pure	None
Chromic acid 10%	High	Chromic acid 10%	Average*
Citric Acid 100%	High*	Citric Acid 100%	High (10%)
Fresh water	High	Fresh water	High
Gasoline 10%	High	Gasoline 10%	High (100%)
Hexane pure	None	Hexane pure	High
Hydrochloric acid 30%	High	Hydrochloric acid 30%	High
Lactic acid 100%	High*	Lactic acid 100%	High (10%)
Linseed oil pure	High	Linseed oil pure	High
Methyl alcohol 50%	Average*	Methyl alcohol 50%	High (96%)
Naptha 100%	High*	Naptha 100%	Average*
Nitric acid 20%	High (20%), None (100%)	Nitric acid 20%	High (10%), None (100%)
Phenol 5%	Average	Phenol 5%	None
Phosphoric acid 100%	High*	Phosphoric acid 100%	High
Saturated chlorine water	High*	Saturated chlorine water	None
Saturated ether	Average*	Saturated ether	Average*
Sea water	High	Sea water	High
Sulfuric acid 70%	High	Sulfuric acid 70%	High (50%), Average (70%), None (100%)
Toluene pure	High	Toluene pure	None
Trichloroethylene pure	None*	Trichloroethylene pure	None
Hexane	Average		
Aromatic Hydrocarbons	None		
Ethers	None		
Fuel Oil	High		
Liquid Bromine	None		
Liquid Chlorine	None		
Mineral Bases	High		
Mineral oils and greases	High		
Mineral Salts	High		
Naphtaline	Average		
Nitrobenzene	None		
Pure Aniline	None		
Sulphuric Acid	High		
Urea	High		

\* Currently undergoing testing - this is a calculated reference.

Please refer to the Corrosion Resistant Section (see pages 119-156) for Non-Metallic Enclosure information.

The table provided is a guide to assist in identifying the suitability of using non-metallic enclosures in various environments. For specific suitability, prototype samples must be evaluated under actual conditions.

Hammond cannot offer guarantees of warranty as actual conditions may differ from test conditions.