CANADIAN ELECTRICAL CODE

SUBJECT: Section 18 – Hazardous locations

Rule 18-006 Locations containing an explosive gas atmosphere

General
For classification requirements at oil and gas facilities please consult the "Code for Electrical Installations at Oil and Gas Facilities" published by the Safety Codes Council.

For classification requirements at dispensing stations, garages, bulk storage plants, finishing processes, and aircraft hangars please consult Section 20 of the Canadian Electrical Code and STANDATA CEC-20.

Anhydrous Ammonia (Liquid Fertilizer)
The space within 3 m surrounding an anhydrous ammonia (NH_3) storage tank, pump, valve, meter, and similar equipment is considered a Zone 2 hazardous area.

Area Classification
Persons doing area classification should consider the following:

a) Although the purpose of area classification, as outlined in the CE Code, is to determine the proper equipment, materials, and wiring methods for electrical installations in the Hazardous Locations, it is important to recognize that other codes and regulations may reference the resulting area classification. In Alberta, the Occupational Health and Safety Code also references the electrical area classification requirements of the CE Code.

b) The area classification should address whether systems are in place to limit a location's exposure time to explosive concentrations of combustible gas to a "short time". When abnormal releases or failure of ventilation result in flammable concentrations of gas or vapour, the hazard caused by the abnormal release or failure of ventilation should be mitigated in a "short time".

c) For remote unattended facilities, gas detection with remote notification should be considered to allow an effective response that limits the facility's exposure to an explosive gas atmosphere to a "short time". Otherwise, the location should be classified as Zone 1 (or Class 1, Division 1).

Issue of this STANDATA is authorized by the Provincial Electrical Administrator

[Original Signed]
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Alberta Government

For an indication on what constitutes a “short time”, the American Petroleum Institute API Recommended Practice 505 - *Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2* states the following:

> “Although there is no firm rule relating the time that flammable mixtures occur in with Zone 0, Zone 1, Zone 2, and unclassified locations, many use the rule-of-thumb shown in Table 3.”

Table 3 – Showing the Typical Relationship Between Zone Classification and the Presence of Flammable Mixtures

Zone	Flammable Mixture Present
0	1000 or more hours / year (10%)
1	>10 and <1000 hours/year (0.1% - 10%)
2	>1 and <10 hours/year (0.01% - 0.1%)
unclassified	Less than 1 hour/year (0.01%)

Rule 18-008 Locations containing an explosive dust atmosphere

Ammonium Nitrate Fertilizer Storage

Areas where ammonium nitrate is stored in bulk, is being placed into bags or is otherwise being handled are not considered to be combustible or electrically conducting. Such areas are therefore, considered to be non-hazardous in so far as electrical requirements are concerned.

Ammonium nitrate however, is an oxidizing agent, and for this reason, corrosion resistant wiring methods should be considered in designing or wiring such installations.

Sulphur Handling Areas

Indoor areas where sulphur dust is in suspension in the air in quantities sufficient to produce explosive or ignitable mixtures should be classified as Zone 20 locations requiring equipment approved for Group G atmospheres. Indoor areas where sulphur dust is not normally in suspension in the air in quantities sufficient to produce explosive or ignitable mixtures may be classified as Zone 22. Outdoor areas where sulphur is being ground, pulverized, or handled in a way that will produce fine dust may also be classified as Zone 22.

NFPA (National Fire Protection Association) Standard 655, Prevention of Sulphur Fires and Explosions, provides additional information on the safe handling of sulphur dusts. Sulphur, under some conditions, is very corrosive and this should be taken into consideration in the design, installation and maintenance of the electrical system for this type of facility.

Rule 18-050 Electrical equipment

Area Classification of Ammonia Machinery Rooms

Ammonia is listed in Rule 18-050 as a Group IIA hazardous gas. CSA Standard B52-Mechanical Refrigeration Code includes installation requirements for refrigerating systems that use ammonia. Where a refrigerating system uses ammonia in a "Machinery Room", the room is normally considered a Zone 2, hazardous location.

However, when a refrigerating system using ammonia is installed in a "Class T Machinery Room", the room shall not be considered a hazardous location. One of the requirements for a Class T machinery room is that where the independent mechanical ventilation system is not operated continuously, a gas monitoring system shall be installed that will automatically start up the ventilation system and actuate a remote alarm at the lowest practical instrument-detection level not exceeding 25 per cent of the lower explosive limit.

To be acceptable as a non-hazardous location, it may be necessary to provide the electrical inspection department written confirmation that the refrigerating system is installed in a "Class T Machinery Room" in conformance with CSA Standard B52.

Installation of Transducers and Similar Devices

Transducers are devices used to convert one form of energy into another (such as pressure-to-current or vice versa). In a typical application the transducer converts an electrical output signal (usually 4-20mA) from a controller to a pneumatic signal necessary to operate a control valve actuator or pneumatic positioner (I/P). Another application may be to monitor the flow and/or pressure of process fluids with transducers that convert pressure to a 4-20mA signal (P/I).

Careful consideration must be given to the selection of an appropriate transducer if a flammable gas or liquid (explosive fluid) is intended as the medium for operation. Using transducers designed only to be operated with “normal air” pose significant safety hazards when they are actually operated by an explosive fluid. In these situations, the device has not been designed or tested for use with an explosive fluid and is not suitable for the application thus voiding its certification and in non-compliance with the Canadian Electrical Code.

When a “normal air” transducer is operated with an explosive fluid there is a significant risk that the explosive fluid will migrate into the wiring system with potentially increased pressures within the equipment and the wiring system further compounding the hazard. Even though the wiring system and equipment enclosure may be explosion proof, they may not have been designed for use where we have a combination of an explosive fluid at elevated pressures. Therefore, the “normal air” transducer is not suitable for the application.

CSA Standard C22.2 No. 30 – *Explosion Proof Enclosures for Use in Class I Hazardous Locations* has provisions for incorporating an explosive fluid seal where a transducer is operated by an explosive fluid. When selecting a transducer (or similar device) intended for operation with an explosive fluid, be sure to specify to the supplier/manufacturer its intended application and that it requires an explosive fluid seal. At existing transducer installations, where an explosive fluid is the medium used to operate the device, you are encouraged to review documentation and consult with the manufacturer to determine whether the device incorporates an explosive fluid seal. Where it is identified that these installations have a transducer that is not suitable for the application, you are advised to take all necessary actions to resolve a potentially hazardous situation.

> **Note:** Although the installation of this type of equipment is prevalent in hazardous locations, there are certainly situations where a transducer operated by an explosive fluid is located in a non-hazardous location. In those cases, the above information is also equally applicable.

Relocatable Structures (Skid Units)

See STANDATA CEC-2, Item “Rule 2-100 Marking of Equipment”.

Rule 18-054 Temperature

To comply with Rule 18-054, electrical equipment that does not bear the temperature mark indicated in Subrule 18-052(2) must not be used where there are vapours with an ignition temperature less than the values given in Subrule 18-052(3).

Where it is intended to use non-explosion proof motors or generators in compliance with Rule 18-150, particular attention should be given to motors with a Class F or Class H insulation. The allowable operating temperature of these motors exceeds the minimum ignition temperature of some flammable vapours and the equipment motors must not be used where these vapours exist.

Rule 18-062 Pressurized equipment or rooms

CE Code Rule 18-062 allows equipment pressurized with a protective gas to be located in an explosive atmosphere. The appendix B note to this Rule suggests three possible references that could be used to meet the requirements of this Rule. The NFPA standard 496 "Standard for Purged and Pressurized Enclosures for Electrical Equipment" is frequently used as a guide in designing systems to meet the requirements of Rule 18-064 in Zone 2 or Class 1, Division 2 Hazardous Locations. The purpose of this STANDATA item is to highlight a common error that is made in applying this Standard, as outlined in the following:

The pressurization system used by the standard to pressurize enclosures in Zone 2/Class 1, Division 2 Hazardous Locations is a type Z purge. Three requirements of type Z pressurizing in the standard read as follows:

> ***4.8* Type Z Purging***
>
> *4.8.1 Detection shall be provided to indicate failure to maintain positive pressure within a protected enclosure.*
>
> *4.8.1.1* Failure to maintain positive pressure within a protected enclosure shall be communicated by an alarm or an indicator.*
>
> *4.8.1.2 It shall not be required to de-energize the protected equipment upon detection of the failure to maintain positive pressure within the protected enclosure.*

Note that when reading the standard an asterisk (*) at the beginning of a paragraph, indicates that explanatory material on the paragraph can be found in Appendix A of the standard.

In some cases designers have interpreted paragraph 4.8.1.2 to mean that while loss of pressurization requires an alarm, it will not be necessary to de-energize the protected equipment. It should be noted that the wording in paragraph 4.8.1.2 should be understood to mean that while it may not be necessary to de-energize the protected equipment immediately "upon" loss of pressurization, if the pressurization cannot be restored within a short period, the protected equipment should be de-energized.

This interpretation is confirmed by the Appendix A note to the definition for an alarm which reads as follows:

> ***A.3.3.1 Alarm.*** *An alarm is intended to alert the user that the pressurizing system should be immediately repaired or that the electrical equipment protected by the failed pressurizing system should be removed from service.*

If the protected equipment is critical to the operation of a facility, installation of backup pressurization means should be considered as a part of the design.

Rule 18-070 Flammable fluid seals

Equipment and cabling below the wellhead in oil and gas facilities are not typically considered as being installed in a hazardous location; however, the wellhead can be considered as a potential source of pressurized flammable fluids. Special consideration should be provided for wiring and fibre optic systems that enter the wellhead from the surface. The "cable pass through" at the wellhead needs to be a process seal that is equivalent to a "single" or "dual" seal, and certified as such.

It may be possible to consider this "cable pass though" a secondary seal, however in this case, there needs to be a primary seal inside the well, and provisions provided to meet Subrule (2). This is not recommended, as there is a possibility for pressurized flammable fluids to exist around the cable within the well, depending on the well design. In this case, the cable could become pressurized as it is normally not designed or certified as a primary seal. There may be some cable designs such as mineral insulated cable that could meet this requirement, but the primary seal failure still needs to be annunciated. For a "secondary seal" approach, there needs to be engineering considerations such as:

- The overall well design,
- Possible sources of pressurized flammable fluids that could enter the cabling system
- Certification of primary seals, e.g. at an instrument device or electrical submersible pump
- Provisions to meet Subrule (2)

Due to the complications with a "secondary seal" approach, it is recommended that wiring and fibre "cable pass throughs" be certified as "single" or "dual" seals.

Rule 18-072 Bonding in hazardous locations

For sizing bonding conductors or bonding jumpers in hazardous locations, Rule 10-814 (Bonding Conductor Size) should be used. The use of table 41, as required by rule 10-614 is intended to apply only to service equipment.

Previously, bonding requirements were such that cables be bonded in accordance with 10-606(1)(a), (c), and (d), essentially requiring grounding bushings to supplement bonding of the sheath. Currently, 18-072(2) recognizes that where cables and raceways incorporate a bonding conductor, the bonding of the sheath through standard locknuts is adequate and bonding bushings are not mandatory.

Rules 18-104 Sealing, Zone 1 & 18-154 Sealing, Zone 2

Sealing of Control Cables with Bundled Sub-Assemblies

CSA Standards C22.2 No.174 (Cables and Cable Glands for Use in Hazardous Locations) and C22.2 No.230 (Tray Cables) have provisions to test and mark cables with bundled sub-assemblies for extending through a sealing fitting or gland without removing the shield. Cables that meet the requirements of these standards will bear the mark "HL" (for cables approved for hazardous locations) or "TC" (for Tray Cable), followed by the appropriate group designation.

Only those cables tested and marked in accordance with the appropriate CSA Standards will be acceptable when extended through a seal without removing the shield and separating the individual conductors of the pairs, triads, etc.

Sealing Underground Conduits and Cables

Areas in earth below grade are normally considered non-hazardous, although the areas above grade have been classified as hazardous locations. In some cases however, spilled flammable liquids or heavier than air gases seeping through the earth and entering underground can enter conduits and cables. Examples of such locations may be service stations, bulk storage plants, refineries, tank farms and batteries.

To prevent the transfer of ignitable vapours into non-hazardous areas, conduits and cables located in such areas should be sealed at the point of emergence in the non-hazardous area. Cables may be sealed at the first point of termination in the non-hazardous area. The holes through which such conduits and cables enter the building should be made vapour-tight to prevent ignitable vapours from entering the building around the outside of the conduits or cables.

Rule 18-150 Equipment, Zone 2 locations

Resistance Temperature Devices (RTDs)

RTDs used to measure temperature do not operate above ambient temperature and are therefore considered part of the exception that exempts them from the requirements of Rule 18-150(1)

Installation of Transducers and Similar Devices

See Information item to Rule 18-050 above.

Rule 18-152 Wiring methods, Zone 2

Use of Non-metallic Liquid-tight Flexible Conduit in Zone 2 Hazardous Locations

Where corrosion problems exist in Zone 2 hazardous locations, the use of Non-metallic liquid-tight flexible conduit is considered acceptable.