

Chapter

3

Selecting an Electrical Enclosure

In this chapter, we will learn the following to World Class standards:

- **Introduction to NEMA Enclosure definitions**
- **Obtaining a NEMA Enclosure Drawing**
- **Modifying a NEMA Enclosure**
- **Making a Panel Modification**

Introduction to NEMA Enclosures Definitions

Many of the assemblies that an electrical designer and engineer will propose will be housed in an enclosure meeting the National Electrical Manufacturers Association or NEMA standard. The following are short descriptions of each container type.

We use NEMA 1 type enclosures to prevent people or animals having accidental contact with the electrical components and to prohibit dirt from falling on the devices inside. These inexpensive assemblies are not complex in design since they are not capable of protecting the electrical components from water. The NEMA 1 enclosure is for indoor use.

The NEMA 2 box is to provide protection for people and animals from the electrical components inside. The enclosure design prohibits dirt from falling inside the assembly and is capable of blocking drips and light splashes from entering the box.

The NEMA 3 enclosure is for indoor and outdoor use and is to provide protection for people and animals from the electrical components inside. The enclosure design prohibits dirt from falling inside the assembly and is capable of blocking windblown dust. The design gives the enclosure protection due to harmful effects of snow, sleet and rain. The enclosure should remain undamaged from the external formation of ice.

The NEMA 3R enclosure is for indoor and outdoor use and is to provide protection for people and animals from the electrical components inside. The enclosure design prohibits dirt from falling inside the assembly. The design gives the enclosure protection due to harmful effects of snow, sleet and rain. The enclosure should remain undamaged from the external formation of ice.

The NEMA 3S enclosure is for indoor and outdoor use and is to provide protection for people and animals from the electrical components inside. The enclosure design prohibits dirt from falling inside the assembly and is capable of blocking windblown dust. The design gives the enclosure protection due to harmful effects of snow, sleet and rain. The enclosure should remain undamaged from the external formation of ice and external components remain operable when covered with ice.

The NEMA 3X enclosure is for indoor and outdoor use and is to provide protection for people and animals from the electrical components inside. The enclosure design prohibits dirt from falling inside the assembly and is capable of blocking windblown dust. The design gives the enclosure protection due to harmful effects of snow, sleet and rain. The enclosure should remain undamaged from the external formation of ice and external components remain operable when covered with ice.

The NEMA 3RX enclosure is for indoor and outdoor use and is to provide protection for people and animals from the electrical components inside. The enclosure design prohibits dirt from falling inside the assembly. The design gives the enclosure protection due to harmful effects of snow, sleet and rain. The enclosure should remain undamaged from the external formation of ice and external components remain operable when covered with ice. The enclosure construction has additional protection against corrosion.

The NEMA 3SX enclosure is for indoor and outdoor use and is to provide protection for people

and animals from the electrical components inside. The enclosure design prohibits dirt from falling inside the assembly and is capable of blocking windblown dust. The design gives the enclosure protection due to harmful effects of snow, sleet and rain. The enclosure should remain undamaged from the external formation of ice and external components remain operable when covered with ice. The enclosure construction has additional protection against corrosion.

We design NEMA 4 enclosures for either indoor or outdoor use and our design provides protection for people and animals from the electrical components inside. The design prevents falling dirt, windblown dust, and is watertight, preventing rain, sleet and snow from entering the enclosure. The enclosure will remain undamaged from the external formation of ice.

We design NEMA 4X enclosures for either indoor or outdoor use and our design provides protection for people and animals from the electrical components inside. The design prevents falling dirt, windblown dust, and is watertight, preventing rain, sleet and snow from entering the enclosure. The enclosure will remain undamaged from the external formation of ice. The enclosure construction has additional protection against corrosion.

The NEMA 5 enclosure is for indoor use and is to provide protection for people and animals from the electrical components inside. The enclosure design prohibits dirt from falling inside the assembly and is capable of blocking airborne dust, lint, and fibers entering the enclosure. The enclosure design prohibits dirt from falling inside the assembly and is capable of blocking drips and light splashes from entering the enclosure.

The NEMA 6 enclosure is for indoor use and is to provide protection for people and animals from the electrical components inside. While the enclosure design protects the internal components from falling dirt, this design is capable of preventing water from entering the assembly. A NEMA 6 enclosure is capable of being submerged at a limited depth and will remain undamaged from the external formation of ice.

The NEMA 6P enclosure is for indoor and outdoor usage and is to provide protection for people and animals from the electrical components inside. While the enclosure design protects the internal components from falling dirt, this design is capable of preventing water from entering the assembly. A NEMA 6P enclosure is capable of being submerged at a limited depth and will remain undamaged from the external formation of ice. The enclosure construction has additional protection against corrosion.

We design NEMA 12 (without knockouts) and 12K (with knockouts) enclosures for indoor use and our design provides protection for people and animals from the electrical components inside. The design prevents falling dirt, windblown dust, lint, fibers and flyings from entering the enclosure. The enclosure design is capable of blocking drips and light splashes from entering the enclosure.

We design NEMA 13 enclosures for indoor use and our design provides protection for people and animals from the electrical components inside. The design prevents falling dirt, windblown dust, lint, fibers and flyings from entering the enclosure. The enclosure design is capable of blocking drips and light splashes from entering the enclosure. The enclosure construction has additional protection against the spraying, splashing, and seepage of oil and non-corrosive coolants.

NEMA 7, 8, 9 and 10 enclosures are certified for hazardous locations. Type 7 and 10 electrical

containers can restrain an explosion within the enclosure from harming anything on the exterior. NEMA 8 enclosures are constructed to thwart combustion through the use of oil-immersed equipment. Type 9 enclosures for indoor applications and are designed to prevent the ignition of combustible dust.

The following table is a quick guide to the NEMA enclosure definitions.

NEMA	Description	Indoor	Outdoor
1	General Purpose	<input checked="" type="checkbox"/>	
2	Drip proof	<input checked="" type="checkbox"/>	
3	Snow, Sleet and Rain proof, dusttight	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3R	Snow, Sleet and Rain proof	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3S	Snow, Sleet and Rain proof, dusttight	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3X	Snow, Sleet and Rain proof, dusttight and Corrosion Resistant	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3RX	Snow, Sleet and Rain proof and Corrosion Resistant	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
3SX	Snow, Sleet and Rain proof, ice covered operable, dusttight and Corrosion Resistant	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4	Watertight and Dusttight	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
4X	Watertight, Dusttight and Corrosion Resistant	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
5	Drip proof dustproof	<input checked="" type="checkbox"/>	
6	Submersible, Watertight, Dusttight and Ice Resistant	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
6P	Hazardous Locations	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
12	Dusttight and Driptight	<input checked="" type="checkbox"/>	
12K	Dusttight and Driptight	<input checked="" type="checkbox"/>	
13	Oiltight and Dusttight	<input checked="" type="checkbox"/>	

Figure 3.1 – Standard NEMA Enclosure Chart

Obtaining a NEMA Enclosure Drawing

Periodically, we need to obtain drawings of a NEMA enclosure. Companies that manufacture these type of enclosures also make the CAD drawings available to designers. We list several companies that have DXF or DWG CAD files available for downloading at their websites shown in the table.

EXM Manufacturing LTD	http://www.mckinstryenclosures.com/
Hammond Manufacturing LTD	http://www.hammondmfg.com
Hoffman	http://www.hoffmanonline.com
Rittal	http://www.rittal.com

We begin by opening our Internet browsing program and typing in the web address of our enclosure manufacturer. Let us say that we will be purchasing the NEMA 12 enclosure from Hammond Manufacturing LTD. We find that we should use the technical drawings provided by our producer than using a drawing from another website. There can be several noticeable variations between types of enclosures from different companies. There can be disparity in the door handle design, locking mechanism and interior panel styles, especially if the manufacturer is making metric standard enclosures and selling them in the United States market. If we have time and the downloadable drawing does not show much detail, order a sample to verify the enclosure's functionality and dimensions.



Figure 3.2 – Hammond Manufacturing Homepage

Next, select the Industrial Enclosure hyperlink shown in figure 3.2. A number of popular models of NEMA 4, 12 and 13 family of boxes are shown. We see in figure 3.3 the Eclipse Junior Series Single Dorr Enclosure and the 1418 Series Single Door Enclosures. We will choose the Eclipse Junior Series Single Door Enclosure by pressing either on the image or the red text to proceed to the webpage showing this family of product.

Industrial Enclosures

Home << Product Information



**Eclipse Junior Series
Single Door Enclosures**
NEMA 12, 13, 4



**1418 Series
Single Door Enclosures**
NEMA 12, 13

Figure 3.3 – Selecting the Single Door NEMA 12 Enclosure

Eclipse Junior Series – NEMA 12, 13, 4 Single Door Enclosures

<< Product Information << Industrial Enclosures <<



Application

- Designed to enclose electrical and/or electronic equipment and protect against harsh, industrial environments.
- For use as instrument enclosures, electric, hydraulic or pneumatic control housings, electrical junction boxes or terminal wiring enclosures.
- Impressive styling features make the Eclipse Junior a suitable addition to any high-tech equipment installation.
- For high temperature applications, a gasket retainer may be required, please refer to factory.

Download - PDF

Drawing Links

**Inner
Panel
Included**

Standards

- UL 508 Type 3R, 4, 12 and 13
- CSA Type 3R, 4, 12 and 13
- Complies with
 - NEMA Type 3R, 4, 12 and 13
 - IEC 60529, IP66

Figure 3.4 – Selecting the Single Door NEMA 12 Enclosure

The next webpage is shown in figure 3.4. We can observe the Drawing Links command button under the image of the enclosure. Press this button to proceed to a table listing all of the electrical boxes available in this family of products as shown in figure 3.5. We are interested in the 10 inch tall, 8 inch wide and 6 inch deep metal container, so we select the part number EJ1086.

Click on a Part Number to download the Zipped DXF

Part No.	Overall Dimensions				Panel Size					Ship Wt. (lbs)
	A	B	C	H	G	D	E	J	F	
EJ443	4.0	4.0	3.0	2.00	4.75	—	—	2.00	—	2
EJ643	6.0	4.0	3.0	2.00	6.75	4.88	2.88	3.00	2.92	2
EJ683	6.0	8.0	3.5	6.00	6.75	4.88	6.75	3.00	3.42	5
EJ863	8.0	6.0	3.5	4.00	8.75	6.75	4.88	4.00	3.42	5
EJ444	4.0	4.0	4.0	2.00	4.75	—	—	2.00	—	3
EJ644	6.0	4.0	4.0	2.00	6.75	4.88	2.88	3.00	3.92	3
EJ664	6.0	6.0	4.0	4.00	6.75	4.88	4.88	3.00	3.92	4
EJ884	8.0	8.0	4.0	6.00	8.75	6.75	6.88	4.00	3.92	7
EJ8104	8.0	10.0	4.0	8.00	8.75	6.88	8.75	4.00	3.92	8
EJ1084	10.0	8.0	4.0	6.00	10.75	8.75	6.88	5.00	3.92	8
EJ1264	12.0	6.0	4.0	4.00	12.75	10.75	4.88	6.00	3.92	8
EJ10125	10.0	12.0	5.0	10.00	10.75	8.88	10.75	5.00	4.92	10
EJ12105	12.0	10.0	5.0	8.00	12.75	10.75	8.88	6.00	4.92	12
EJ866	8.0	6.0	6.0	4.00	8.75	6.75	4.88	4.00	5.92	7
EJ1086	10.0	8.0	6.0	6.00	10.75	8.75	6.88	5.00	5.92	10
EJ10106	10.0	10.0	6.0	8.00	10.75	8.75	8.88	5.00	5.92	12
EJ12126	12.0	12.0	6.0	10.00	12.75	10.75	10.88	6.00	5.92	15
EJ12146	12.0	14.0	6.0	12.00	12.75	10.88	12.75	6.00	5.92	17
EJ1486	14.0	8.0	6.0	6.00	14.75	12.75	6.88	7.00	5.92	10
EJ14126	14.0	12.0	6.0	10.00	14.75	12.75	10.88	7.00	5.92	17
EJ14166	14.0	16.0	6.0	14.00	14.75	12.88	14.75	7.00	5.92	21
EJ16106	16.0	10.0	6.0	8.00	16.75	14.75	8.88	8.00	5.92	15
EJ16146	16.0	14.0	6.0	12.00	16.75	14.75	12.88	8.00	5.92	21
EJ12108	12.0	10.0	8.0	8.00	12.75	10.75	8.88	6.00	7.92	15
EJ14128	14.0	12.0	8.0	10.00	14.75	12.75	10.88	7.00	7.92	18
EJ16148	16.0	14.0	8.0	12.00	16.75	14.75	12.88	8.00	7.92	22
EJ161410	16.0	14.0	10.0	12.00	16.75	14.75	12.88	8.00	9.92	23

Figure 3.5 – Selecting the 10 x 8 x 6 Inch Enclosure

The next step in the procedure is to choose the PDF, Step or DXF file for download. There is a message to designers that if a file format they need is not listed, we can email the company and request the document. Our experience with all the enclosure manufacturers is that they are very helpful when supporting their products. We will press the green DXF button on the right side of figure 3.6.



Figure 3.6 – Selecting the DXF Download Button

Now we need to save the file to a folder on our computer or company file server. For many designers, we need to assign a part number from our drawing database for this enclosure. We can use the drawing provided by the manufacturer placing the top, front and side orthographic views on the drawing sheet. The incoming receiving team at our organization will use these details in our part drawing to identify and label the product. Many business's have material databases that require digital images or drawings for every purchased component.

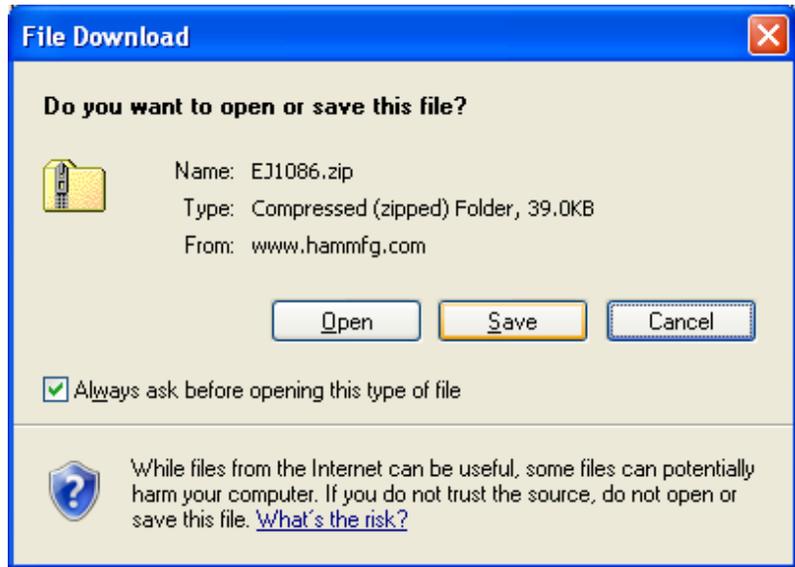


Figure 3.7 – Saving the DXF File

As shown in figure 3.7, we will press save and then proceed to the Electrical Enclosure folder to store the downloaded information. Again organized engineering departments have a protocol for collecting information concerning purchased materials. Once a part number is assigned to the item, standardized subfolders under the main part number folder can house data. One such folder can hold downloaded CAD files. This may seem like a lot of work at first, but mechanical and electrical designers will use common parts repeatedly, so ultimately good organization skills save time and money.

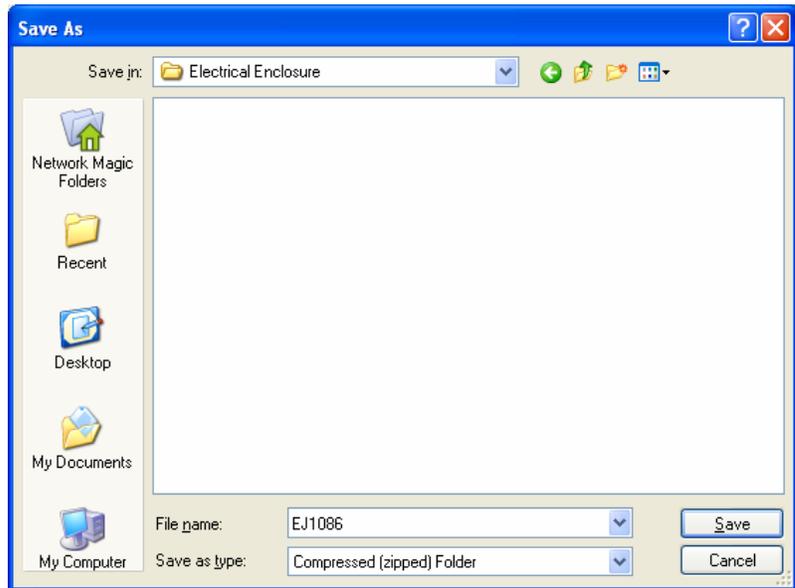


Figure 3.8 – Placing the File in the Enclosure Folder

In figures 3.9 and 3.10, we see the Zipped file and the DXF computer file. Now that we have saved the downloaded information, we can open the file with our CAD program as shown in figure 3.11. We will place



Figure 3.9 – The Downloaded Zip File



Figure 3.10 – The DXF File

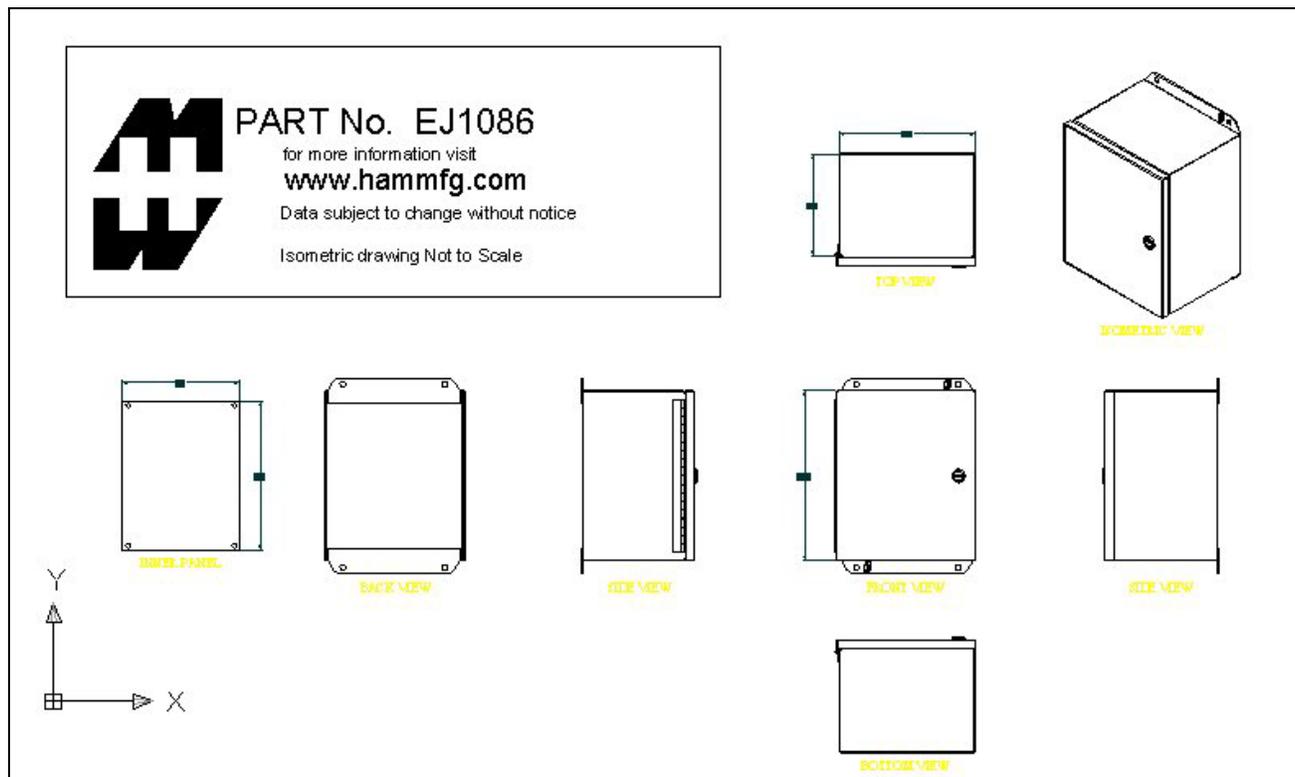


Figure 3.11 – The Orthographic and Isometric Views of the EJ1086 Enclosure

* World Class CAD Challenge 9-3 * - The project engineer wants to use a NEMA 4 enclosure that measures 24 inches tall, 20 inches wide and 8 inches deep. Locate an electrical enclosure meeting this specification and download the drawing file. Place three orthographic views and the panel detail in a part drawing along with notes, border and completed title block in 30 minutes.

Continue this drill four times using some other ideas, such as single pole, double throw switch or with multiple switches, each time completing the drawing under 30 minutes to maintain your World Class ranking.