July 2013

Class 1, Division 2

Many times project specifications require that the product be built such that it is suitable for "Class 1, Division 2" installation. What does that mean?

The National Electrical Code (NEC) defines hazardous locations as those areas "where fire or explosion hazards may exist due to flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings."

The following chart lists the 3 classes and 2 divisions defined within National Electric Code 500 (NEC-500) for hazardous area installations.

CLASSIFICATION OF HAZARDOUS AREAS		
	Constant or occasional hazard	**Rare or temporary hazard**
USA NEC 500 Class I (gas) Class II (dust) Class III (fibers)	Division 1	Division 2

OSHA defines the hazardous location (class) types as follows:

Class 1 Locations

"According to the NEC, there are three types of hazardous locations. The first type of hazard is one which is created by the presence of *flammable gases or vapors* in the air, such as natural gas or gasoline vapor. When these materials are found in the atmosphere, a potential for explosion exists, which could be ignited if an electrical or other source of ignition is present. The Code writers have referred to this first type of hazard as *Class 1*. So, a *Class 1 Hazardous Location* is one in which *flammable gases or vapors* may be present in the air in sufficient quantities to be explosive or ignitable. Some typical Class 1 locations are:

- Petroleum refineries, and gasoline storage and dispensing areas;
- Dry cleaning plants where vapors from cleaning fluids can be present;
- Spray finishing areas;
- Aircraft hangars and fuel servicing areas; and
- Utility gas plants, and operations involving storage and handling of liquified petroleum gas or natural gas.
- All of these are Class 1 . . . gas or vapor . . . hazardous locations. All require special Class 1 hazardous location equipment.

Class 2 Locations

"The second type of hazard listed by the *National Electrical Code* are those areas made hazardous by the presence of combustible *dust*. These are referred to in the Code as "Class 2 Locations." Finely pulverized material, suspended in the atmosphere, can cause as powerful an explosion as one occurring at a petroleum refinery. Some typical Class 2 locations are:

- Grain elevators;
- Flour and feed mills;
- Plants that manufacture, use or store magnesium or aluminum powders;
- Producers of plastics, medicines and fireworks;
- Producers of starch or candies;
- Spice-grinding plants, sugar plants and cocoa plants; and
- Coal preparation plants and other carbon handling or processing areas."

Class 3 Locations

"Class 3 hazardous locations, according to the NEC, are areas where there are *easily-ignitable fibers or flyings* present, due to the types of materials being handled, stored, or processed. The fibers and flyings are not likely to be suspended in the air, but can collect around machinery or on lighting fixtures and where heat, a spark or hot metal can ignite them. Some typical Class 3 locations are:

- Textile mills, cotton gins;
- Cotton seed mills, flax processing plants; and
- Plants that shape, pulverize or cut wood and create sawdust or flyings."

OSHA clarifies and defines the hazardous location conditions (division) as follows:

"The NEC specifies that hazardous material may exist in several different kinds of *conditions* which, for simplicity, can be described as, first, normal conditions, and, second, abnormal conditions.

In the *normal* condition, the hazard would be expected to be present in everyday production operations or during frequent repair and maintenance activity.

When the hazardous material is expected to be confined within closed containers or closed systems and will be present only through accidental rupture, breakage or unusual faulty operation, the situation could be called "abnormal."

The Code writers have designated these two kinds of conditions very simply, as Division 1 - normal and Division 2 - abnormal. Class 1, Class 2, and Class 3 hazardous locations can be either Division 1 or Division 2.

Good examples of Class 1, Division 1 locations would be the areas near open dome loading facilities or adjacent to relief valves in a petroleum refinery, because the hazardous material would be present during *normal* plant operations.

Closed storage drums containing flammable liquids in an inside storage room would not normally allow the hazardous vapors to escape into the atmosphere. But, what happens if one of the containers is leaking? You've got a Division 2 -abnormal - condition . . . a Class 1, Division 2 hazardous location."

By virtue of the markets in which Pacific Crest Transformers is involved, a Class 1, Division 2 designation is the most common seen.

The following chart serves as a quick reference as to the class, group, and divisions as defined above. Class 1, Division 2 criteria have been highlighted.

OSHA Summary of Class I, II, III Hazardous Locations

CLASSES	GROUPS	DIVISIONS	
		1	2
I Gases, vapors, and liquids (Art. 501)	A: Acetylene B: Hydrogen, etc. C: Ether, etc. D: Hydrocarbons, fuels, solvents, etc.	Normally explosive and hazardous	Not normally present in an explosive concentration (but may accidentally exist)
II Dusts (Art. 502)	E: Metal dusts (conductive,* and explosive) F: Carbon dusts (some are conductive,* and all are explosive) G: Flour, starch, grain, combustible plastic or chemical dust (explosive)	Ignitable quantities of dust normally are or may be in suspension, or conductive dust may be present	Dust not normally suspended in an ignitable concentration (but may accidentally exist). Dust layers are present.
III Fibers and flyings (Art. 503)	Textiles, wood-working, etc. (easily ignitable, but not likely to be explosive)	Handled or used in manufacturing	Stored or handled in storage (exclusive of manufacturing)

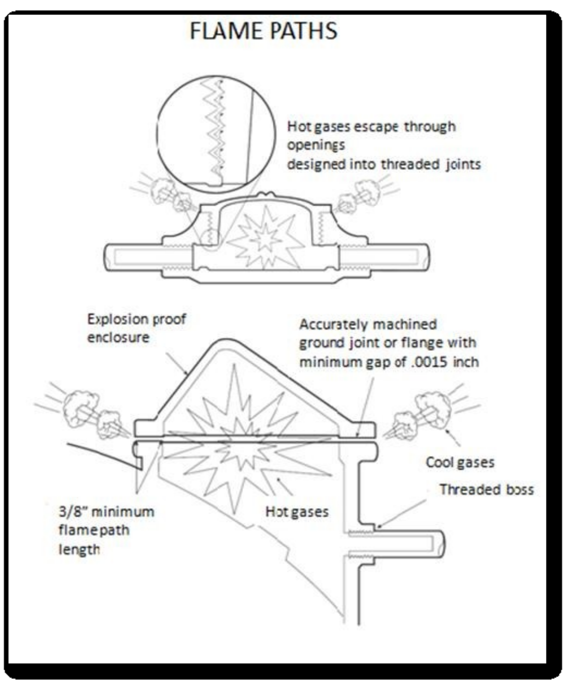
The adjacent photo depicts a transformer designed for installation within a non-hazardous site. Note that the wiring from the various gauges is exposed SO cable. Entrances to the terminal box are made via watertight connections. The terminal box enclosure itself provides a _degree_ of protection against:

- accidental contact with enclosed equipment by personnel
- falling dirt, rain, sleet, and snow
- damage from the external formation of ice

This photo provides a view of a transformer which has been constructed for installation in a hazardous environment. The gauge wiring has been enclosed in solid or flexible conduit in route to the explosion proof terminal box.

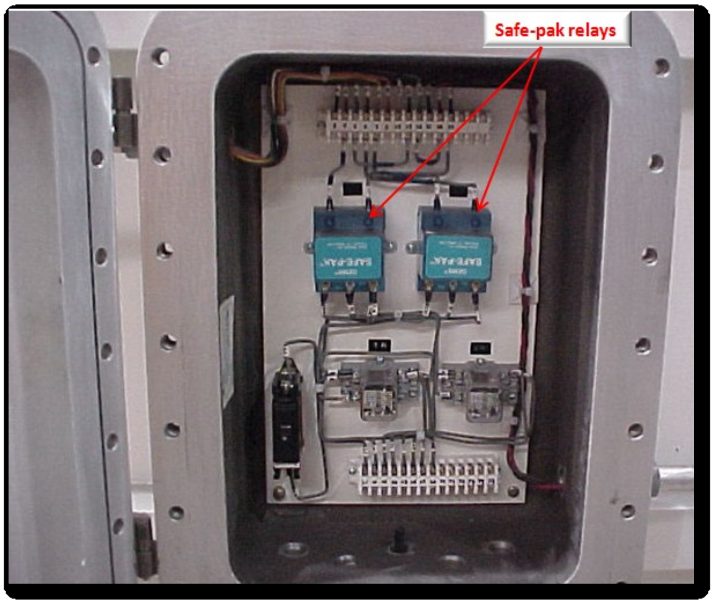
In addition to providing all the features listed in the preceding example, this arrangement is rated explosion proof.

Explosion proof is defined by the NEC as "capable of withstanding an explosion of a specified gas or vapor that may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and that operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby." Further, explosion proof does not mean "explosion-resistant". It refers to an enclosure designed in such a way that an ignition inside the enclosure does not propagate to the outside of the enclosure.



Threaded and/or flat joint conduit unions are used with conduit and enclosures in explosion proof equipment. Both joints work on the principle of a long flame path. The flame path or escape path is the path the hot gases or vapors must take after ignition. For threaded joints to be effective, they must be made up wrench tight with five fully engaged threads. The flat joint involves carefully machined mating surfaces, bolted securely together. The joints perform properly, if the hot gases are cooled enough so they do not ignite an explosive mixture in the surrounding atmosphere. The flame must not propagate outside the enclosure.

Although a Class 1 designation requires the capability to withstand an explosion within an enclosure, an effective design incorporates measures to minimize such a possibility.



Adjacent is a close up photo of the previous image detailing the control enclosure. The enclosure serves as a centralized point in which to terminate the output from a variety of gauges and devices located on the transformer including liquid level gauge, thermometer, pressure vacuum gauge, and sudden rise pressure relay. The outputs from these devices control the operation of connected equipment, largely through relays. To prevent the possibility of explosive ignitions, intrinsic safe devices such as Safe-pak relays are used. The contacts in such relays are hermetically sealed to contain sparking during operation.

In conclusion – Class 1, Division 2 operating environments are defined as those in which explosive gases may exist at time to time. Associated equipment in such environments must be designed to operate safely with minimum possibility of sustaining an explosive event.