

# ENCLOSURE TYPES




**NEMA (National Electrical Manufacturer's  
Association)**




**AND**

**UL (Underwriters Laboratories)**

- Similarities & one key difference
- (21) Enclosures
- Summary
- Questions



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- Both agencies use the same enclosure ID's (1, 2, 3, etc.).
  - Both agencies have very similar wording when describing the application and the requirements. Therefore, for this presentation, we will not get into any of those details or minor wording differences.



We will concentrate on the **intended application** for each of the enclosures.



**The one key difference between the two sets of standards, is in the area of testing.**



- The UL standards require that manufacturers arrange for independent testing to their (UL) standard compliance, using independent evaluators.
- NEMA standards have no such independent testing requirement, and they allow manufacturers (members of NEMA) to monitor their own compliance.





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## UL 50E

### STANDARD FOR SAFETY

Enclosures for Electrical Equipment,  
Environmental Considerations

The UL requirements for all non-hazardous locations can be found in UL Standard **UL 50E**.

The UL requirements for enclosures in Hazardous locations can be found in **UL 1230**.





Indoor



Falling Dust

## NEMA 1 or UL Type 1

Type 1 is an electrical enclosure built for indoor applications. This is the base unit. It really has two purposes:

1. Keep people away from parts that could be hazardous to them. It is designed to stop people from touching live electrical parts, accidentally.
2. Protection against falling dust from getting inside the enclosure and potentially disrupting operation or causing overheating and a potential fire hazard.





Indoor



Falling Dust



Dripping & Light splashing water

## NEMA 2 or UL Type 2

Type 2 serves the same function as Type 1 (indoor applications) but includes protection against dripping and light splashing water from entering the enclosure above live parts.

**DRIP TEST (UL):** (1) drip source for each 20 sq.-in.; (20) drops of water/minute for (30) minutes. No water is visible on the live parts, insulating material, or mechanism parts, and no water has entered any space within the enclosure in which wiring may be present under any proper installation conditions.





Windblown Dust



Rain



Sleet



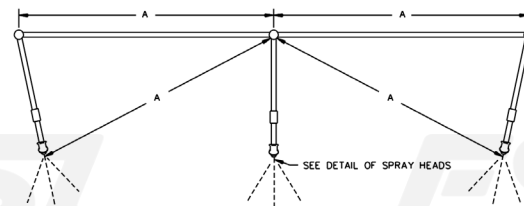
Snow

## NEMA 3 or UL Type 3

Type 3 electrical enclosures are built for outdoor applications (but can be also used indoors). These enclosures are intended to prevent against windblown dust, rain, sleet and snow. In addition, the enclosure (and the components within) must not be damaged by sheet ice forming on the enclosure.

**WINDBLOWN DUST TEST (UL):** Talcum powder, sprayed at 90-100 lbs/sq.in. at a rate of 5 lbs./minute from a distance of 12 -15 inches. No dust can enter the enclosure.

**RAIN TEST (UL):** (3) spray nozzles of a specific design; 5 psi water pressure at each nozzle; run for (1) hour. There is no accumulation of water within the enclosure; and no water has entered the enclosure at a level higher than the lowest live part





Rain



Sleet



Snow



Ventilation

## NEMA 3R or UL Type 3R

Type 3R enclosures are identical to the requirements for Type 3, but 3R allows ventilation (usually in the form of louvers) and as such the requirement to protect against windblown dust has been removed. If windblown dust is a concern, then louvers with filters are quite commonly employed.

This is a common enclosure rating for outdoor applications NOT near salt water.







Windblown Dust



Rain



Sleet



Snow



External Icing

## NEMA 3S or UL Type 3S

The Type 3S enclosures have the same requirements as the Type 3, but the Type 3S includes a requirement that external mechanisms remain operable when ice-laden.

**EXTERNAL ICING TEST (UL):** Build up of ice of  $\frac{3}{4}$ " thick on a test bar next to the unit under test. External mechanisms can be manually operated by one person without any damage to the enclosure, internal equipment, or the mechanism.





Windblown Dust



Rain



Sleet



Snow



Corrosion Protection

## NEMA 3X or UL Type 3X

Type 3X enclosures are identical to the requirements for Type 3, but 3X, requires extra corrosion protection.

### **OUTDOOR CORROSION PROTECTION (UL):**

- 600 hour salt spray test, must have same or better results than same test of G90 galvanized specimen.
- 1200 hour moist carbon dioxide-sulphur dioxide-air test. Too many detailed conformance results to describe here.

Enclosures fabricated from stainless steel are considered to comply with the requirement.





Rain



Sleet



Snow



Ventilation



Corrosion Protection

## NEMA 3RX or UL Type 3RX

(UL introduced in 2016)

Type 3RX enclosures are identical to the requirements for Type 3R, but 3RX, requires extra corrosion protection.

This is the most common type of enclosure rating for outdoor enclosures that **ARE** near salt water





Windblown Dust



Rain



Sleet



Snow



External Icing



Corrosion Protection

## NEMA 3SX or UL Type 3SX

Type 3SX enclosures combine the requirements for both 3S and 3X.

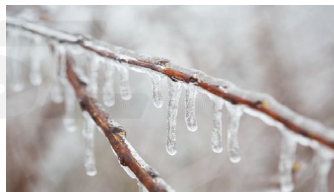




Windblown Dust



Hosedown



Sleet



Snow

## NEMA 4 or UL Type 4

Type 4 enclosures are more stringent than Type 3 enclosures, in that this category adds the requirement to provide protection against splashing and hose directed water. This category is primarily used where wash-down with a commercial hose is intended, such as in food preparation facilities and/or meat processing plants. These enclosures are typically referred to as “rain-tight” or “water-tight”.

**HOSEDOWN TEST (UL): 1" ID hose; 65 gals./min. from a distance of 10-12 feet; move at a rate of 1/4"/sec. No water can enter the enclosure.**

This is the most common type of enclosure rating for outdoor enclosures that are NOT near salt water but need protection from “hose down washing” and water splashing (near a lake)





Windblown Dust



Hosedown



Sleet



Snow



Corrosion Protection

## NEMA 4X or UL Type 4X

Type 4X enclosures have the same requirements as Type 4 enclosures but have the added corrosion protection requirement. This type of enclosure is often found where disinfectants and/or chemicals are used during the wash-down process.

This is the most common type of enclosure rating for outdoor enclosures that ARE near salt water but need protection from “hose down washing” and water splashing.





Indoor



Dripping & Light splashing water



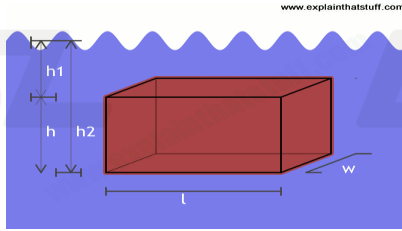
Settling/Circulating Dust

## NEMA 5 or UL Type 5

Type 5 enclosures are “dust-proof” and are intended for indoor use only. They also include the same requirements as Type 2 enclosures with respect to water.

**SETTLING DUST TEST (UL):** Talcum powder; .85 oz./cubic foot; circulate air 15 seconds ON, 30 seconds OFF for 7 cycles. No dust can enter the enclosure.





Submersion



Sleet

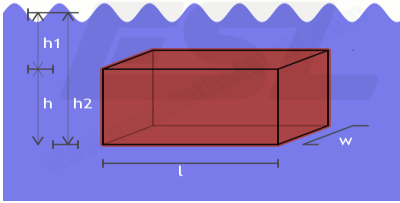
## NEMA 6 or UL Type 6

Type 6 enclosures are intended to provide protection against water submersion for a limited depth and time. These enclosures also have to withstand ice formation.

**SUBMERSION TEST (UL):** Highest point of enclosure 6 feet below the surface. 30 minute test. No water can enter the enclosure.







Submersion



Internal Pressure



Sleet

## NEMA 6P or UL Type 6P

Type 6P enclosures are intended to provide protection against water submersion for a limited depth and time and must also withstand an internal pressure increase. These enclosures also have to withstand ice formation.

**INTERNAL PRESSURE TEST (UL):** Internal air pressure raised to 6 psi above ambient. After 24 hours, internal psi must be no lower than 4 psi above ambient, and no permanent deformation to the enclosure.

**EXTERNAL PRESSURE TEST (UL):** Highest point of enclosure 6 feet below the surface. 24 hour test. No water can enter the enclosure.



Indoor



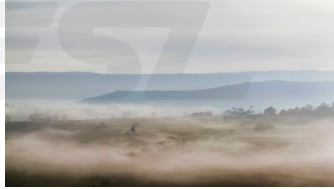
Class I, Zone 1, Group IIA (Group D)  
Class I, Zone 1, Group IIB (Group C)  
Class I, Zone 1, Group IIC (Group A)  
Zone 20 and Zone 21 (Class II, Div. 1)

Contain Internal Explosion

## NEMA 7 – or UL Type 7

These units are designed specifically for use in indoor hazardous locations. They are designed to contain any internal explosion without causing any external hazards.





Windblown Dust



Rain



Sleet



Snow



Outdoor



Class I, Zone 1, Group IIA (Group D)  
Class I, Zone 1, Group IIB (Group C)  
Class I, Zone 1, Group IIC (Group A)  
Zone 20 and Zone 21 (Class II, Div. 1)

Contain Internal Explosion

## NEMA 8 – or UL Type 8

These units are similar to Type 7 but are intended for outdoor applications.





Indoor



Class I, Zone 1, Group IIA (Group D)  
Class I, Zone 1, Group IIB (Group C)  
Class I, Zone 1, Group IIC (Group A)  
Zone 20 and Zone 21 (Class II, Div. 1)

Contain Internal Explosion



Prevent Ignition of Combustible Dust

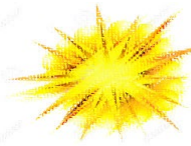
## NEMA 9 – or UL Type 9

These units are also intended for indoor hazardous locations (same as Type 7) but are required to prevent the ignition of combustible dust.





Indoor



Class I, Zone 1, Group IIA (Group D)  
Class I, Zone 1, Group IIB (Group C)  
Class I, Zone 1, Group IIC (Group A)  
Zone 20 and Zone 21 (Class II, Div. 1)

Contain Internal Explosion



## NEMA 10 - no UL equivalent

These units are identical to Type 7, NEMA however adds the notation that they are to meet the requirements of Mine Safety and Health Administration. MSHA publishes a Code of Federal Regulations, entitled Title 30 Mineral Resources (806 pages)





Indoor



Falling Dust



Protection from  
Corrosive Liquids & Gases

## NEMA 11 – no UL equivalent

These units are similar to Type 2, but include protection against the corrosive effects of liquids and gases.





Indoor



Settling/Circulating Dust



**NO** Knockouts

## NEMA 12 or UL Type 12

Type 12 enclosures are a “general” purpose enclosure, intended for indoor use, and by requirement, are not manufactured with knockouts.

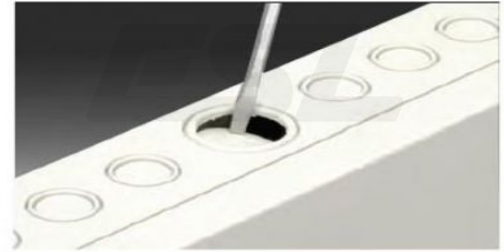




Indoor



Settling/Circulating Dust



Knockouts

## NEMA 12K or UL Type 12K

Type 12K enclosures are identical to Type 12, but 12K enclosures are manufactured with knockouts.







Indoor



Dripping & Light splashing water



Light spraying of water

## NEMA 13 or UL Type 13

Type 13 enclosures are an extension of Type 2 and includes protection against light spraying of water.



		NON-HAZARDOUS LOCATIONS	
INDOOR		OUTDOOR	
		SUBMERSIBLE	
<p><b>All the below enclosures protect against:</b></p> <ul style="list-style-type: none"> <li>• Access to Hazardous Parts</li> <li>• Falling Dust</li> </ul>		<p><b>All the below enclosures require protect against:</b></p> <ul style="list-style-type: none"> <li>• Access to Hazardous Parts</li> <li>• Falling Dust</li> <li>• Dripping &amp; Light Splashing of water</li> <li>• Rain, Snow, Sleet</li> </ul>	
1		3	<ul style="list-style-type: none"> <li>• Windblown Dust</li> </ul>
2	<ul style="list-style-type: none"> <li>• Dripping &amp; Light Splashing of water</li> </ul>	3S	<ul style="list-style-type: none"> <li>• Windblown Dust</li> <li>• External Icing</li> </ul>
5	<ul style="list-style-type: none"> <li>• Dripping &amp; Light Splashing of water</li> <li>• Settling air-borne dust, fibers</li> </ul>	3SX	<ul style="list-style-type: none"> <li>• Windblown Dust</li> <li>• External Icing</li> <li>• Corrosion Protection</li> </ul>
11	<ul style="list-style-type: none"> <li>• Protection from Corrosive Liquids &amp; Gases</li> </ul>	3X	<ul style="list-style-type: none"> <li>• Windblown Dust</li> <li>• Corrosion Protection</li> </ul>
12	<ul style="list-style-type: none"> <li>• Dripping &amp; Light Splashing of water</li> <li>• Settling air-borne dust, lint, fibers</li> <li>• Circulating dust, lint, fibers</li> <li>• Oil &amp; Coolant Seepage</li> <li>• NO knockouts</li> </ul>	3R	<ul style="list-style-type: none"> <li>• Ventilation allowed</li> </ul>
12K	<ul style="list-style-type: none"> <li>• Dripping &amp; Light Splashing of water</li> <li>• Circulating dust, lint, fibers</li> <li>• Settling air-borne dust, lint, fibers</li> <li>• Oil &amp; Coolant Seepage</li> <li>• Knockouts</li> </ul>	3RX	<ul style="list-style-type: none"> <li>• Ventilation allowed</li> <li>• Corrosion Protection</li> </ul>
13	<ul style="list-style-type: none"> <li>• Dripping &amp; Light Splashing of water</li> <li>• Settling air-borne dust, lint, fibers</li> <li>• Circulating dust, lint, fibers</li> <li>• Oil &amp; Coolant Seepage</li> <li>• Oil or Coolant spraying and splashing</li> </ul>	4	<ul style="list-style-type: none"> <li>• Windblown Dust</li> <li>• Hosedown and Splashing Water</li> </ul>
		4X	<ul style="list-style-type: none"> <li>• Windblown Dust</li> <li>• Hosedown and Splashing Water</li> <li>• Corrosion Protection</li> </ul>
		6	<ul style="list-style-type: none"> <li>• Pressure</li> </ul>
		6P	<ul style="list-style-type: none"> <li>• Pressure</li> </ul>



ESL

ESL

ESL

HAZARDOUS LOCATIONS			
INDOOR		OUTDOOR	
<b>All the below enclosures protect against:</b> <ul style="list-style-type: none"><li>• Contain internal explosion without causing external hazards</li></ul>		<b>All the below enclosures protect against:</b> <ul style="list-style-type: none"><li>• Contain internal explosion without causing external hazards</li></ul>	
7		8	
9	<ul style="list-style-type: none"><li>• Prevent ignition of combustible dust</li></ul>		
10	<ul style="list-style-type: none"><li>• Comply with MSHA requirements</li></ul>		



**Thank you for your time.**

**Questions ?**

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