
Part 10 Fire and Explosion Hazards

Highlights

- Section 162 prohibits a person from entering or working in a work area if the atmosphere contains more than 20 per cent of the lower explosive limit of a flammable or explosive substance.
- Section 162.1 requires employers to ensure that locations are classified according to the classification method described in the *CEC* if a hazard assessment determines that the area is a “hazardous location” as defined in the Occupational Health and Safety (OHS) Code.
- Section 165 describes protective measures required in defined hazardous locations.
- Section 166 places limits on where and how an internal combustion engine can be used. The employer is responsible for ensuring the limits are observed.
- Section 169 lists requirements for, and limits on, the conditions under which hot work can be performed. The employer is responsible for ensuring the limits are observed.
- Section 170 lists requirements applicable to hot tap work, including the requirement that hot tap procedures are written into a hot tap plan.
- Section 170.1 describes requirements for spray operations.
- Section 171.1 and 171.2 describe general welding requirements.
- Sections 172 through 174 list requirements applicable to welding services that are provided from vehicles.

Requirements

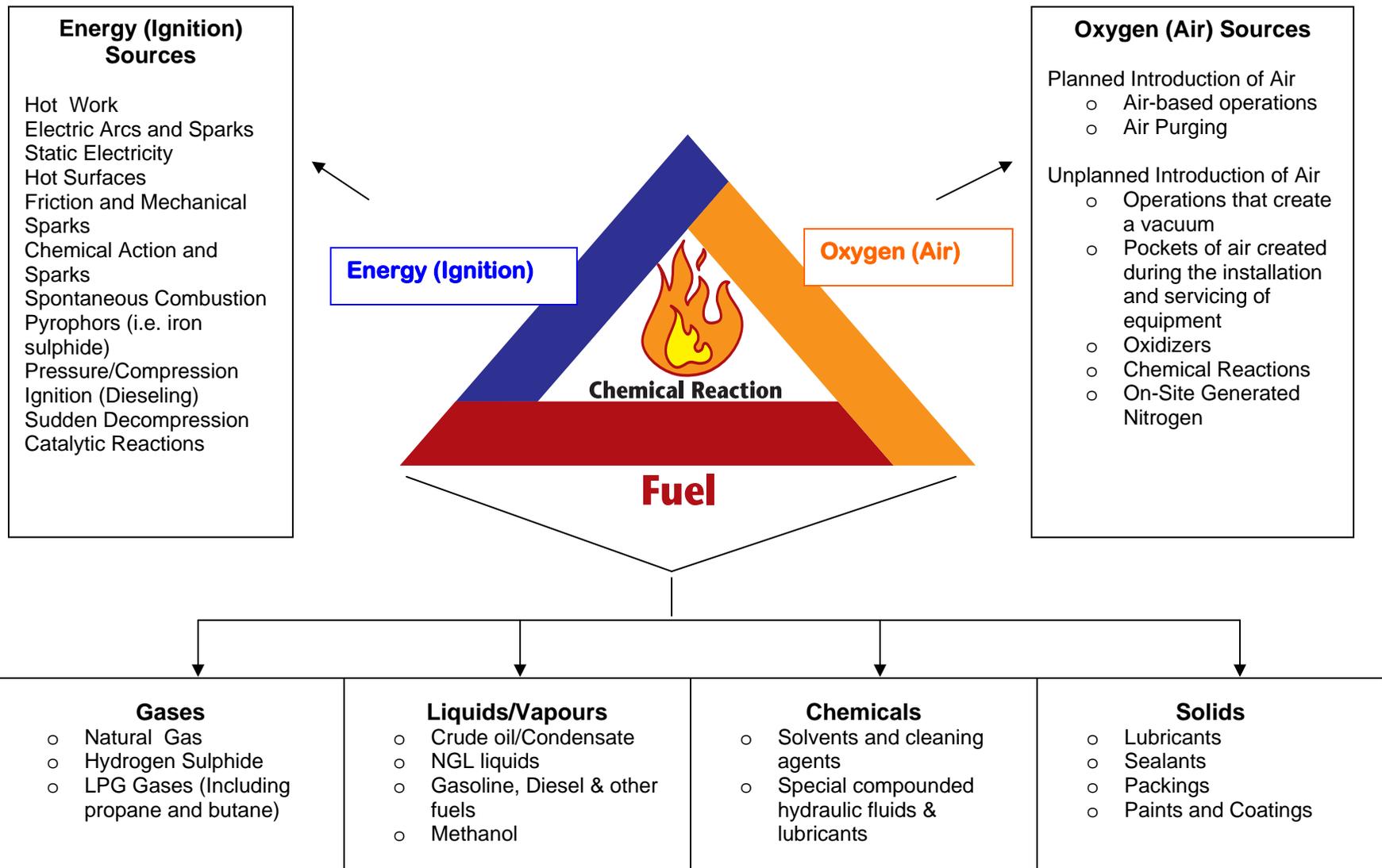
For a fire to occur, three elements must come together at the same time and in the right proportions ... fuel, heat and oxygen. This is commonly known as the “fire or explosion triangle” (see Figure 10.1). Fuels may be flammable or combustible materials and can be gases, liquids or solids. Heat is the ignition source and can include open flames and sparks as well as chemical reactions that create heat. The most common source of oxygen is air, but oxygen can also come from chemicals called oxidizers e.g. chlorine, potassium permanganate, potassium chlorate, etc. and from membrane-generated nitrogen.

Fire prevention consists of making sure that the three legs of the fire triangle do not occur at the same time. It is important to note that even when all three sides co-exist, there is not always a 100 percent certainty that a fire will start. The three elements need to be present in the right amount and near one another. Important factors include:

- upper/lower explosive limits — the concentration range of a flammable gas or vapour in air that will form an ignitable mixture;
- ignition source energy — a source of energy that will produce enough heat to ignite a flammable concentration of gas or vapour in air;
- mixture — mixing compounds with different chemical properties can result in unique substances with significantly different explosive limits and/or ignition temperatures; and
- flash point — the minimum temperature of a liquid at which sufficient vapour is given off to form an ignitable mixture with air, near the surface of the liquid. Materials such as diesel fuel, lubricating oils and solvents that are used below their flash points will not form an ignitable mixture in air. However, when liquids are released in the form of a mist the mist may be ignitable below the liquid’s flash point.

Figure 10.1

Fire or Explosion Triangle



Source: Industry Recommended Practice # 18 , Enform

General Protection and Prevention

Section 162 Prohibitions

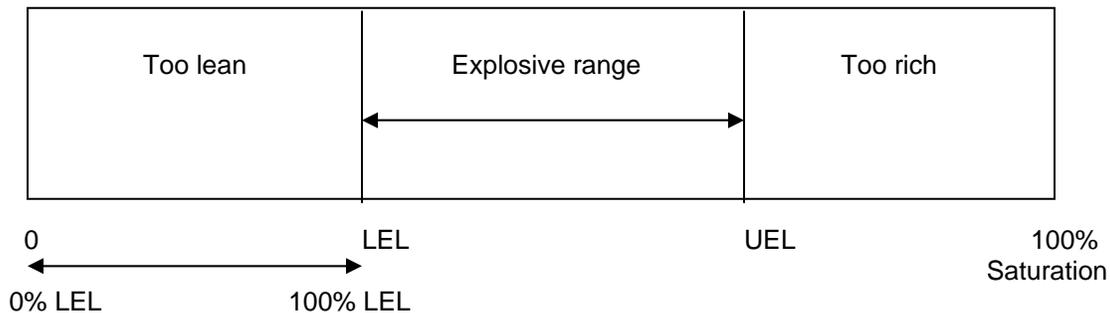
Subsections 162(1) and 162(2)

Employers must ensure that flammable and combustible substances at the workplace do not ignite and harm workers or damage equipment. No worker, other than a competent worker responding in an emergency, must enter or work at a work area in which the atmosphere exceeds 20 percent of a substance's lower explosive limit (LEL). Above this limit the safety margin, or margin for error, is small.

Before performing work involving an atmosphere that may contain an explosive gas, the atmosphere may need to be tested to determine if a flammable mixture is present. Where atmospheric testing is required, it must be done before work begins and may be required at regular intervals while work continues. The use of electronic gas detection equipment is recommended as it allows for the continuous monitoring of gas or vapour concentration in air. The most common unit of measurement is the percentage of the lower explosive limit (% LEL).

The LEL is the minimum amount of fuel that must be present in air to ignite. If the air/fuel mixture is below the LEL, it is considered too "lean" and will not ignite. The upper explosive limit (UEL) is the maximum amount of fuel that can be present in air for ignition to occur. If air/fuel mixture is above the UEL, it is considered too "rich" and will not ignite (see Figure 10.2). In this situation there is insufficient oxygen to support combustion. The wider the explosive range, the more difficult it is to manage the potential of an ignition resulting in a fire or explosion.

Figure 10.2 Graphic explanation of LEL and UEL



Using methane as an example, a 5 percent mixture of methane in air is the minimum concentration that will ignite and explode in the presence of an ignition source. When the concentration of methane in air reaches its LEL of 5 percent, a gas monitor calibrated for methane will read 100 percent LEL. If the concentration of methane in the air is 0.5 percent, the instrument will read 10 percent LEL. Table 10.1 shows LEL and UEL limits for selected hydrocarbon gases and liquids

Table 10.1 LEL and UEL limits for selected hydrocarbon gases and liquids

Flammable substance	Lower Explosive Limit (LEL)	Upper Explosive Limit (UEL)
Methane	5%	15%
Ethane	3%	12.5%
Propane	2.3%	9.5%
Butane	1.9%	8.5%
Hydrogen sulphide	4.0%	46%
Toluene	1.27%	7.0%
Gasoline	1.3%	6.0%
Cutter oil	1.1%	6.0%
Envirovert (drilling fluid)	0.7%	6.0%
Crude oil	1%	7%

To ensure the health and safety of workers, gas monitor readings in work areas should not exceed 20 percent of the LEL for the following reasons:

- (a) gas monitors may be calibrated for a flammable gas or vapour other than the one being tested for;
- (b) the atmosphere being tested may contain a mixture of unknown flammable gases or vapours;
- (c) the gas monitor's correction factors may be inaccurate or unreliable;
- (d) worker sampling techniques may not be the best e.g. it may be difficult to get to the bottom of a vessel where gases that are heavier than air can pool; and
- (e) to provide an added safety factor that reduces the likelihood of an explosion.

For more information



http://employment.alberta.ca/documents/WHS/WHS-PUB_h1001.pdf

Combustible Gas Meters – Function Testing

Subsections 162(3) and 162(3.1)

Smoking materials and open flames are a potential source of ignition. They may not be present during the storing, handling or processing of a flammable substance. If open flames are unavoidable during these activities, the “hot work” requirements of section 169 must be met.

Subsections 162(4) and 162(5)

Exposing flammable or combustible liquids which are at a temperature at or above their flash point to the air can result in explosive mixtures in the air. Equipment in the area that is not designed to prevent it from becoming an ignition source could cause an explosion or fire.

Flammable liquids are those that flash at temperatures below 37.8°C (100°F), while combustible liquids flash at temperatures above 37.8°C (100°F). Different liquids flash at different temperatures. Some “flammable liquids”, such as gasoline (flash point approximately -46°C), flash at very low temperatures and should be considered flammable at all temperatures.

Material Safety Data Sheets (MSDSs) provide information such as a particular liquid’s flash point. MSDSs also describe any precautions that need to be taken when handling the liquid.

A flammable or combustible liquid at a temperature above its flash point presents a potential fire and explosion hazard, particularly if a potential source of ignition is present. The restrictions on mixing, washing, cleaning, and other uses of a flammable or combustible liquid at a temperature at or above its flash point are intended to prevent a fire or explosion.

Subsection 162(6)

Rags contaminated with flammable or combustible substances can heat up and burst into flames under the right conditions. Such rags must therefore be stored in containers with a lid that keep out air. Without air, a fire quickly smothers itself. Temporary storage containers should be emptied frequently and used as recommended by the manufacturer. The container must be clearly labelled as being for the storage of contaminated rags (see Figure 10.3)

Figure 10.3 Example of temporary storage container for contaminated rags



Section 162.1 Classification of work sites

The hazard assessment required by Part 2 of the OHS Code will help an employer to determine if there are one or more locations at a work site where there exists or where there is the potential for an explosive atmosphere to exist. If such locations are present, they are considered to be a “hazardous” location.

A “hazardous location” is further described in Part 1 of the *CEC*. According to the *CEC*, a hazardous location is a premises, building, or parts thereof, in which

- (a) an explosive gas atmosphere is present, or may be present, in the air in quantities that require special precautions for the construction, installation and use of electrical equipment;
- (b) combustible dusts are present, or may be present, in the form of clouds or layers in quantities to require special precautions for the construction, installation, and operation of electrical equipment; or
- (c) combustible fibres or flyings are manufactured, handled or stored in a manner that will require special precautions for the construction, installation, and operation of electrical equipment.

An explosive atmosphere is a mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapour, or mist in which, after ignition, combustion spreads throughout the unconsumed mixture.

Explosive concentrations of gas, vapour or dust might be present temporarily as a result of flammable materials being brought into an area. As a result, the area might not be classified under this section. Special precautions, including the features, design and installation of electrical equipment must still be taken in these areas to ensure that ignition of the flammable gas, vapour or dust is prevented (see section 169(1)(b)). An example of one of these situations would be the use of a solvent, near or above its flash point, in an enclosed area.

Flammable gases and vapours, and flammable or combustible liquids, can burn and explode. Some dusts can also burn and explode. Examples include grain dust, sugar dust, cardboard dust, and metal dust.

If a flammable or combustible dust (or ignitable fibres) is suspended in air at a high enough concentration, a source of ignition such as a spark, open flame, or hot surface can trigger a fire and explosion. The minimum concentration in air of suspended dust that can burn and explode is approximately 50,000 milligrams/ cubic metre (0.05 ounces/cubic foot). This amount is 5,000 times greater than the occupational exposure limit permitted for nuisance dusts. The exact concentration varies from substance to substance and depends on factors such as particle size and oxygen concentration.

While most dust clouds with a sufficiently high concentration of particles occur within process equipment, dust clouds can be formed by the mechanical disturbance of an accumulated layer of dust. Often the mechanical impact that disturbs the dust also creates an incendive spark resulting in an explosion that raises more dust, thereby creating a series of violent explosions. In areas where the fine dust particles accumulate, the frequency of cleaning may determine whether or not the area is classified as a hazardous location.

Ignitable fibres and flyings are materials cast off into the air that normally fall to the ground because of their size and weight. By example, small particles of sawdust that remain suspended in the air are dust. Wood chips created by a chain saw or planer are flyings. While fibres are not generally a threat to cause an explosion, fibres collecting on heat-producing equipment can be the source of serious fires.

Subsection 162.1(1) Classification of hazardous locations

Except for the situations noted in subsections 162.1(1)(b) and 162.1(1)(c), a professional engineer experienced in such classifications (or a competent person authorized by a professional engineer) must carry out the classification in accordance with Section 18 of the *CEC*.

Rule 18-004 of the *CEC* classifies hazardous locations into three Classes as follows based on the degree of hazard in the location:

- (1) Class I – locations which are hazardous because of the presence of gas or vapour in the air;
- (2) Class II – locations which are hazardous because of the presence of combustible or electrically conductive combustible dust; and
- (3) Class III – locations which are hazardous because of the presence of easily ignitable fibres or flyings.

Currently the *CEC* requires that Class I hazardous locations be divided into three zones based on the frequency and duration of the occurrence of an explosive gas atmosphere. Facilities that were in existence prior to the 1998 edition of the *CEC* may continue to use the two Division method of classification for Class I hazardous locations. Class II hazardous locations are currently divided into two Division based on the probability that flammable concentrations of dust may be in the air or could be thrown into the air as a result of the failure of equipment or apparatus. Class III hazardous locations are currently divided into two Divisions based on the likelihood of an accumulation of fibres or flyings.

The intended purpose of the classification system from the perspective of the *CEC* is to help define the design characteristics of electrically powered equipment used within these zones. In the more hazardous zones or Divisions, equipment must be of a higher level of design to ensure it will not become an ignition source. However, the classification system can also be used for such purposes as assessing hazards, establishing control areas, and defining where personal protective equipment may be required.

Class I – Flammable gases and vapours

- locations in which flammable gases or vapours such as natural gas or gasoline vapour are or may be present in the air in quantities sufficient to produce explosive gas atmospheres
- gas or vapour could be ignited if an electrical or other source of ignition was present
- electrically powered equipment in such locations must meet the explosion-proof enclosure requirements of section 18 of the *CEC*
- examples of typical Class I locations are:
 - petroleum refineries and gasoline storage and dispensing areas
 - dry cleaning plants where vapours from cleaning fluids can be present
 - aircraft hangars and fuel servicing areas
 - utility gas plants and operations involving the storage and handling of liquefied petroleum gas or natural gas

Class II – Combustible dusts

- locations that are hazardous because of the presence of combustible or electrically combustible dusts
- electrically powered equipment in such locations must meet the dust-tight enclosure requirements of section 18 of the *CEC*
- examples of typical Class II locations are:
 - flour and feed mills
 - plants that manufacture, use or store magnesium or aluminum products
 - producers of plastics, medicines and fireworks
 - producers of starch or candies
 - spice-grinding and sugar plants
 - coal preparation plants and other carbon handling or processing areas

Class III – Easily ignitable fibres and flyings

- locations that are hazardous because of the presence of easily ignitable fibres or flyings
- the fibres and flyings are not likely to be suspended in the air but can collect around machinery or on lighting fixtures
- heat, a spark, or hot metal can ignite the fibres or flyings
- electrically powered equipment in such locations must meet the requirements of section 18 of the *CEC* e.g. totally enclosed motors and dustproof enclosures
- examples of typical Class III locations are:
 - textile mills
 - flax processing plants
 - plants that shape, pulverize or cut wood and create sawdust or flyings.

Compared to previous editions of the *CEC*, classification terminology has changed. Class I locations have changed from the Division system of classification to the Zone system of classification. This provides users with the option of using either the North American approach (electrical equipment approved and marked with the location (Division) in which it can be used) or the IEC (International Electrotechnical Commission) approach (equipment approved and marked with the methods of protection used).

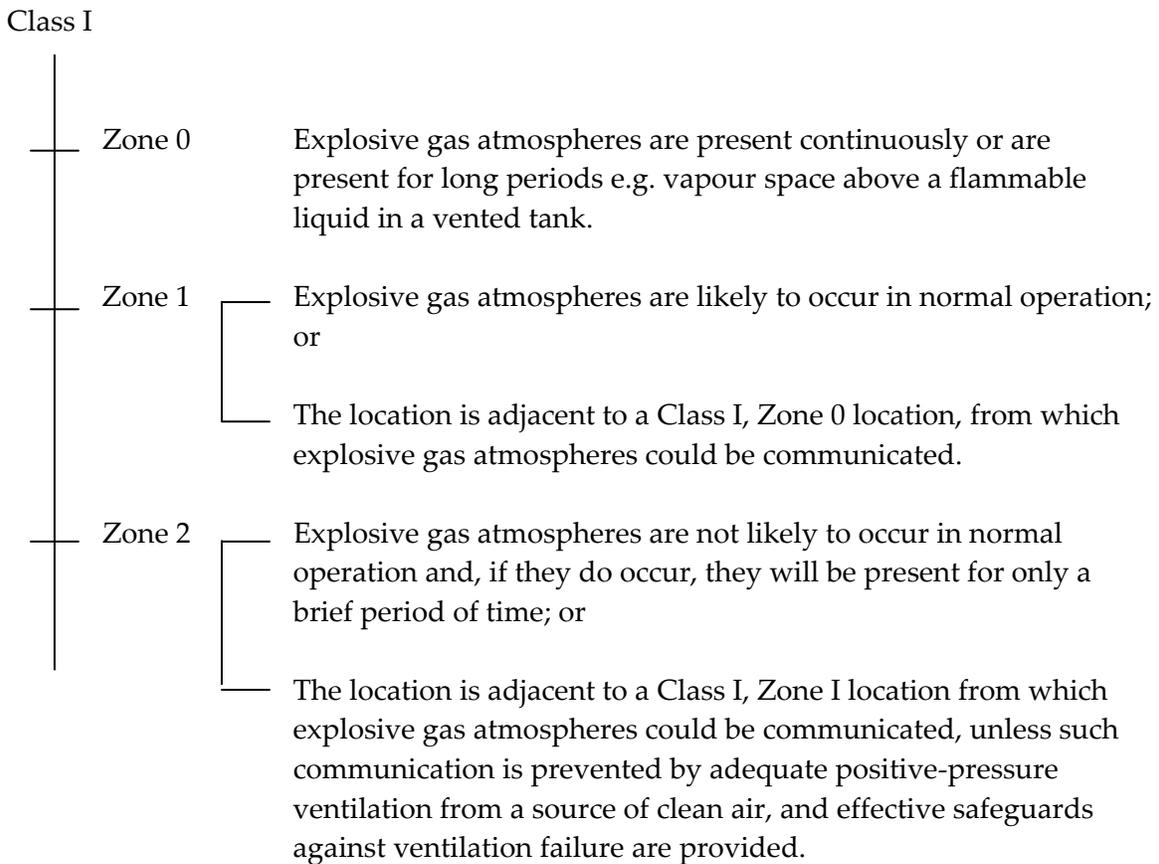
Class I locations further subdivided

Class I locations are further divided into three Zones (see Figure 10.4) as described in Rule 18-006 of the *CEC*. This subdivision of the Class is based on the frequency and duration at which concentrations of a gas exceed the gas's lower explosive limit (LEL). Providing adequate ventilation in buildings to dilute the normal (fugitive) emissions to safe levels, and providing means to eliminate large (abnormal) emissions within a short period may reduce the hazardous location within buildings

to Zone 2. In general, outdoor (unenclosed) areas above grade are considered to be adequately ventilated.

Area classification is done for normal and abnormal operating conditions, but does not consider the conditions associated with catastrophic failure. During normal operation, the gases or vapours present are the result of an accumulation of “fugitive emissions”. Fugitive emissions are the continuous flammable gas and vapour releases that are relatively small compared to releases due to equipment failure. These releases occur during normal operation of closed systems from components such as pump seals, valve packing, and flange gaskets. Abnormal operating conditions in which flammable concentrations (>100% LEL) of gas or vapour could be present may be the result of events such as valve or pump packing failures. Catastrophic events such as well blowouts or process vessel rupture are unpredictable events and are not considered for classification of hazardous locations. Such events require the use of emergency measures.

Figure 10.4 Class I locations subdivided



Classification examples

Some locations in which flammable materials are present in closed piping and containers at very low pressure may be unclassified. This is often the case with heating boilers or natural-gas-fuelled engines where the gas pressure relative to the piping design pressure is low. For example, CSA Standard CAN/CSA-B149.1 *Natural Gas and Propane Installation Code* allows pressure as high as 450 kPa (66 psig) in industrial buildings. This assumes that the piping and containment systems meet the requirements of that code. Proper area classification requires an understanding of the various parameters such as normal and abnormal process conditions and ventilation.

A common rule of thumb used by industry is:

- Zone 0 hazardous locations are those where flammable concentrations of gas or vapour (100% LEL or greater) are present for more than 1,000 hours per year
- Zone 1 hazardous locations are those where flammable concentrations of gas or vapour are present for less than 1,000 hours and more than 10 hours per year
- Zone 2 hazardous locations are those where flammable concentrations of gas or vapour are present for less than 10 hours per year

Some typical examples are:

- Zone 0 — the vapour space above a flammable liquid in a tank vented to atmosphere
- Zone 1 — the interior of an inadequately ventilated natural gas compressor building
- Zone 2 — the interior of an adequately ventilated natural gas compressor building where there are means to limit the time flammable concentrations of gas can be present to a short time.

For the purpose of a Zone 2 area classification, buildings may be considered adequately ventilated when the ventilation rate is four times the rate required to dilute the normal (fugitive) emissions to concentrations below 25% LEL.

Class II locations further subdivided

Class II locations are further divided into two Divisions (see Figure 10.8) as described in Rule 18-008 of the *CEC*. Class II locations are those which are hazardous because of the presence of combustible or electrically combustible dusts.

Division 1 locations are those in which

- explosive concentrations of dust are present in the air during normal operation,
- accumulation of dust is sufficient that explosive quantities of dust may be

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- thrown in the air as a result of abnormal operation or failure of equipment, or
- electrically conductive, combustible dust may be present.

Division 2 locations are those in which

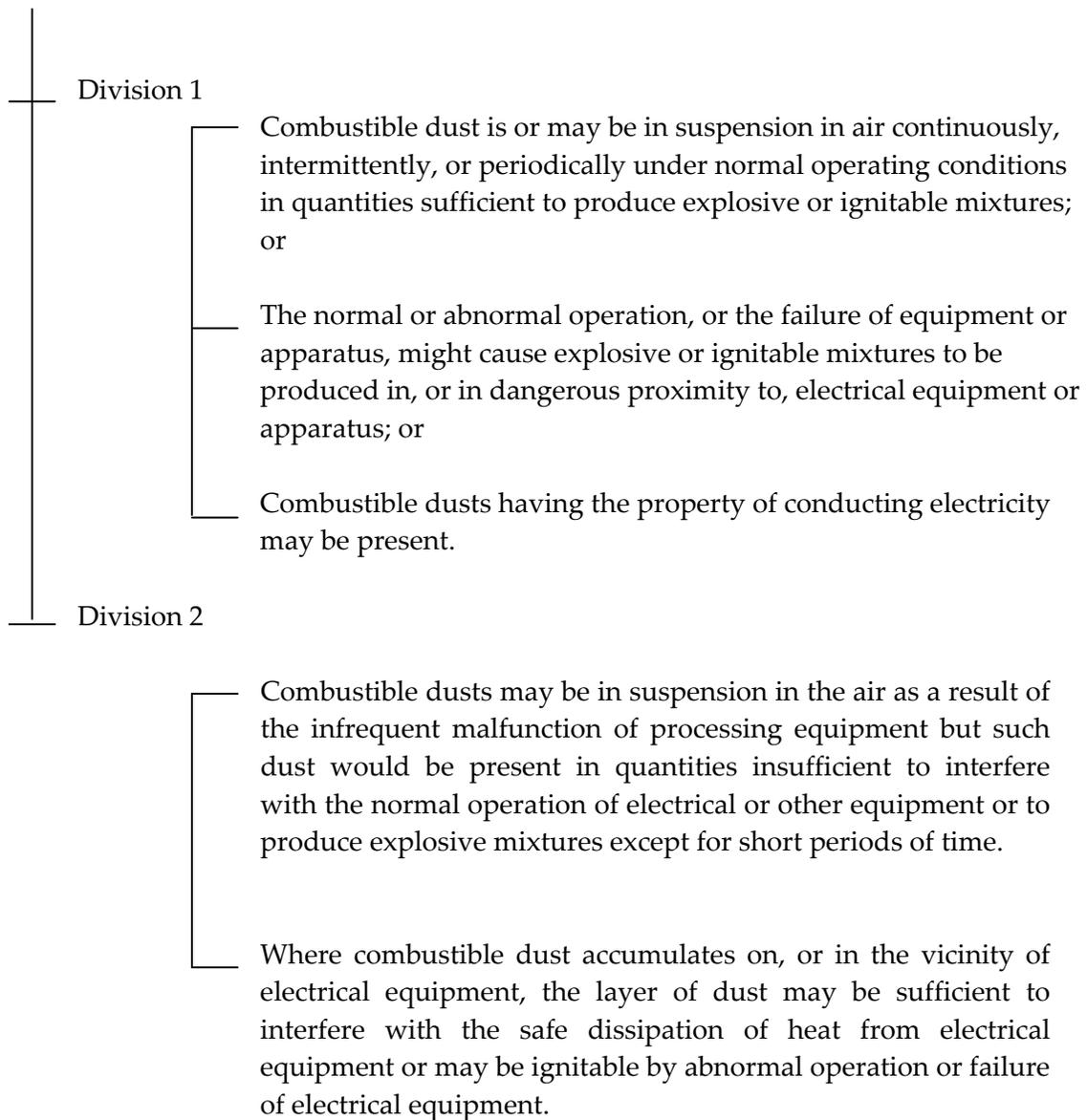
- explosive concentrations of dust may be present in the air as a result of the infrequent malfunction of handling or processing equipment, but such dust would be present in quantities insufficient to produce explosive or ignitable mixtures, except for short periods of time and would be insufficient to interfere with the normal operation of electrical or other equipment.

Combustible dust that blankets electrical equipment can cause overheating because the dust layer acts as insulation and prevents the release of heat from heat producing equipment such as electric motors. Sparks or fire from the equipment can ignite the combustible dust layer, and may throw dust into suspension in the air in sufficient quantity to form an explosive mixture, which in turn would be ignited by the sparks or fire. Combustible dusts include dusts produced in the handling and processing of materials such as coal, agricultural materials, resins, and combustible metallic dust. Finely pulverized material, suspended in the air, can cause as powerful an explosion as one occurring at a petroleum refinery.

Some metallic dusts, such as magnesium and aluminum, are both combustible and conductive. Nonmetallic dusts, such as pulverized coal, carbon black, and coke dust, are not considered to be conductive for the purposes of area classification. For information about classifying dusts, readers are referred the CEC Handbook, referenced at the end of this section.

Figure 10.5 Class II locations subdivided

Class II

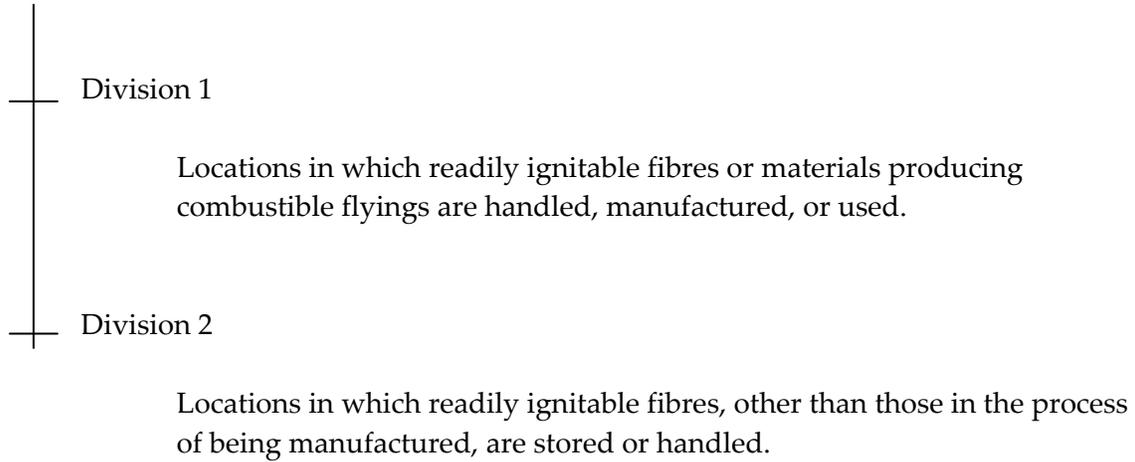


Class III locations further subdivided

Class III locations are further divided into two Divisions (see Figure 10.6) as described in Rule 18-010 of the *CEC*. Class III locations are those which are hazardous because of the presence of easily ignitable fibres or flyings, but in which such fibres or flyings are not likely to be in suspension in air in quantities sufficient to produce ignitable mixtures.

Figure 10.6 Class III further subdivided

Class III



Unlike Class I and Class II hazardous locations, the hazard in Class III areas does not include explosions. Rather it is the danger of fires resulting from a buildup of fibres on electrical or other heat producing equipment.

Equipment for hazardous locations

Electrical equipment has three recognized sources of ignition:

- (1) arcs and sparks – produced by normal equipment operation. Motor starters, contactors, and switches can ignite a hazardous location atmosphere;
- (2) high temperatures – equipment such as lamps and lighting fixtures can produce heat. If this heat exceeds the ignition temperature of the hazardous material that is present, a flammable atmosphere can be ignited; and
- (3) electrical equipment failure – the shorting of an electrical terminal, set of contacts, or failure of a motor winding or power cable could create a spark that ignites an explosive atmosphere.

Electrical equipment used in hazardous locations is specially designed and constructed. The type of equipment allowed in each Zone is based on the frequency and duration of the occurrence of explosive concentrations of gas or vapour in the Zone.

In areas classified as Zone 0, explosive concentrations of gas or vapour are present for very long periods i.e. more than 1,000 hours/year. As a result, the only electrical equipment allowed is equipment that does not contain sufficient energy to ignite the specific gas or vapour in the area i.e. intrinsically safe electrical equipment.

In areas classified as Zone 1, explosive concentrations of gas may be present during normal operation i.e. more than 10 and less than 1,000 hours/year. As a result, all electrical equipment that produces incendive arcs or sparks during normal operation must be contained in explosion-proof or flameproof enclosures. Equipment that does not produce arcs or sparks must be enclosed in explosion-proof or flameproof enclosures or be certified as using an “increased safety” method of protection and be enclosed in “safety enclosures”.

In areas classified as Zone 2, explosive concentrations of gas occur only as the result of the abnormal operation of equipment and the concentrations are allowed to persist for a short time only (less than 10 hours per year). Equipment that arcs and sparks during its normal operation must still be enclosed in explosion-proof or flameproof enclosures. Equipment that does not produce arcs or sparks, such as lighting fixtures and 3-phase motors is allowed to be contained in a variety of non-explosion-proof or non-flameproof enclosures.

In Class I areas it is assumed that gas or vapour will eventually enter electrical equipment if the equipment is exposed to explosive concentrations of gas or vapour for a sufficiently long period. Therefore devices that produce incendive arcs or sparks must be contained in explosion-proof or flameproof enclosures that are sufficiently strong to prevent rupture when gas or vapour inside the enclosure is ignited. Gases that are released along the “flame paths” (around covers, conduits and cable entries) are cooled to the point that they will not ignite the gas outside the enclosure. For the flame paths to function properly, it is important that the equipment is properly assembled and that the flame paths are not damaged by corrosion or other mechanical means.

For Class II equipment, explosive dust must be kept away from equipment housed within an enclosure. This prevents an internal explosion from occurring and does away with the need for heavy explosion-containing construction or gas escape routes. This difference explains why Class I, Zone 0 equipment is called

“explosion-proof” and Class II equipment is called “dust-ignition proof”.

Class II equipment must seal out dust and be able to operate with a blanket of dust covering it without the temperature of the enclosure increasing to the point that the dust layer is ignited.

Class III equipment is very similar in design to Class II equipment. Class III equipment must minimize the entrance of fibres and flyings; prevent the escape of sparks, burning material or hot metal particles resulting from failure of equipment, and operate at a temperature that prevents the ignition of fibres that have settled on the equipment.

For more information

 American Petroleum Institute RP500. *Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class 1 and 2.*

 American Petroleum Institute RP505. *Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities Classified as Class I, Zone 0, Zone 1, and Zone 2.*

 Bossert, J. CSA Special Publication PLUS 2203, *Hazardous Locations: A Guide for the Design, Testing, Construction, and Installation of Equipment in Explosive Atmospheres.* Canadian Standards Association, Rexdale, Ontario.

 CSA Handbook to the Canadian Electrical Code, Part 1, 2002. Canadian Standards Association, Rexdale, Ontario.

 International Electrotechnical Commission (IEC). IEC Standard 60079-10, *Area Classification.*

 Institute of Petroleum (British). *Model Code of Safe Practice – Part 15: Area Classification Code for Petroleum Installations.*

 National Fire Protection Association (NFPA). NFPA Standard 497 (1997 Edition), *Recommended Practice for Classification of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas.*

 www.gov.ab.ca/ma/ss/pdf/CEC/458-cec-18.pdf

Alberta Municipal Affairs. Canadian Electrical Code: Section 18 – Hazardous Locations. STANDATA Electrical Safety Information Bulletin; October 2001

Code for Electrical Installations at Oil and Gas Facilities

Area classification of most Class I hazardous locations requires qualified individuals to classify these areas in accordance with the definitions in Rule 18-006 of the CEC. Individuals carrying out area classifications of Class I hazardous locations will typically be guided by the principles and recommendations in the Standards and Recommended Practices listed above. Individuals classifying hazardous locations using the three zone method will typically follow classification methods outlined in API RP505 and individuals classifying hazardous locations using the two Division method will typically follow recommended practice API RP500. The remaining publications are most frequently used for additional reference material.

However there are two publications that define the area classification of specific types of installations. These are

- (1) Alberta's *"Code for Electrical Installations at Oil and Gas Facilities"*, and
- (2) Section 20 of the *CEC* titled *"Flammable Liquid and Gas Dispensing and Service Stations, Garages, Bulk Storage Plants, Finishing Processes, and Aircraft Hangers"*.

The Alberta Code, commonly referred to as the *"Oilfield Code"*, is updated on the same cycle as the *CEC*. The Alberta Code applies to electrical installations used in the search and transmission of oil, natural gas and related hydrocarbons. It does not apply to

- (a) petroleum refineries,
- (b) petrochemical facilities, or
- (c) gas distribution systems distributing gas to consumers.

The Alberta Code allows professional engineers to establish the area classification, typically by using the procedures outlined above. Where this is not done, the Alberta Code mandates the area classification for specific installations.

Section 20 of the *CEC* specifies the area classification of the following installations:

- Gasoline dispensing and service stations
- Propane dispensing, container filling, and storage
- Compressed natural gas refueling stations and compressor and storage facilities
- Commercial garages – repairs and storage
- Residential storage garages
- Bulk storage plants
- Finishing processes
- Aircraft hangers

In addition to specifying the area classification of these facilities, section 20 also contains some additional installation requirements in addition to those outlined in section 18 of the *CEC*.

Area classification of Class II and Class III hazardous locations requires them to be classified in accordance with the definitions in Rules 18-008 and 18-010 of the *CEC*. Unlike Class I, there are far fewer standards available to assist the user in determining the classification of the Class II and Class III hazardous locations. Two standards that are available for classification of Class II hazardous locations are

- (1) ISA-12.10 *Area Classification in Hazardous (Classified) Dust Locations*, and
- (2) IEC Standard 61241-10 *Electrical Apparatus for Use in the Presence of Combustible Dust – Part 10: Classification of Areas Where Combustible Dusts Are or May Be Present*.

Note that the IEC standard uses a three zone approach to the classification of hazardous dust areas. However, the principles involved are similar to the North American two division approach.

Subsection 162.1(2)

No explanation required.

Section 163 Procedures and precautions

Subsection 163(1)

Repealed

Subsection 163(2)

A hazardous location is by definition a location where a fire or explosion hazard may exist. If the hazard assessment required by section 7 determines that the potential for such a hazard does not exist, then the location is not a hazardous location. To ensure that this state continues, certain site requirements must be met:

- (a) The quantity of flammable substance stored or used at the site must not be such that, if inadvertently released into the atmosphere, an explosive atmosphere (as defined) will be created. This quantity is dependent on such things as the type of substance, its explosive limits and other explosive properties, expected concentration if released, site environmental conditions, etc.
- (b) Flammable substances must be prevented from unintentionally flowing into underground shafts. The 30 metre storage distance is intended to keep the substances far enough away to prevent this from happening.
- (c) Flammable substances can give off vapours under the right conditions. If the substances are stored too close to the intake(s) of a ventilation system, vapours may be drawn into the air supply. This contamination could be harmful to workers or, under worst-case conditions, create an explosive atmosphere.

If flammable vapours enter an internal combustion engine, the engine runs faster, overheats, and can explode. A flashback from the engine could ignite the flammable substance outside the engine. Flammable vapours entering the firebox of a fired heater or furnace could similarly cause the equipment to overheat and explode.

- (d) Only approved containers may be used to store portable quantities of flammable liquids. Containers manufactured on or after July 1, 2009 must be approved to
- (i) CSA Standard B376-M1980 (R2008), *Portable Containers for Gasoline and Other Petroleum Fuels*,
 - (ii) NFPA Standard 30, *Flammable and Combustible Liquids Code*, 2006 edition, or
 - (iii) ULC Standard C30-1995, *Containers Safety*.

Such containers are specially designed for this purpose and bear the mark or label of a nationally accredited testing organization such as CSA, ULC, UL, etc. Liquids stored in these containers are unlikely to leak vapours into the air. Unapproved containers may not prevent leaks. Particular care must be taken when liquids are stored at temperatures above their flash point.

Containers manufactured prior to July 1, 2009 are acceptable if they were approved to an earlier edition of one of these referenced standards.

Subsection 163(2.1)

When transferred into or out of containers, flammable liquids can cause a static charge to build up on the container. This charge could create a difference in voltage potential between the containers, creating the possibility of an incendive spark igniting the vapours from the liquid. Effective control of static electricity can include actions such as grounding and bonding.

Metallic or conductive containers or vessels used to contain flammable or combustible liquid can be electrically bonded to one another and electrically grounded during the transfer of their contents. Bonding and grounding techniques prevent sparks from being created. Sparks are a potential source of ignition.

Making a low resistance electrical connection between two or more conductive containers is called “bonding”. Bonding ensures that the containers have the same electrical potential relative to one another. Without a difference in charge or “electrical potential”, a spark cannot be created that jumps from one container to another.

A container is grounded when a low resistance electrical connection is made between it and the earth (hence the term “earthing” or “grounding”). This ensures that the container has the same electrical charge as the earth. As with bonding, without a potential difference, no spark can be created. Figures 10.7 and 10.8 show examples of bonding and grounding situations.

Figure 10.7 Bonding and grounding during the transfer of flammable fluid from one conductive container to another

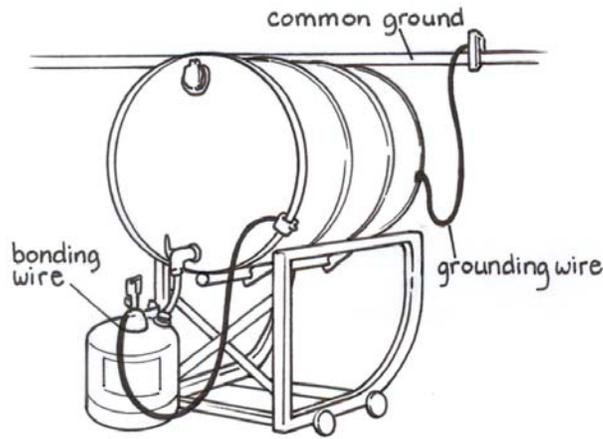
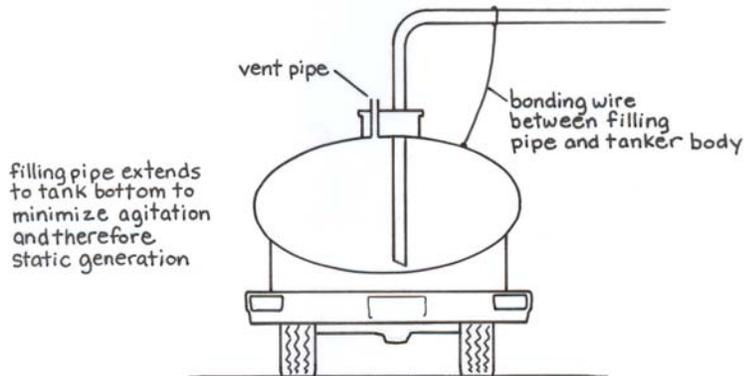


Figure 10.8 Filling a tanker with a flammable liquid



For proper electrical connections to be made, bonding and grounding conductors and the containers involved must all be conductive. This permits electrical charges to flow and disperse instead of building up and then jumping as a spark from one container to another. The use of non-conductive plastic containers to hold flammable liquids can be dangerous. When transferred into or out of such containers, flammable liquids can cause a static charge to build up on the container. This charge may result in a spark being created that ignites the liquid or its vapours.

For more information



<http://www.osh.dol.govt.nz/order/catalogue/799.shtml>

Guidelines for the Control of Static Electricity in Industry
(Department of Labour, New Zealand)

Section 164 Contaminated clothing and skin

Clothing contaminated with a flammable or combustible substance can be dangerous to the wearer. A spark, open flame, or other ignition source can easily ignite the clothing. A person wearing contaminated clothing must avoid any activity where a spark may be created. Contaminated clothing must be removed at the earliest possible time. Even flame resistant fabrics may burn if soaked with a flammable or combustible substance.

Flammable and combustible substances are often harmful to the skin. These substances can remove the natural layer of protective oil from a person's skin, resulting in dry, cracked skin. This skin condition is known as dermatitis.

Section 165 Protective procedures and precautions in hazardous locations

Subsections 165(1) and (2)

Repealed

Subsection 165(3)

Static electricity is always present in the industrial setting. Examples of typical situations likely to produce static electricity are:

- (a) the use of conveyor belts in which non-conductive materials move over or between pulleys and rollers;
- (b) pulverized materials or dusts passing through chutes or being conveyed pneumatically;
- (c) the flow of fluids through pipes or conduits, or from orifices into tanks or containers;
- (d) the flow of gases from orifices; and
- (e) the general accumulation of static charge on workers at the workplace, particularly when they wear overalls made of synthetic materials.

When transferred into or out of containers, flammable liquids can cause a static charge to build up on the container. This charge may result in a spark being created that ignites the liquid or its vapours. Effective control of static electricity can include actions such as grounding and bonding.

For more information



<http://www.osh.dol.govt.nz/order/catalogue/799.shtml>

Guidelines for the Control of Static Electricity in Industry
(Department of Labour, New Zealand)

Subsection 165(4)

If a hazardous location (as defined) is a particular work area at a work site, the boundaries of the hazardous location must be

- (a) clearly identified to warn workers of the nature of the hazards associated with the presence of the flammable substance in that work area. Effective signage that warns workers of the hazards as they approach the work area is one way of meeting the requirement; or
- (b) fenced off to prevent workers or equipment entering the area without authorization.

Subsections 165(5) and 165(6)

Subsection 165(5) and 165(6) are to be taken together. The conditional “if reasonably practicable” of subsection 165(5) is understood to apply to the prevention of an inadvertent release of a flammable substance or oxygen gas. The written procedures and precautionary measures are a required element of subsection 165(5). It is always practicable to develop the required procedures and precautionary measures.

In those cases where it is not reasonably practicable to prevent an inadvertent release of a flammable substance or oxygen gas, an employer must comply with the requirements of subsection 165(6).

Subsection 165(6) acknowledges that a release has happened and requires the employer to prevent an explosive atmosphere from igniting.

Section 166 Internal combustion engines

Subsections 166(1) through 166(4)

Flammable substances can give off vapours under the right conditions. If flammable vapours enter the intake of an internal combustion engine, the engine may run uncontrollably and fail to shut down when the normal fuel source is removed. A flashback from the engine cylinders could ignite the gas or vapour in the air.

Whenever possible, the internal combustion engines driving stationary equipment should be located outside the hazardous location.

Except for a vehicle powered by an internal combustion engine [see subsection 166(4)], an internal combustion engine used in a hazardous location must have a combustion air intake and exhaust discharge that are equipped with a flame arresting device or the air intake and exhaust discharge must be located outside the boundaries of the area classified under section 162.1. Flame arresting devices prevent a flame front from leaving the engine and igniting the atmosphere in the hazardous location.

If an internal combustion engine is present in a hazardous location, the temperature of all its surfaces exposed to the atmosphere in that location must be lower than the temperature at which the flammable substance(s) present in the hazardous location will ignite. This requirement does not apply to a vehicle that is powered by an internal combustion engine as the engine in the vehicle must be considered a source of ignition. Instead, the requirements of section 169 involving hot work apply.

Subsection 166(5)

An internal combustion engine cannot be located in a hazardous location classified as Zone 0 as explosive concentrations of gas or vapour are present for long periods in these areas. Section 18 of the *CEC* only allows the use of intrinsically safe electrical equipment that has insufficient energy to ignite the gas in the area in Zone 0 hazardous locations.

Subsection 166(6)

While a hazardous location classified under Section 162.1 as Class I, Zone 1 or Class I, Division 1 will have explosive concentrations of gas present for shorter periods than a Zone 0 hazardous location, explosive concentrations of gas or vapour may be present for relatively long periods. An internal combustion engine located in a Zone 1 hazardous location must have a combustible gas detection system and controls in accordance with Rule 18-070 of the *CEC*. This Rule requires that

- (a) if the gas concentration in the air reaches 20% LEL, an alarm must be activated and additional ventilation must be activated, and
- (b) if the gas concentration reaches 40% LEL the engine must be shut down.

Subsection 166(7)

Internal combustion engines are not allowed in Class II or Class III, Division 1 hazardous locations due to the high risk of igniting dust or fibres in those areas.

For further information about Zones and Divisions as classified under the *CEC*, readers are referred to the explanation for section 162.

Section 167 Flare stacks, flare pits and flares

Open flames from flare stacks, flare pits and flares are a potential source of ignition. Open flames from these sources must be located at least 25 metres beyond the boundary of a hazardous location.

Section 168 Industrial furnaces and fired heaters

Subsections 168(1) and 168(2)

The employer must take measures to ensure that gas and oil-fired furnaces do not explode. If a furnace is being used to heat a flammable substance other than its fuel, the fuel supplying the furnace's heating system must not mix with the flammable substance that is being heated. The two systems must function independently – inserted blinds or double block and bleed systems are not acceptable methods of isolation.

Subsection 168(3)

No explanation required

Subsections 168(4) and 168(5)

For information about Zones and Divisions as classified under the *CEC*, readers are referred to the explanation for section 162.

While prohibited outright for Division 1, Zone 0 or Zone 1 classified areas, a furnace or fired heater may be located and operated in a Division 2 or Zone 2 classified area if:

- (a) the combustion mechanism of a furnace or heater is located within an enclosure that completely separates it from the external environment. Only the air intake and the exhaust discharge may protrude but there should be an adequate seal placed around these to prevent the return of stray emissions. This helps prevent stray emissions of explosive substances from reaching the ignition component of the furnace or heater;
- (b) flammable substances are prevented from igniting on any surface of the furnace or heater that may be exposed to atmosphere. This can be accomplished by
 - (i) ensuring that the furnace or heater is operated in such a way that the

-
- temperature of the exposed surface is *below* the ignition temperature range of the flammable substances that may be on the site,
- (ii) preventing contact by placing barriers or blanketing material between the surface and the flammable substance;
- (c) a flame arrestor is placed in the air intake *and* the discharge of the furnace or the heater, or, alternatively, the intake and discharge mechanisms are extended beyond the boundaries of the hazardous location.

Subsection 168(6)

If it is not reasonably practicable to ensure that flammable substances do not ignite on the surface of the furnace or heater [in accordance with subsection 168(5)], other effective means must be used to prevent ignition.

Section 169 Hot work

Subsection 169(1)

Section 1 of the OHS Code defines hot work as work in which a flame is used or sparks or other sources of ignition may be produced. This includes

- (a) cutting, welding, burning, air gouging, riveting, drilling, grinding, and chipping,
- (b) using electrical equipment not classified for use in a hazardous location, and
- (c) introducing a combustion engine to a work process.

Work activities that meet the definition of “hot work” must be carried out in accordance with the requirements of this section when:

- (a) they are carried out in a work area that is itself a hazardous location (as defined);
- (b) they are carried out in a work area (defined as part of a work site) that is *not* a defined hazardous location (normally) but is one where an explosive atmosphere exists temporarily because
 - (i) a flammable substance is or may be in the atmosphere of the work area;
 - (ii) a flammable substance stored, handled, processed or used in the location may be released into the air in flammable concentrations during the work process;
 - (iii) the hot work is on or in an installation or item of equipment that contains a flammable substance or its residue; or
 - (iv) the hot work is on a vessel that contains residue that may release a flammable gas or vapour when exposed to heat.

Subsections 169(2) and 169(3)

The employer must ensure that hot work is not started until:

- (a) a “hot work” permit is issued in accordance with the employer’s permit system (see Figure 10.9 for an example of a hot work permit). This permit must indicate the nature of the hazard considering
 - (i) the presence of flammable materials,
 - (ii) the presence of combustible materials that burn or give off flammable vapours when heated, and

Figure 10.9 Example of hot work permit

SAFE WORK PERMIT FOR HOT WORK NO WORK IS ALLOWED EXCEPT THAT WHICH IS SHOWN ON THE PERMIT				
DATE OF ISSUE _____ TIME OF ISSUE _____ EXPIRES _____				
LOCATION OF WORK _____				
DEPARTMENT DOING WORK _____				
DESCRIPTION OF WORK TO BE DONE _____				
NAME MATERIALS ONLY _____ TOXIC _____ CORROSIVE _____				
FLAMMABLE _____ OTHER _____				
	N/A	NO	YES	
(1)	Has an inspection been made of the unit/equipment to be worked on?			
(2)	Where inspected, was it found to be free of the above materials?			
(3)	Is an adequate supply of fresh air assured?			
(4)	Do unit and atmospheric conditions permit safe work?			
(5)	Equipment has been cleaned by (Specify) _____			
(6)	The necessary equipment has been adequately protected by (Specify) _____			
(7)	Have electrical switches been locked out and tagged? Signature for Process: _____ Electrical: _____ Mechanical: _____ Other: _____			
(8)	Have combustible waste materials been removed from the area?			
(9)	Have nearby sewers been properly protected?			
(10)	Is fire protection required? (Specify) _____			
(11)	(a) May underground obstructions be encountered? (b) May underground or overhead electrical power lines be encountered? (c) Signature of electrical supervisor or designate: _____			
(12)	Have precautions been taken against radioactive sources?			
(13)	Is permit receiver aware of material safety data sheets pertaining to this job?			
(14)	Is there a need to review a special procedure such as handling asbestos, pyrophoric materials, confined space entry, Hydrofluoric Acid Area, etc.?			
(15)	Are gas tests required during the job?			
(16)	Has the confined space or vessel been prepared for safe entry and entry signs installed?			
(17)	Is it permissible to use (a) Electrical equipment? (b) Diesel, gasoline & propane driven equipment?			
(18)	Is welding permitted?			
TYPES OF GAS TESTS REQUIRED & RESULTS OBTAINED (Check Where Required)				
I examined the above equipment at _____ AM/PM & observed the reading to be : Combustible: _____% Hydrogen Sulphide: _____ ppm Oxygen: _____ % Other: (Name): _____ ppm Gas Tester's Signature: _____				
What additional protective equipment is required? (Specify) _____				
PRECAUTIONS TO BE FOLLOWED OTHER THAN THOSE LISTED ABOVE				
AGREEMENT: I HAVE CHECKED BOTH THE PERMIT AND THE JOB. I UNDERSTAND THE NATURE AND EXTENT OF THE WORK AND THE PRECAUTIONS TO BE FOLLOWED IN COMPLETING THE WORK.				
Permit	Issued by: _____	Job Title: _____	Time: _____	
	Received by: _____	Job Title: _____	Time: _____	
Permit	Work Complete: _____	Job Title: _____	Time: _____	
Sign	For Permit Issuer: _____	Job Title: _____	Time: _____	
Off	Work Not Complete: _____	Job Title: _____	Time: _____	
All Safe Work Permits must be signed by both the Permit Receiver and Permit Issuer before work is started and after it is completed.				Permit No: _____

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- (iii) the presence of a flammable gas in the atmosphere, or gas entering from an adjacent area, such as a sewer that has not been properly protected. (Portable detectors for detecting the presence of combustible gases can be placed in the area to warn workers of the entry of these gases);
 - (b) any combustible material that is close enough to be ignited by sparks or heat from the work process is cleared from the work location or shielded or otherwise isolated from potential ignition;
 - (c) procedures are implemented that make sure that the hot work is done safely. Section 8 of the *OHS Regulation* requires the procedures to be in writing and available to workers;
 - (d) testing shows that the atmosphere does not contain
 - (i) a flammable substance, in a mixture with air, in an amount exceeding 20 percent of that substance's lower explosive limit (LEL) for gas or vapours, or
 - (ii) more than 20 percent of the minimum ignitable concentration of dust in air or more than moderate accumulations of dust on surrounding surfaces. Accumulations of dust can be considered moderate if the colour of the surface beneath the surface is visible through the dust layer.

The LEL is the minimum concentration of gas or vapour that must be present in order for ignition to occur. Below that concentration, the air/fuel mixture is too "lean" and will not ignite. A limit of 20% LEL provides a safety factor to account for the delay in response of gas detectors or the variation of the gas or vapour concentration over the area of the hot work.

Test instruments must be calibrated and used according to the manufacturer's specifications. Workers using test instruments must be made aware through training that the reading on the instrument depends on the chemical used to calibrate the instrument. For example, a test instrument calibrated using methane will read correctly for atmospheres containing methane, but may not give correct readings for atmospheres containing a flammable substance that is not methane.

Sometimes manufacturers publish correction factors that can be used when working with different flammable substances. Test instruments may sometimes give a "false" reading if the atmosphere being tested is deficient in oxygen. Many combustible gas sensors need a minimum percentage of atmospheric oxygen to function properly. The employer must ensure that workers are trained in how to correctly use the test instrument, including understanding the instrument's limitations.

While hot work is being done, atmospheric tests must be repeated at regular intervals appropriate to the hazard associated with the work being done. Regular testing confirms that a flammable or explosive atmosphere, capable of causing a fire or explosion, has not built up over time. Continuous monitoring is often required to

accomplish this. Recent improvements in portable electronic combustible gas detection systems make continuous monitoring more practical. Use of the older manual sampling systems is not recommended.

For more information



http://employment.alberta.ca/documents/WHS/WHS-PUB_sh013.pdf

Safe Work Permits



http://employment.alberta.ca/documents/WHS/WHS-PUB_hl001.pdf

Combustible Gas Meters – Function Testing



<http://www.osh.dol.govt.nz/order/catalogue/229.shtml>

Hot Work on Drums and Tanks (Department of Labour, New Zealand)

Section 170 Hot taps

Section 1 of the OHS Code defines a hot tap as a process of penetrating through the pressure-containing barrier of a pipeline, line, piping system, tank, vessel, pump casing, compressor casing or similar facility that has not been totally isolated, depressurized, purged and cleaned.

Before hot tap work begins on an enclosure containing a flammable substance, the employer must develop procedures in a hot tap plan specific to the type or class of hot tap work that will be done. A unique hot tap plan is not required for each hot tap – the plan must be specific to the type or class of hot tap work. If a variety of hot taps all involve the same hazards, and all the hot tap equipment and procedures are identical, a single hot tap plan applicable to all the hot taps is acceptable. Only in the event of a unique work situation arising would a new or amended hot tap plan be required. Section 8 of the *OHS Regulation* requires that the hot tap procedures be in writing and available to workers.

The hot tap plan must include

- (a) a site hazard analysis,
- (b) a description of the sequence of events,
- (c) safety precautions to address the hazards, and
- (d) an emergency response plan.

Workers performing hot tap work must be competent and trained in the procedures of the hot tap plan. The point in the pressure-containing barrier to be hot tapped must be strong enough to allow the hot tap to be done safely. There must be enough

room to work safely, with exit routes available and their locations known to workers involved in the work.

Workers must wear appropriate personal protective equipment and there must be a method of shutting off material being supplied to the equipment being hot tapped if an emergency arises. The machine and fittings used to do the tapping must be of adequate design and capability and the pressure within the equipment being hot tapped must be reduced to as low as practical during the hot tap operation

For more information

 American Petroleum Institute, Recommended Practice 2201, *Procedures for Welding or Hot Tapping on Equipment in Service*

Section 170.1 Spray operations

The fire and explosion hazards of spray application of flammable and combustible materials vary depending on the arrangement and operation of the particular process and on the nature of the material being sprayed. Properly designed, constructed, and ventilated spray areas are able to confine and control combustible residues, dusts, or deposits and to remove vapours and mists from the spray area and discharge them to a safe location, thus reducing the likelihood of fire or explosion. Likewise, accumulations of overspray residues, some of which are not only highly combustible but also subject to spontaneous ignition, can be controlled.

The control of sources of ignition in spray areas and in areas where flammable and combustible liquids or powders are handled, together with constant supervision and maintenance, are essential to safe spray application operations.

- (1) Adequate ventilation to remove flammable vapours, mists or powders should be provided at all times, particularly when spray application is conducted in relatively small rooms or enclosures. For enclosed operations, Part 26 of the OHS Code provides design requirements and guidelines for ventilation systems. In addition, the spraying equipment must be interlocked with the ventilation system so that it cannot be used if the ventilation system is not operating.
- (2) Spray application should not be conducted in the vicinity of open flames or other sources of ignition. Either the spray operation should be relocated or the source of ignition removed or turned off. Electrical equipment is governed by the area classification requirements described in section 161.1(1)(c).

Other considerations include:

- containers of coating materials, thinners, or other hazardous materials should be kept tightly closed when not actually being used
- oily or coating-laden rags or waste should be disposed of promptly and in a safe manner at the end of each day's operations due to the potential for spontaneous ignition.

If the spray operation takes place indoors but in other than a specifically designed and constructed spray booth, the requirements of Section 5.4 of the *Alberta Fire Code (1997)* require that:

The operation of any process involving the use of flammable liquids or combustible liquids shall conform to NFPA 33 "Spray Application Using Flammable and Combustible Materials".

NFPA Standard 33 requires, in general, that,

Each spray area shall be provided with mechanical ventilation that is capable of confining and removing vapors and mists to a safe location and is capable of confining and controlling combustible residues, dusts and deposits. The concentration of the vapors and mists in the exhaust stream of the ventilation system shall not exceed 25 percent of the lower flammable limit.

In addition, anything that might obstruct ventilation must be at least 6 metres from the spraying location. If it is not reasonably practicable to maintain the 6 metre separation, the spraying area must be ventilated to remove vapours, mists, or powders. Part 26 of the OHS Code provides design and construction requirements.

In this case, all sources of ignition located within an envelope measuring 2 metres above and 6 metres in all other directions from the spraying location must be effectively isolated from the spraying location. One way this can be accomplished is by providing barrier shielding between the ignition source and the spraying operation. Electrical equipment is governed by the area classification requirements as described in section 161.1(1)(c) of the OHS Code.

If the spraying operation takes place outdoors, then anything that might obstruct ventilation must be at least 6 metres from the spraying location. If it is not reasonably practicable to maintain the 6 metre separation, the spraying area must be ventilated to remove vapours, mists or powders. Part 26 of the OHS Code provides design and construction requirements.

Also in this case, all sources of ignition located within an envelope measuring 2 metres above and 6 metres in all other directions from the spraying location, must be effectively isolated from the spraying location. One way this can be accomplished is

by providing barrier shielding between the ignition source and the spraying operation. Electrical equipment is governed by the area classification requirements as described in section 161.1(1)(c) of the OHS Code.

Section 171 Compressed and liquefied gas

Subsections 171(1) through 171(3) and subsections 171(5) through 171(8)

Compressed and liquefied gas containers and systems must be protected against damage and dislodgment that could result in a fire or explosion. The manufacturer's specifications must always be followed.

Cylinders that have their valve stem break off can become rocket-like projectiles. Oxygen cylinders, for example, can explode if grease or oil is permitted to enter the cylinder or its regulator.

Acetylene cylinders contain acetone (a flammable liquid) in the bottom of the cylinder to help hold the acetylene. If the cylinder is on its side, the acetone may escape, causing the cylinder to explode. Acetylene cylinders must always be secured in their upright position.

Subsection 171(1)(b)

A cylinder of compressed flammable gas cannot be stored in the same room as a cylinder of compressed oxygen unless specific requirements of Part 3 of the Alberta Fire Code (1977) are met. This subsection is understood to apply to the *indoor* storage of compressed gas within a building. In this case, section 3.2.8.2 of the Alberta Fire Code applies.

Section 3.2.8.2 of the Alberta Fire Code requires that the storage room meets the following requirements:

- (a) the room must be separated from the remainder of the building by a gas-tight fire separation having a fire-resistance rating of at least 2 hours;
- (b) the room must be located on an exterior wall of the building;
- (c) a person must be able to enter the room from the exterior;
- (d) any doors from the room into the interior of the building must be
 - (i) equipped with self-closing devices, and
 - (ii) constructed in such a way that gases from the storage room cannot enter other parts of the building;
- (e) the room must be designed using good engineering practice to prevent critical structural and mechanical damage resulting from an internal explosion;

-
- (f) the room must be provided with natural or mechanical ventilation as required by subsection 4.1.7 of the Alberta Fire Code;
 - (g) the room must not contain fuel-fired appliances or high temperature heating elements; and
 - (h) the room must not be used for any purpose other than the storage of Class 2 gases. Class 2 gases are defined in the federal Transportation of Dangerous Goods Regulations.

Subsection 171(4)

Each hose of an oxygen-fuel system e.g. oxyacetylene torch system that uses acetylene and oxygen gases, must have

- (a) a flashback device installed at either the torch end or the regulator end, and
- (b) a back-flow prevention device installed at the torch end.

Flashbacks are the unintentional and uncontrolled burning of gas back into an oxygen-fuel system, resulting in possible damage to the equipment. This can range from carbon being deposited within the torch tip, valves and hose, which affects their operation, to substantial and expensive damage to the regulator and possibly the cylinder. A flashback may cause the torch and hoses to explode.

A flashback arrestor is a device designed to prevent the backflash of a flame through the torch into the hoses and regulator by quenching the flame. Most flashback arrestors available today also contain check valves intended to prevent the backflow of gases in addition to providing protection against flashbacks.

A backflow preventer is sometimes called a reverse flow valve or check valve. It is designed to prevent gases coming from the torch from mixing and flowing back into the hose lines. A backflow preventer will not always stop a flashback from reaching the hoses, regulator and cylinders.

Since flashback arrestors and backflow preventers serve different safety functions, a combination of both devices is required. Flashbacks can occur due to:

- (a) excessive or incorrect pressures. The gas at the higher pressure flows into the lower pressure line. This can occur if incorrect pressures are used or if incompatible equipment is connected together;
- (b) a leak from a regulator, hose or connection that results in a drop in pressure, and gas from the higher pressure line back-feeds into the other line;
- (c) leaking valves that allow gas to mix when the equipment is not in use;
- (d) lighting up with both torch valves open, but one cylinder closed; and
- (e) nozzle blockage or faulty equipment.

Flashback arrestors and backflow prevention devices are intended to enhance safety on oxygen-fuel systems where there is a potential for the unwanted and hazardous creation of flammable or explosive mixtures within hose lines.

Such mixtures can inadvertently be created through improper operating procedures or equipment malfunction. Oxygen, at higher pressure than the fuel gas, can back up into the fuel gas line due to a plugged tip orifice, or fuel gas can back up into the oxygen line if, for example, the oxygen cylinder goes empty while cutting.

Where there is no oxygen being supplied, and there is only one line supplying the fuel gas to the torch and nozzle, there is no possibility of reverse flow that could produce a hazardous gas mixture. It is therefore not necessary to install flashback arrestors in such systems e.g. such torches and nozzles are commonly used in the plumbing and HVAC industries, as well as for heating and brazing applications in industrial settings.

Section 171.1 Welding – General

Subsection 171.1(1)

The employer must ensure that welding activities comply with CSA Standard W117.2-06, *Safety in Welding, Cutting and Allied Processes*. The Standard provides minimum requirements and recommendations to protect persons who work in an environment affected by welding, cutting, and allied processes. It is also intended to prevent damage to property arising from the installation, operation and maintenance of equipment used in such processes.

The Standard identifies the requirements for the operation of cutting and welding equipment, and equipment of related processes. In doing so, the Standard addresses specifically the operator of such equipment, the supervisor, and the employer under whose authority such operations are carried out.

The Standard identifies the health and safety hazards that may be encountered when such equipment is operated. It provides two options to the employer on how to implement the necessary health and safety measures by

- (a) following procedural guidelines identified in the Standard, or
- (b) implementing a health and safety program.

When welding on a boiler, pressure vessel or pressure piping system, the requirements of the *Pressure Welder's Regulation* (AR 169/2002) are also applicable.

Subsection 171.1(2)

No explanation required.

Subsection 171.1(3)

Employers must ensure that before welding starts, an inspection of a reasonable area surrounding the welding operation is carried out and that combustible, flammable and explosive material, dust, gases, or vapours that are present or likely to be present in the work location are identified. Steps must be taken to ensure that such materials are not exposed to ignition by taking one or more of the following actions:

- (a) have the combustible, flammable and explosive material, dust, gas, or vapour, or the sources of these, moved a safe distance from the work location;
- (b) have the combustible, flammable and explosive material, dust, gas or vapour properly shielded against ignition;
- (c) have the work moved to a location free from combustible, flammable and explosive material, dust, gas, or vapour;
- (d) schedule the welding operation so that such combustible, flammable and explosive material, dust, gas, or vapour is not exposed during welding and cutting operations;
- (e) other effective methods that will render the area safe.

For more information

 ANSI/NFPA Standard 51B, *Standard for Fire Prevention in Use of Cutting and Welding Processes*

 American Petroleum Institute, Recommended Practice 2201, *Procedures for Welding or Hot Tapping on Equipment in Service*

 Alberta Boiler Safety Association, AB-513, *Alberta Repair and Alteration Requirements*

Subsection 171.1(4)

In addition to barrier protection from such hazards as falling tools or materials, other people in the work area should also be protected from the intense light of the welding arc, heat, and hot spatter.

Subsection 171.1(5)

When not in use, electrodes must be removed from holders to eliminate danger of electrical contact with persons or conducting objects. When not in use, electrode holders should be placed so that they cannot make electrical contact with persons,

conducting objects such as metal or wet earth, flammable liquids, or compressed gas cylinders. When not in use, guns of semiautomatic welding machines should be placed so that the gun switch cannot be operated accidentally.

Subsection 171.1(6)

The work lead and the ground lead are not the same. The work lead should not be referred to as the grounding lead. It is preferable to connect the work lead directly to the work. The work clamp should never be stored by clamping it to any part of the grounded power source frame. Grounding of electrical systems and circuit conductors is done to limit voltages due to lightning, line voltage surges, or unintentional contact with higher voltage lines, and to stabilize voltage to ground during normal operations. Grounding of workpieces, equipment housings, metal cabinets and frames, or other conductive material that form part of the equipment is done to limit the voltage to ground on these items. Limiting the voltage by grounding helps to prevent accidental shocks when equipment is misconnected or insulation fails.

After assembling any connection to the machine, each assembled connection should be checked before starting operations to ensure that it is properly made. In addition, the work lead should be firmly attached to the work. Clean and tight connections are necessary to prevent local heating. Properly insulated and dry connections are necessary to prevent stray electrical currents and possible shock or short circuits.

Coiled welding cable should be kept to a minimum and any excess is to be spread out before use to avoid overheating and damage to insulation. Jobs alternately requiring long and short cables should be equipped with insulated connectors so that idle lengths can be disconnected when not needed.

Section 171.2 Gas welding or allied processes

Subsection 171.2(1)

Connections must be checked for leaks after assembly and before lighting the torch. Flames must not be used. Leak test solutions for use on oxygen connections are commercially available and their use is recommended. Leak testing should be repeated after the equipment has been used in a manner that could cause leaks.

Subsection 171.2(2)

No explanation required.

For more information



http://employment.alberta.ca/documents/WHS/WHS-PUB_ch032.pdf

A Welder's Guide to the Hazards of Welding Gases and Fumes

Welding Services From Vehicles

Section 172 Storage compartments

Subsection 172(1)

The employer must ensure that welding services provided from vehicles comply with CSA Standard W117.2-06, *Safety in Welding, Cutting and Allied Processes*. Readers are referred to section 171.1(1) for a complete explanation of this standard.

Subsection 172(2)

This subsection applies to solid-walled storage compartments in which compressed gas cylinders are stored. If one or more of the external walls (the top and bottom of the compartment are not considered to be walls) of the compartment is made of expanded metal, then the compartment is not considered to be solid-walled and the requirements do not apply. The expanded metal used must be at least 80 percent open space to provide an acceptable level of passive flow-through ventilation. Louvres are not an acceptable alternative to expanded metal as they do not provide the same degree of passive flow-through ventilation.

The design of the compartment must permit passive flow-through ventilation. To do this, vents must provide 0.18 square metres (2 square feet) of free area for every 0.42 cubic metres (15 cubic feet) of compartment volume. The free area of the vents must be divided equally between the top surface and bottom surface of the storage compartment. Additional vents exceeding the specified 2 square feet :15 cubic feet ratio may be added to the storage compartment.

Vents must remain unobstructed under all conditions of use e.g. free of ice and snow build-up during winter operating conditions and free of mud and other debris at all times.

For more information



http://employment.alberta.ca/documents/WHS/WHS-PUB_al026.pdf

Update and Correction of AL025 – Welding Gas Explosion on Service Truck

Subsection 172(3)

The gas cylinder storage compartment must be fabricated and assembled in such a way that gases or vapours arising in the compartment cannot flow to, and accumulate in, adjoining compartments.

Subsection 172(4)

Latching and locking hardware used on compartment doors must be made of non-sparking materials to minimize the possibility of creating a spark.

Electrical components such as wiring harnesses, cables, lights and switches should not be located within gas cylinder storage compartments. However, if present, they must be designed for use in an explosive atmosphere. Products approved as suitable for use in the appropriately classified hazardous location must bear the mark or label of a nationally accredited testing organization such as CSA, ULC, UL, etc.

Subsection 172(5)

No explanation required.

Section 173 Horizontal cylinder storage

Alberta Employment, Immigration and Industry is concerned about the uncontrolled storage of compressed gas cylinders in the horizontal position. Compressed gas cylinders can leak or be damaged in transport. Hazards can be created when a cylinder is subject to impact from a vehicle accident, when a cylinder is not properly secured in a vehicle or when the product being transported is released and exposes workers to hazardous materials.

Issues of particular concern are:

- (a) preventing the cylinder from becoming a horizontal projectile if the valve stem is damaged – the bottom of the cylinder must be in direct contact with a “back stop” strong enough to prevent the cylinder from passing through it. Direct contact prevents the cylinder from accelerating and gaining momentum;

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- (b) scoring of a cylinder during insertion and removal from its horizontal location – this can create weak spots that may result in cylinder failure; and
 - (c) cylinders must not be handled by their valve or valve protection cap – damage to a cylinder’s valve can result in uncontrolled venting of the cylinder contents.

To ensure all these concerns are addressed, a professional engineer must certify horizontal storage compartments on vehicles.

Section 174 Handling cylinders

Subsections (3) and (4) make a distinction between a welding service vehicle being “not in service” versus a welding service vehicle that is “not in use”. Examples of when a welding service vehicle is “not in service” include:

- (a) the vehicle is in a maintenance shop for repairs;
- (b) the vehicle stands idle while the operator is on holidays; and
- (c) the vehicle is being used for purposes other than providing welding services.

When this is the case, the worker must close compressed gas cylinder valves, remove regulators if they are not integral to the cylinder, and put on and secure the valve protection caps or plugs.

Examples of when a welding service vehicle is “not in use” include:

- (a) welding activities are completed for the shift, day, etc. but will soon resume;
- (b) while driving on public or private roads; and
- (c) when the vehicle is parked unattended and at the end of the shift.

When this is the case, the worker must shut off the cylinder valve and release the pressure in the hose(s).