Introduction to Area Classification

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Introduction

Zones and Divisions for Area Classification

There are several documents that can be used to aide in the decision to classify an area. How an area is classified determines the type of equipment that can be used in it. Most engineers are familiar with the terms hazardous, non-hazardous, classified, unclassified and Class I, Division 1, Class I, Division 2. Less familiar are the Class II, Divisions 1 and 2, Class III, Divisions 1 and 2, and the Class I, Zone 0, Class I, Zone 1, and Class I, Zone 2 designations. The designations are also further defined by groups which further breakdown the type of hazardous material.

An area is classified based on the properties of the flammable vapors, liquids, gases, or combustible dust or fiber that may be present and the chance that a flammable or combustible concentration would be present. The class designations tell you what type of flammable or combustible material is present. Class designations use Roman numerals. The division designation tells you to what degree the hazard is present. Division designations and Zone designations use Arabic numbers.

When flammable gases or combustible dusts are mixed in the proper proportion with air, a source of energy is all that is needed to create an explosion. This source could be from electricity - equipment that can produce arcs or sparks under normal operation when contacts are opened or closed (such as switches, circuit breakers, motor starters, or plugs and receptacles). Another source could be from heat. Lights (luminaries) and motors could have a surface temperature that may exceed the safe limits of a flammable atmosphere. Sometimes there could be a non-electrical source of ignition, such as a hammering on masonry or dropping a tool on a ferrous surface if the tool is not made of non-sparking material (such as aluminum).

The Fire Triangle (also for explosions)

The “fire triangle” refers to the three elements below that must be present for a fire (or explosion) to occur and sustain itself.

1. A flammable liquid or vapor or combustible dust must be present in sufficient quantity.
2. There must be the proper mixture of oxygen
3. There must be an ignition source.

Each element above comprises one side of the triangle. If any side of the triangle is broken, then a fire cannot start or sustain itself.

Article 500 of the NEC

Article 500 of the NEC covers Class and Division designations.

Class I

Class I locations are those in which flammable gases or vapors exist or may be present in the air in enough of a quantity to produce explosive or ignitable mixture.

Class I, Division 1

A Class I, Division 1 location is a location in which:

1. Ignitable concentrations of flammable gases or vapors can exist under normal operating conditions;

2. Ignitable concentrations of such gases or vapors may exist frequently because of repair or maintenance operations or because of leakage;

3. Breakdown of the equipment or a failure of the process 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.

Examples include:

- Places where volatile flammable liquids or liquefied flammable gases are transferred from one container to another
- Locations containing open tanks or vats of volatile flammable liquids
- Interiors of spray booths and areas in the vicinity of spraying and painting operations where volatile flammable solvents are used
- Gas generator rooms and other portions of gas manufacturing plants where flammable gas may escape.

In some Division 1 locations, ignitable concentrations of flammable gases or vapors may be present continuously or for long periods of time, such as in the inside of inadequately vented enclosures containing instruments normally venting flammable gases or vapors to the interior of the enclosure or the inside of vented tanks containing volatile flammable liquids.

Class I, Division 2

A Class I Division 2 location is a location in which:

a. Volatile flammable liquids or flammable gases are handled, processed or used but which will normally be kept within closed containers or systems from where they can escape only in the case of accidental rupture or breakdown of the containers (abnormal operation);

b. Ignitable concentrations of gases or vapors are normally prevented by positive mechanical ventilation. The ignitable concentrations of the gases or vapors may become hazardous if the ventilation system fails;

c. Any location that is adjacent to a Class I, Division 1 location where ignitable concentrations of gases or vapors might be communicated unless prevented by adequate positive-pressure ventilation from a clean source of air and safeguards against ventilation failure.

Class I Groups

Class I Group classifications are listed as Groups A, B, C, and D:

Group A is acetylene.

Group B is typically hydrogen, but is a flammable gas, flammable liquid produced vapor or combustible liquid produced vapor mixed with air that may burn or explode that has a maximum experimental safe gap (MESG) value less than or equal to .45 mm or a minimum igniting current ratio (MIC ratio) less than or equal to .40.

Group C is typically ethylene, but is a flammable gas, flammable liquid produced vapor or combustible liquid produced vapor mixed with air that may burn or explode that has a maximum experimental safe gap (MESG) value greater than .45 mm and less than or equal to .75 mm or a minimum igniting current ratio (MIC ratio) greater than .40 and less than or equal to .80.

Group D is typically propane, but is a flammable gas, flammable liquid produced vapor or combustible liquid produced vapor mixed with air that may burn or explode that has a maximum experimental safe gap (MESG) value greater than .75 or a minimum igniting current ratio (MIC ratio) greater than .80.

MESG is the maximum experimental safe gap in millimeters. It is the maximum gap between mating surfaces of explosion proof enclosures that will prevent the flames or hot gases resulting from an explosion inside the enclosure from causing ignition of the surrounding external atmosphere. This can only be determined experimentally and is dependent on several factors.

MIC is the minimum igniting current ratio. It is the ratio of the minimum current required from an inductive spark discharge to ignite the most easily ignitable mixture of a

gas or vapor divided by the minimum current required from an inductive spark discharge to ignite methane under the same test conditions.

Class II

Class II locations are those in which there is the presence of combustible dust. There are three groups of combustible dusts based on the type of material – metallic, carbonaceous, or organic.

Class II, Division 1

A Class II Division 1 location is a location:

a. In which combustible dust is in the air under normal operating conditions in quantities sufficient to produce explosive or ignitable mixtures;

b. Where mechanical failure or abnormal operation of machinery or equipment might cause such explosive or ignitable mixtures to be produced, and might also provide a source of ignition through simultaneous failure of electric equipment, through operation of protection devices, or from other causes;

c. In which combustible dusts of an electrically conductive nature may be present in hazardous quantities.

Combustible dusts that are electrically nonconductive include dusts produced in the handling and processing of grain, pulverized sugar, pulverized spices, dried hay and other organic materials that may produce combustible dusts when processed or handled.

Only Group E dusts are considered to be electrically conductive for classification purposes. Dusts containing magnesium or aluminum are particularly hazardous and extreme precaution must be used with them.

Class II, Division 2

A Class II, Division 2 location is a location where:

a. Combustible dust is not normally in the air in enough quantity to produce an explosive or ignitable mixture and dust accumulations are normally not enough to interfere with the normal operation of electrical equipment. Combustible dust may be in suspension in the air as a result of infrequent malfunctioning of handling or processing equipment;

b. Combustible dust accumulations around the vicinity of the electrical equipment may be enough to interfere with the dissipation of heat from electrical equipment or may be ignited by abnormal operation or failure of electrical equipment.

The quantity of combustible dust that may be present and the adequacy of dust removal systems are factors in determining if the area should be classified or unclassified. Where products such as seed are handled such that there is a low quantity of dust, the amount of dust may be a factor in determining if the area should be classified.

Class II Groups

Class II Groups are listed as Groups E, F, and G:

Group E is an atmosphere containing combustible metal dusts including aluminum, magnesium and their commercial alloys or other combustible dusts whose particle size, abrasiveness, and conductivity present similar hazards in the use of electrical equipment.

Group F is an atmosphere containing combustible carbonaceous dust that have more than 8 percent total entrapped volatiles or that have been sensitized by other materials so that they present an explosion hazard. Coal, carbon black and charcoal are examples of carbonaceous dusts.

Group G is an atmosphere that contains combustible dusts not included in Group E or F such as flour, grain, wood or plastic. Certain dusts may require additional precautions due to chemical phenomena that can result in the generation of ignitable gases.

Class III

Class III locations are those where there are easily ignitable fibers or where materials that produce combustible flyings are handled, manufactured or used.

A Class III, Division 1 location is a location in which easily ignitable fibers or materials producing combustible flyings are handled, manufactured or used.

For example, textile mills and fiber manufacturing and processing plants, cotton gins and cotton seed mills, clothing manufacturing plants. Easily ignitable fibers and flyings include rayon, cotton, and Spanish moss.

A Class III, Division 2 location is a location in which easily ignitable fibers are stored or handled.

Article 505 of the NEC

Article 505 of the NEC covers Class and Zone designations.

Class I

Class I, Zone 0

A Class I, Zone 0 is a location where:

a. Ignitable concentrations of flammable gases or vapors are present continuously;
b. Ignitable concentrations of flammable gases or vapors are present for long periods of time.

This includes inside vented tanks or vessels that contain volatile flammable liquids and inside inadequately vented spraying or coating enclosures where volatile flammable solvents are used. It is not good practice to install electrical equipment in Zone 0 locations except when the equipment is essential to the process or when other locations are not feasible. If it is necessary to install the equipment, it is good practice to use an intrinsically safe system. In Class I, Zone 0 locations only intrinsically safe wiring methods may be used.

Class I, Zone 1

A Class I, Zone 1 location is a location where:

a. Ignitable concentrations of flammable gases or vapors are likely to exist under normal operating conditions;
b. Ignitable concentrations of flammable gases or vapors may exist frequently because of repair or maintenance operations or leakage;
c. Equipment is operated or processes are carried on such that equipment breakdown or fault[illegible]s could result in the release of ig[illegible]mable gases or vapors [illegible]ctrical equipment in a [illegible]become a source of
d. [illegible]n from which ignitable [illegible]cated unless [illegible]sitive pressure [illegible]ective safeguards

This includes loca[illegible]l flammable gases are transferred from o[illegible]

Class I, Zone 2

A Class I, Zone 2 l[illegible]

a. [illegible]s of vapors are not likely [illegible] and if they do occur, will exist only [illegible] period;