



Apollo Solar App Note: NEMA 3 and NEMA 4 rated Enclosures.

Apollo Solar offers our Pre Wired Panels for users to use indoors or for outdoor use in NEMA rated enclosures. The NEMA ratings for typical enclosures used in the PV industry are described in simple terms as follows in order from least to the most protection:

A **NEMA 3R** enclosure can be used outdoors for equipment which needs to have some outside air for cooling. It means that the enclosure is going to have louvers to prevent falling water or snow from getting inside. A jet of water however, from a pressure washer or just a hose will get in through the louvers. A NEMA 3R enclosure can have knock-outs on vertical surfaces as long as water can not run in.

NEMA 3 is a small step up since filters are added behind the louvers to stop wind blown dust. The “wind” can be the internal fans that are bring in air to cool the equipment inside. Of course, the filters have to be cleaned or changed periodically.

NEMA 3X adds corrosion resistance. This means that the NEMA 3 enclosure is made from Stainless Steel or Powder Coated Aluminum. This is a good idea for salt sea air environments, but if the air is corrosive, maybe the enclosure should be sealed in which case NEMA 4X is recommended. Sometimes aluminum is preferred simply because it is lighter and easier to work with. This makes NEMA 3X worth considering.

NEMA 4 is totally sealed. The doors have gaskets and there are no knockouts which could leak. Any wiring to a NEMA 4 enclosure will require that holes need to be drilled by the installer. If cooling is required, we add an external air conditioner which is also NEMA 4 rated.

NEMA 4X adds corrosion resistance. This usually means that the NEMA 4 enclosure is made from Stainless Steel or Powder Coated Aluminum. This is a best possible enclosure for outdoor PV installations. If cooling is required, we add an external air conditioner which is also NEMA 4X rated.

Ratings below 3 are for indoor use and our Pre Wired Panels don't need any additional enclosure. Ratings above 4 are for total submersion in water and you had better not need that in the PV business.

The details starting with the Table below are copied from the NEMA 2003 description for the degree of protection of Outdoor equipment.

Table 2
[From NEMA 250-2003]
 Comparison of Specific Applications of Enclosures
 for Outdoor Nonhazardous Locations

Provides a Degree of Protection Against the Following Conditions	Type of Enclosure									
	3	3X	3R*	3RX*	3S	3SX	4	4X	6	6P
Access to hazardous parts	X	X	X	X	X	X	X	X	X	X
Ingress of water (Rain, snow, and sleet **)	X	X	X	X	X	X	X	X	X	X
Sleet ***	...	...	...	...	X	X	...	...	...	...
Ingress of solid foreign objects (Windblown dust, lint, fibers, and flyings)	X	X	...	...	X	X	X	X	X	X
Ingress of water (Hosedown)	...	...	...	...	...	...	X	X	X	X
Corrosive agents	...	X	...	X	...	X	...	X	...	X
Ingress of water (Occasional temporary submersion)	...	...	...	...	...	...	...	...	X	X
Ingress of water (Occasional prolonged submersion)	...	...	...	...	...	...	...	...	...	X

* These enclosures may be ventilated.

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

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

The following are the NEMA descriptions.

Type 3 Enclosures 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); and that will be undamaged by the external formation of ice on the enclosure.

Type 3R Enclosures 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 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); and for which the external mechanism(s) remain operable when ice laden.

Type 3X Enclosures 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); that provides an additional level of protection against corrosion and that will be undamaged by the external formation of ice on the enclosure.

Type 3RX Enclosures 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 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); that provides an additional level of protection against corrosion; and for which the external mechanism(s) remain operable when ice laden.

Type 4 Enclosures 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, splashing water, and hose directed water); and that will be undamaged by the external formation of ice on the enclosure.

Type 4X Enclosures 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 dust); 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.