Hazardous Area Classification

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Changes:
Date: June 14, 2004
Details: Added section 3.4 for aboveground tanks and vents.

1.0 Introduction

When processing hazardous chemicals, it is important to be aware of area classifications. Newterra uses the class/division method found in the Canadian Electrical Code (CEC), the National Electrical Code (NEC), and the National Fire Protection Agency (NFPA). Each area, section or room is subject to its own classification.

This report will discuss how to find an area's class, division and group. It will also discuss how to classify areas surrounding Newterra's equipment, as well as how all equipment in hazardous areas needs to be marked. Finally, it will discuss the various protection techniques, wiring methods and sealing methods that need to be observed in hazardous locations.

2.0 Class, Division and Group

Hazardous areas are divided into classes based on the properties of the hazardous substance: (1)

(a) Class 1: Flammable liquids and vapors
(b) Class 11: combustible or electrically conductive dusts
(c) Class 111: easily ignitable fibers or flyings

Due to the nature of Newterra's technology, we deal primarily with Class 1 locations. This report will focus on Class 1 locations.

Class 1 locations are placed into divisions based on the extent of the hazard: (1)

(a) Division 1 is for systems that may have flammable gases or vapors present under normal operation.
(b) Division 2 is for systems in which flammable gases or vapors will only be present due to breakdown or abnormal operation of the equipment.

Newterra manufactures equipment to either Class 1 Div 1 or Class 1 Div 2 standard.

There is one further classification to consider: the Group. An area is grouped according to the particular chemical to be processed. The table on the following page identifies groups with the corresponding chemical.

Table 1.1: Chemicals and Groups (1)

Group	Chemical
A	Acetylene
B	Butadiene, Ethylene Oxide, Hydrogen, Propylene Oxide
C	Acetaldehyde, Cyclopropane, Diethyl Ether, Ethylene, Hydrogen Sulfide Unsymmetrical Dimethyl Hydrazine
D	Acetone, Acrylonitrite, Alcohol, Ammonia, Benzine, Benzol, Butane, Ethylene Dichloride, Gasoline, Hexane, Isoprene, Lacquer solvent vapors, Naphtha Natural gas, Propane, Propylene, Styrene, Vinyl Acetate, Vinyl Chloride Xylenes
E	Metal dust
F	Carbon black, Coal, Coke dust
G	Flour, Starch, Grain dust

Newterra deals with primarily with Group D.

3.0 Hazardous Area

The areas immediately surrounding Newterra's Class 1 systems are also subject to Area classification. The following descriptions and diagrams outline the different standards for systems in Canada and in the US as well as distinguishing between indoor and outdoor skids.

3.1 Class 1 Div 1 skid: (1; 2; 3)

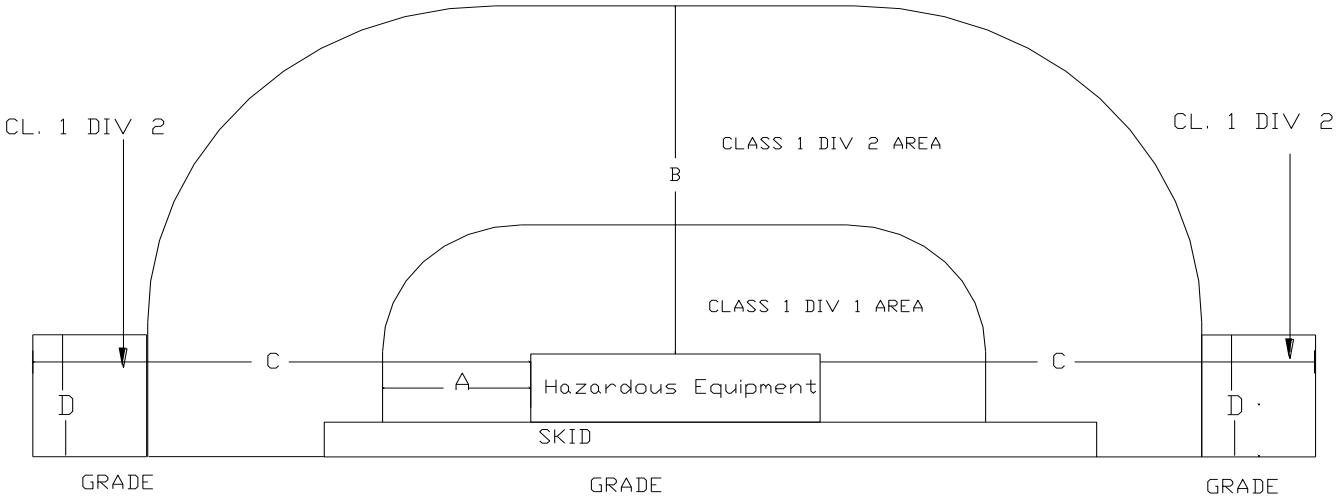
The following diagram illustrates a Class 1 Div 1 skid. The dimensions can be looked up in Table 2 according to the area the skid will be installed. The control panel is always shipped loose in a Class 1 Div 1 skid mounted system. The control panel should be installed outside of the class 1 Area. The panel has to be either further away than dimension C or further than dimension B and above dimension D. The following table and diagram illustrate the extent of the hazardous area around a class 1 div 1 skid.

Table 2: Dimension for a Class 1 Div 1 skid

	A	B	C	D	Relevant code
US Indoor	5 ft	8ft	25 ft	3 ft	NEC Table 515-3, row 1
US Outdoor	3ft	8ft	10ft	3 ft	NEC Table 515-3, row 1
Canada Indoor	5ft	The rest of the enclosure			NFPA Figure 3-8.6

Canada Outdoor	1.5 m	4.5 m			CEC J20-062

Figure 1: Class 1 Div 1 Skid, front view



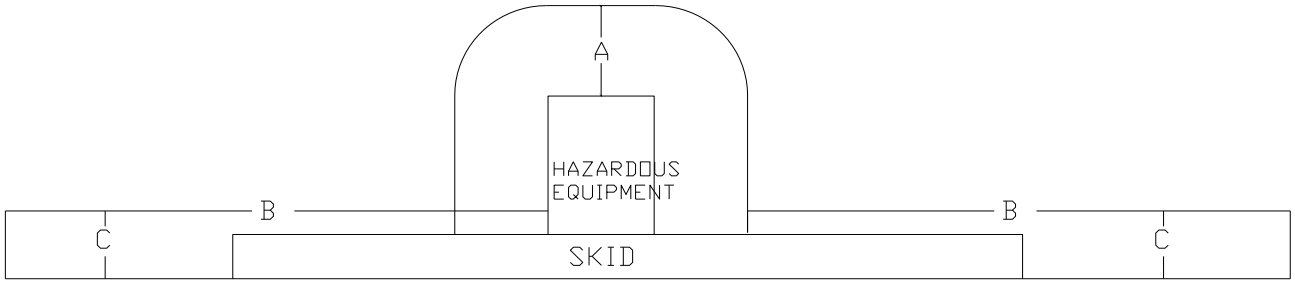
3.2 Class 1 Div 2 Skid (2; 3)

For a Class 1 Div 2 skid, the control panel is usually shipped mounted to the skid but in a non hazardous area. This means that it must be at least the distance of dimension A away from all hazardous equipment and located dimension C above grade or further away than dimension B. The following table and diagram illustrate the extent of the hazardous area around a Class 1 Div 2 skid.

Table 3: Dimension for a Class 1 div 2 skid

	A	B	C	Relevant code
US Indoor	5 ft	25 ft	3 ft	NEC table 514-2, row 7
US Outdoor	3’	10 ft	18”	NEC table 514-2, row 7
Canada Indoor	5 ft	25 ft	3 ft	NFPA Figure 3-8.3
Canada Outdoor	3 ft	10 ft	18 inches	NFPA figure 3-9.1

Figure 2: Class 1 Div 2 Skids



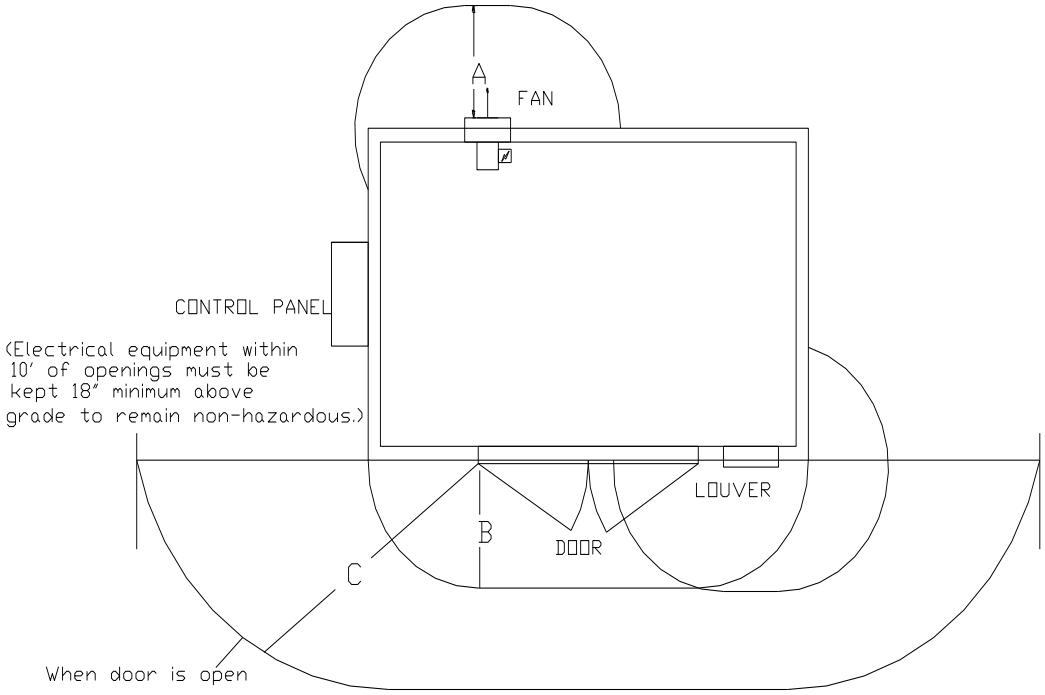
3.3 Class 1 Building: (1; 2)

The area around an opening to a Class 1 building, such as a fan or a door, is subject to Area classification. Newterra uses the code for enclosed spray booths when determining the extent of the hazardous area. The control panel must be mounted outside of the Class 1 Div 2 area.

Special consideration must be given to vents or discharge stacks from processing equipment. Refer to section 3.4.

Figure 3: Plan View of a Remediation Enclosure

	A	B	C	Relevant code
US	3 ft	3 ft	10 ft	NEC 516-2 b (4)
Canada	1m	1.5m	3m	CEC J20-402 (3)

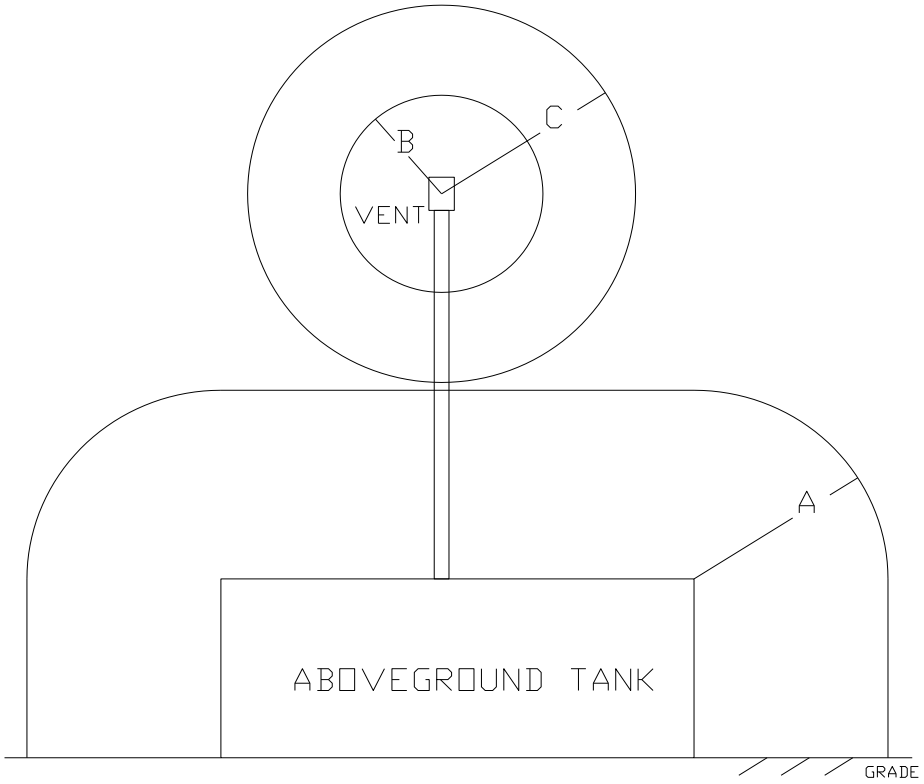

A
FAN
CONTROL PANEL
(Electrical equipment within
10' of openings must be
kept 18" minimum above
grade to remain non-hazardous.)
LOUVER
B
DOOR
C
When door is open

3.4 Class 1 Aboveground Tanks (containing flammable liquids): (1; 2)

The area immediately surrounding a closed tank containing flammable liquids such as gasoline shall be considered a Class 1 Div 2 area as defined by dimension 'A' in the figure below. The area surrounding vents or openings are considered as Class 1 Div 1 within radius 'B', and Class 1 Div 2 between radius 'B' to radius 'C'. Interiors of tanks, piping, and equipment processing flammable vapours is considered Class 1 Div 1.

Figure 3: Profile View of Aboveground Tank

	A	B	C	Relevant code
US	3 m (10ft)	1.5 m (5 ft)	3 m (10ft)	NEC 515-3 (table)
Canada	3 m	1.5 m	3 m	CEC J20-302 (4)



4.0 Marking

All equipment used in hazardous locations must be marked with the Class, the maximum external temperature, and either the Group or the specific chemical.

The CEC defines certain temperature codes that correspond to maximum external temperatures as follows:

Table 2.2: Temperature Codes (1; 2)

Temperature Code	Maximum External Temperature (˚C)
T1	450
T2	300
T2A	280
T2B	260
T2C	230
T2D	215
T3	200
T3A	180
T3B	165
T3C	160
T4	135
T4A	120
T5	100
T6	85

If there is no temperature marking on the equipment, the following maximum temperatures may be used: (1; 2)

Group A- ˚280 C
Group B-˚280 C
Group C- ˚160 C
Group D– ˚215 C

The equipment used in a Class 1 area must have a maximum external temperature that is less than the ignition temperature of the hazardous vapor or liquid being processed. (1; 2)

If there are lights in a Class 1 area they must be clearly marked with the wattage. (1; 2)

5.0 Protection Techniques

There are various techniques that can be utilized to protect equipment used in hazardous areas. The following techniques may be used for equipment in a Class 1 Div 1 area:

1) **Explosion proof Apparatus** (2)**:** Apparatus enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor that may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and that operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby.

2) **Intrinsically Safe** (IS) (2): A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under prescribed test conditions

The above protection techniques may be utilized in a Class 1 Div 2 system, as well as the following protection techniques:

3) **Non- Incendive Circuit** (2): A circuit in which any arc or thermal effect produced, under intended operating equipment or due to opening, shorting or grounding of field wiring, is not capable of igniting the flammable gas-, vapor- or dust- air mixture.

4) **Non incendive equipment** (2): equipment having electric circuitry that is incapable of causing ignition of a specified flammable gas- vapor-dust- air mixture.

5) **Oil immersion** (2): The current make or break contacts are oil-immersed and of the general purpose type having a 2” minimum immersion for power contacts and a 1” minimum immersion for control contacts.

6) **Hermetically Sealed** (2): A hermetically sealed device shall be sealed against the entrance of an external atmosphere and the seal shall be made by fusion, e.g. soldiering or welding. This protection technique shall be permitted for current interrupting contacts in Class 1 Div 2 locations.

6.0 Wiring Methods

Hazardous areas require special wiring methods. The following wiring methods apply to all Class 1 areas.

All wiring in Class 1 areas need to be either in rigid metal conduit, cables approved for hazardous locations or flexible connections. In Class 1 Div 1 systems all flexible connections need to be approved for class 1 locations. Newterra uses braided type flexible connections. (1)

In Class 1 Div 2 systems, liquid tight flexible metal conduit with approved fittings, liquid tight flexible nonmetallic conduit with approved fittings or flexible cord approved for hard usage and provided with approved bushed fittings may be used as flexible connections. (1; 2)

All boxes, fitting and joints are required to be explosion proof and have to be threaded for connection to conduit. They also have to be approved for Class 1 locations. (1; 2)

IS Circuits are an exception to this rule. All enclosures housing an IS circuit may be general purpose. Most switches in Newterra's systems are wired into IS circuits, and therefore may have general-purpose enclosures. (1; 2)

IS circuits may not share conduit with any other non-IS circuit; they must have a separate run of conduit. In addition, all IS circuits must be kept a minimum of 5" from non IS circuits. Newterra installs IS barriers in the top left corner of the panel so that the conduit can enter the panel directly across from the IS barriers. This facilitates keeping the IS circuits away from the non-IS circuits. (1; 2)

7.0 Sealing

Seals are required in hazardous areas to prevent explosive gases from spreading through the conduit to other parts of the system.

Seals are required in each run of conduit that enters a hazardous area. The seal is required to be within 450 mm of the boundary of the hazardous area and there cannot be any junction or fitting between the boundary and the seal. (1; 2)

The sealing compound must be approved for hazardous locations and cannot have a melting point of less than 200 °F. (1; 2)

The exception to this rule is if a run of rigid, unbroken conduit passes completely through a hazardous area with no fittings less than 300 mm away from the hazardous area. In such cases no seals are required. (1; 2)

8.0 Conclusion

It is important to consider Area classification when designing or using equipment with hazardous substances. There are specific standards that must be met. All equipment must be approved for the Class, Division and Group. Hazardous area wiring methods and sealing methods must be taken into account.

Newterra uses the standards outlined in the CEC, the NEC and the NFPA when designing our equipment. Many of these standards were not intended for remediation equipment and leave room for interpretation when applied to our systems.

The information used in this report should be used as a suggestion for dealing with hazardous areas. Newterra does not assume any responsibility for decisions based on the information contained in this report.

By effectively using available guidelines, Newterra is striving to set the standard for the safe use of equipment in hazardous areas.

9.0 References

(1) Canadian Electrical Code, 1998
(2) National Electrical Code, 1999
(3) National Fire Protection Agency, 1997