

**TSEWG TP-8: ELECTRICAL EQUIPMENT ENCLOSURES AND
HAZARDOUS LOCATIONS****ENCLOSURES.**

Select equipment enclosures to provide the following:

- To protect facility personnel from coming in contact with live parts.
- To protect the equipment as necessary.

NEMA classifies enclosures based on the degree of protection provided by the enclosure and the environmental conditions to which the enclosure will be exposed. Table 1 summarizes the NEMA enclosure types. For additional information, refer to NEMA 250, *Enclosures for Electrical Equipment (1000 Volts Maximum)*. If needed, contact the enclosure manufacturer to determine the closest International Electrotechnical Commission (IEC) equivalent designation (NEMA 250, Appendix A, also provides limited information).

Table 1 NEMA Enclosure Types

| NEMA Type | Description | Application |
|------------------|---|------------------------------------|
| NEMA 1 (vented) | General purpose. Primarily used to provide a degree of protection against contact with the enclosed equipment or locations where unusual service conditions do not exist. | Indoor |
| NEMA 1 | General purpose against limited amounts of falling dirt. Primarily used to provide a degree of protection against contact with the enclosed equipment or locations where unusual service conditions do not exist. | Indoor |
| NEMA 2 (vented) | General purpose and drip-proof. Provides protection against limited amounts of falling water and dirt. Not dust-tight. | Indoor |
| NEMA 2 | General purpose, drip-proof and dust-proof. Provides protection against limited amounts of falling water and dirt. | Indoor |
| NEMA 3 | Dust tight, rain tight, and sleet/ice resistant. | Outdoor |
| NEMA 3R (vented) | Rain-proof, sleet/ice resistant. Vented version is not dust-tight. | Outdoor |
| NEMA 3R | Rain-proof, sleet/ice resistant. | Outdoor |
| NEMA 3S | Dust tight, rain tight, and sleet/ice proof. | Outdoor |
| NEMA 4 | Water tight, dust tight. Provides protection against windblown dust and rain, splashing water, and hose directed water. Undamaged by ice formation. | Indoor/Outdoor |
| NEMA 4X | Water tight, dust tight, corrosion resistant. Provides protection against corrosion, windblown dust and rain, splashing water, and hose directed water. Undamaged by ice formation. | Indoor/Outdoor |
| NEMA 5 | General purpose against dust and falling dirt | Indoor |
| NEMA 6 | Temporary submersion, dust tight, rain tight, sleet/ice resistant. | Indoor/Outdoor |
| NEMA 6P | Prolonged submersion, dust tight, rain tight, sleet/ice resistant. | Indoor/Outdoor |
| NEMA 7 | Class 1, Division 1, Groups A, B, C, or D. | Indoor hazardous locations |
| NEMA 8 | Class 1, Division 1, Groups A, B, C, or D. | Indoor/Outdoor hazardous locations |
| NEMA 9 | Class 2, Division 1, Groups E, F, or G. | Indoor hazardous locations |
| NEMA 10 | Mining enforcement safety requirements. | |
| NEMA 11 | Corrosion resistant by oil immersion. | Indoor |
| NEMA 12 | Industrial use, drip tight, dust tight, non-corrosive liquids. | Indoor |
| NEMA 12K | Industrial use with knockouts, drip tight, dust tight, non-corrosive liquids. | Indoor |
| NEMA 13 | Oil tight, dust tight, non-corrosive coolants. | Indoor |

Select enclosures for indoor applications in accordance with the conditions specified in Tables 2 and 3 for non-hazardous and hazardous locations, respectively. Refer to NEC Article 500 (2005 Edition) for the definition of various hazardous locations. Contact the equipment manufacturer for assistance with hazardous environment applications.

Table 2 Indoor Nonhazardous Locations

| NEMA Enclosure Type | 1 | 2 | 4 | 4X | 5 | 6 | 6P | 11 | 12 | 13 |
|--------------------------|---|---|---|----|---|---|----|----|----|----|
| Accidental Contact | x | x | x | x | x | x | x | x | x | x |
| Falling Dirt | x | x | x | x | x | x | x | x | x | x |
| Light Splashing | | x | x | x | x | x | x | x | x | x |
| Dust and Fibers | | | x | x | x | x | x | | x | x |
| Washdown with Water | | | x | x | | x | x | | | |
| Oil and Coolant Seepage | | | | | | | | | x | x |
| Oil and Coolant Spraying | | | | | | | | | | x |
| Corrosive Agents | | | | x | | | x | | | |
| Occasional Submersion | | | | | | x | x | | | |
| Sustained Submersion | | | | | | | x | | | |

Table 3 Indoor Hazardous Applications

| Protection Provided For: | Class | Type of Enclosure | | | | | | |
|--|-------|---------------------|---|---|---|---------------|---|---|
| | | <u>NEMA 7 and 8</u> | | | | <u>NEMA 9</u> | | |
| | | A | B | C | D | E | F | G |
| Acetylene | I | x | | | | | | |
| Hydrogen, manufactured gas | I | x | x | | | | | |
| Ethyl ether, ethylene, cyclopropane | I | x | x | x | | | | |
| Gasoline, jet fuel, hexane, butane, naphtha, propane, acetone, toluene, isoprene | I | x | x | x | x | | | |
| Metal dust | II | x | x | x | x | x | | |
| Carbon black, coal dust, coke dust | II | x | x | x | x | | x | |
| Flour, starch, grain dust | II | x | x | x | x | x | x | x |
| Fibers, flyings | III | x | x | x | x | x | x | X |

Note: Refer to NEC Article 500.4 (2005 Edition) for information regarding hazardous substances not listed in this table.

Evaluate the enclosure temperature rise and determine if special cooling options will be required to dissipate the generated heat. Enclosure manufacturers can provide application guidance to assist in the selection and sizing of cooling options.

HAZARDOUS LOCATIONS.

NEC Article 500 (2005 Edition) establishes hazardous location classifications based on the flammable vapors, liquids, or gases, or combustible dusts or fibers that might be present. The classification also considers the likelihood that a flammable or combustible concentration or quantity is present. Electrical design criteria are based on the specific location classification. Table 4 lists the various hazardous location classifications; refer to NEC Article 500 (2005 Edition) for the definition of each location.

Table 4 Hazardous Location Classifications

| Class | Group | Examples |
|-------|-------|--|
| I | A | Acetylene |
| I | B | Hydrogen, manufactured gas |
| I | C | Ethyl ether, ethylene, cyclopropane |
| I | D | Jet fuel, gasoline, hexane, butane, naphtha, propane, acetone, toluene, isoprene |
| II | E | Metal dust |
| II | F | Carbon black, coal dust, coke dust |
| II | G | Flour, starch, grain dust |

Referring to Table 4, a Class I location contains flammable gases or vapors that might be present in air in sufficient quantities to produce explosive or ignitable mixtures. Class I locations are further subdivided into Division 1 and Division 2, as described below.

In accordance with NEC Article 500.5 (2005 Edition), a Class I, Division 1 classification applies to the following types of locations.

- Locations in which ignitable concentrations of flammable gases or vapors can exist under normal operating conditions.
- Locations in which ignitable concentrations of such gases or vapors might frequently exist because of repair or maintenance operations or because of leakage.
- Locations in which breakdown or faulty operation of equipment or processes might release ignitable concentrations of flammable gases or vapors, and might also cause simultaneous failure of electrical equipment in such a way as to directly cause the electrical equipment to become a source of ignition.

In accordance with NEC Article 500.5 (2005 Edition), a Class I, Division 2 classification applies to the following types of locations.

- Locations in which volatile flammable liquids or flammable gases are handled, processed, or used, but in which the liquids, vapors, or gases will normally be confined within closed containers or closed systems from which they can escape only in cases of accidental rupture or breakdown of such containers or systems, or in case of abnormal operation of equipment.

- Locations in which ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation, and which might become hazardous through failure or abnormal operation of the ventilating equipment.
- Locations that are adjacent to a Class I, Division 1 location and to which ignitable concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.

Evaluate each location for a possible classification as a hazardous area. All hazardous areas must comply with the design criteria specified in NEC Articles 500 and 501 (2005 Edition). Refer to NEC Article 504 (2005 Edition) for the design criteria for intrinsically safe systems.

The Zone classification system described in NEC Article 505 [2005 Edition] can be applied as an alternative to the Class and Division designations.

Refer to NEC Article 511 (2005 Edition) for design criteria for commercial-type garages in which service or repair operations are performed on all or all types of self-propelled vehicles.

Refer to NEC Article 514 (2005 Edition) for design criteria for gasoline dispensing and service stations. This applies to any location where gasoline or other volatile flammable liquids or liquefied flammable gases are transferred to the fuel tanks (or auxiliary fuel tanks) of self-propelled vehicles or approved containers.

Refer to NEC Article 515 (2005 Edition) for design criteria for bulk storage plants. This applies to any location where flammable liquids are received by tank vessel, pipeline, tank car, or tank vehicle, and are stored or blended in bulk for the purpose of subsequent distributing of such liquids.

Wherever possible, do not locate electrical distribution or utilization equipment in zones classified as hazardous.