

Enclosure Ratings and Their Applications

Abstract

There are a wide variety of enclosure styles available when supplying variable frequency drives (VFDs). Understanding these styles and their associated uses is critical when selecting the enclosure that will allow for a successful installation. Selecting enclosures that do not meet the environmental needs of the installation can cause poor product operation and premature product failure that is likely not covered by product warranty.

IP Rating vs. UL Type vs. NEMA Type Enclosures

- **IP ratings** for enclosures are increasingly being observed in North America with the proliferation of worldwide standards and inter-continental product shipments. IP ratings for enclosures are governed by European standard IEC 60529 and are recognized internationally.

The IP rating of a product is made up of a two number descriptor, as described in the following table:

First number = Solid object protection	Second number = Liquid protection
0 = No protection	0 = No protection
1 = Objects over 50 mm (2.0 in.)	1 = Vertical falling drops of water
2 = Objects over 12 mm (47 in.)	2 = Spray of up to 15 degrees vertical
3 = Objects over 2.5 mm (0.10 in.)	3 = Spray of up to 60 degrees vertical
4 = Objects over 1 mm (0.04 in.)	4 = Light spray all directions
5 = Dust protected with limited ingress	5 = Light jets of water all directions
6 = Totally protected from dust	6 = Jets of water all directions
	7 = Water immersion to 1 meter

- **UL Type** enclosure ratings are written as application descriptions and expected performance guidelines. The governing guidelines are UL 508 for Type 1 enclosures and UL 50 for all other enclosures. UL requires that the enclosures be tested to qualify for the listed Type rating and the specific test guideline as described. UL also inspects enclosure manufactures and field sites to ensure adherence to the prescribed guidelines.

A short summary of the UL Type description follows:

**IP Rating vs.
 UL Type vs.
 NEMA Type
 Enclosures
 (Continued)**

UL Type	Description
Type 1	<ul style="list-style-type: none"> • Indoor use • Protected against personal contact with enclosed equipment • Limited protection against falling dirt • Generally considered equivalent to IP21
Type 2	<ul style="list-style-type: none"> • Indoor use • Protection against personal contact with enclosed equipment • Limited protection against falling water and dirt
Type 3	<ul style="list-style-type: none"> • Outdoor • Protection against windblown dust • Protection against windblown rain • Protection against the formation of ice
Type 3R	<ul style="list-style-type: none"> • Outdoor • Protection against falling rain • Protection against the formation of ice
Type 4	<ul style="list-style-type: none"> • Indoor or outdoor • Protection against falling rain, splashing water and hose down • Protection against the formation of ice
Type 4X	<ul style="list-style-type: none"> • Indoor or outdoor • Protection against falling rain, splashing water and hose down • Protection against the formation of ice • Resists corrosion
Type 6	<ul style="list-style-type: none"> • Outdoor or outdoor • Protection against temporary submersion to a limited depth • Protection against the formation of ice
Type 12	<ul style="list-style-type: none"> • Indoor • Protected against dust and dripping water • Protected against non-corrosive condensation • Generally considered equivalent to IP54
Type 13	<ul style="list-style-type: none"> • Indoor • Protected against dust • Protected against non-corrosive condensation • Protected against spraying water and oil

NOTE: Highlighted UL Types are available from Siemens Building Technologies, Inc as part of the VFD product offering. For Type 2 applications, use Type 3R enclosures.

**IP Rating vs.
UL Type vs.
NEMA Type
Enclosures
(Continued)**

NEMA Type enclosure ratings are written as application descriptions and generally follow the same guidelines as UL Type. One significant difference between NEMA Type and UL Type ratings is that NEMA does *not* require third-party testing and leaves compliance completely up to the manufacture.

**Applying the
Appropriate
Enclosure Rating to
the Application****UL Type 1 Enclosure**

- Use in clean and dry mechanical rooms.
- Cover during the construction phase to ensure equipment does not get infiltrated with construction dust.
- Use in environments that do not exceed 95% non-condensing humidity. This requirement is usually exceeded when the mechanical room is a penthouse or similar area that is directly open to the outside because most areas of the country exceed these levels for at least parts of the year.
- *SED2 NEMA Type 1 VFD, Conventional Bypass Option, and Electronic Bypass Option packages all fall into the category.*

UL Type 12 Enclosure

- Dusty locations.
- When the equipment must be operational during the installation phase.
- Air plenum mechanical rooms.
- Air stream mounting.
- Splashing water, in limited amounts, is possible. Such locations may include pump rooms.
- Penthouse and similar areas that are open to the extreme temperature swings, humidity changes and corrosive properties of the uncontrolled outside environment. Ocean area penthouses in particular are good locations for NEMA 12 in that the humid salt air is particularly electrically **deductive** and corrosive to electronic products.
- *SED2 IP54/UL Type 12 VFDs are appropriate for these locations. If a bypass is required for a UL Type 12 drive, contact the VFD group at Siemens Building Technologies, Inc.*

UL Type 3R

- Outdoor locations that may be exposed to falling rain, snow and ice.
- Indoor locations that may be exposed to falling water. Such locations may be those that have sprinkler fire protection.
- *SED2 NEMA Type 3R Bypass packages are appropriate for these locations. See SED2 VFD NEMA Type 3R Bypass submittal document (Document No. 154-062).*

Applying the Appropriate Enclosure Rating to the Application (Continued)

UL Type 4 and 4X

- Protected against water from all directions.
- Wash-down areas.
- 4X gives the added protection of being corrosive resistant. These enclosure types include stainless steel and fiberglass.
- Typically used in industrial locations not associated with variable torque HVAC drive locations. Such locations include food production and wastewater treatment plants.
- *Siemens Building Technologies, Inc. does not supply packages suitable for these locations.*

Summary

One of the key criteria for VFD applications is selection of the appropriate enclosure rating. Understanding the various ratings, how the ratings compare to one another and how these guidelines should practically be applied is critical to ensure that the installation will have long-term operation.

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