

# Industry Standards and Definitions

Three popular methods of protection which exist in North America for hazardous electrical locations:

Type of Protection	Method of Protection
1. Explosionproof	Containment
2. Increased Safety	Mechanical
3. Intrinsically Safe	Electrical

## North American Classification System for Hazardous Locations

North American hazardous locations are categorized by three criteria: Class - nature of hazardous substance present; Division - frequency of presence; Group - specific type of hazardous material.

- Class I** Potentially explosive gas or vapor
- Class II** Potentially explosive dust
- Class III** Potentially explosive fiber

- Division 1** Potentially explosive substance present under normal operating conditions
- Division 2** Potentially explosive substance present under abnormal operating conditions

## HAZARDOUS (CLASSIFIED) LOCATIONS or Selected Gases, Vapors and Dusts

<b>Group A - Atmospheres</b> acetylene	ethylenimine ethyl mercaptan ethyl sulfide	ethyl acrylate (inhibited) ethylene diamine (anhydrous) ethylene dichloride ethylene glycol monomethyl ether gasoline heptanes hexanes isoprene isopropyl ether mesityl oxide	propane 1-propanol (propyl alcohol) 2-propanol (isopropyl alcohol) propylene styrene toluene vinyl acetate vinyl chloride xylenes
<b>Group B - Atmospheres</b> acrolein (inhibited) (2) arsine butadiene (1) ethylene oxide (2) hydrogen manufactured gases containing more than 30% H <sub>2</sub> (by volume) propylene oxide (2) propylnitrate	hydrogen cyanide hydrogen sulfide morpholine 2-nitropropane tetrahydrofuran unsymmetrical dimethyl hydrazine	methane (natural gas) methanol (methyl alcohol) 3-methyl-1 butanol (isoamyl alcohol) methyl ethyl ketone methyl isobutyl ketone 2-methyl-1-propanol (isobutyl alcohol) 2-methyl-2-propanol (tertiary butyl alcohol) petroleum naphtha (4) pyridine octanes pentanes 1-pentanol (amyl alcohol)	<b>Group E - Atmospheres</b> containing metal dust, including aluminum, magnesium, and their commercial alloys, and other metals of similarly hazardous characteristics
<b>Group C - Atmospheres</b> acetaldehyde allyl alcohol n-butyraldehyde carbon monoxide crotonaldehyde cyclopropane diethyl ether diethylamine epichlorohydrinn ethylene	<b>Group D - Atmospheres</b> acetic acid (glacial) acetone acrylonitrile ammonia (3) benzene butane 1-butanol (butyl alcohol) 2-butanol (secondary butyl alcohol) n-butyl acetate isobutyl acetate di-isobutylene ethane ethanol (ethyl alcohol) ethyl acetate		<b>Group F - Atmospheres</b> containing carbon black, coal or coke dust  <b>Group G - Atmospheres</b> containing flour, starch or grain dust  <b>Note:</b> Carbon disulfide must be treated in a special manner.

**Example:** An area where hydrogen was present under normal operating conditions would require a product suitable for Class I, Division 1, Group B applications.

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	<b>NEMA Designation</b>	<b>Underwriters Laboratories Inc. UL 50 and UL 508</b>	<b>Canadian Standards Association CSA Standard C22.2 No 94</b>
<b>Type 1</b>	Indoor use to provide a degree of protection against contact with the enclosed equipment; in locations where unusual service conditions do not exist	Indoor use to provide a degree of protection against contact with the enclosed equipment and against a limited amount of falling dirt	General purpose enclosure; protects against accidental contact with live parts
<b>Type 2</b>	Indoor use to provide a degree of protection against contact with the enclosed equipment and against limited amounts of falling water and dirt	Indoor use to provide a degree of protection against limited amounts of falling water and dirt	Drip proof enclosure same as Type 1; indoor use to provide a degree of protection against dripping and light splashing of non-corrosive liquids and falling dirt
<b>Type 3</b>	Indoor or outdoor use to provide a degree of protection against windblown dust, rain and sleet; undamaged by the formation of ice on the enclosure (not sleet proof)	Indoor or outdoor use to provide a degree of protection against windblown dust, rain and sleet; undamaged by the formation of ice on the enclosure	Weatherproof enclosure; indoor or outdoor use to provide a degree of protection against rain, snow and blown dust; undamaged by the external formation of ice on the enclosure
<b>Type 3R</b>	Indoor or outdoor use to provide a degree of protection against falling rain and sleet; undamaged by the formation of ice on the enclosure	Indoor or outdoor use to provide a degree of protection against falling rain and sleet; undamaged by the formation of ice on the enclosure	Weather proof enclosure; indoor or outdoor use to provide a degree of protection against rain or snow; undamaged by the external formation of ice on the enclosure (CSA does not specify sleet resist)
<b>Type 3S</b>	Indoor or outdoor use to provide a degree of protection against windblown dust, rain and sleet; provides for operation of external mechanisms when ice laden	Indoor or outdoor use to provide a degree of protection against windblown dust, rain and sleet; external mechanisms remain operable while ice laden	Weather proof enclosure; indoor or outdoor use to provide a degree of protection against rain or snow; undamaged by the external formation of ice on the enclosure surface (CSA does not specify sleet proof)
<b>Type 4</b>	Indoor or outdoor use to protect the enclosed equipment against splashing water, seepage of water, falling or hose-directed water, and severe external condensation; these enclosures are sleet resistant but not sleet proof	Indoor or outdoor use to provide a degree of protection against splashing water, windblown dust and rain, and hose directed water; undamaged by the formation of ice on the enclosure	Watertight enclosure; indoor or outdoor use to provide a degree of protection against rain, snow, blown dust, splashing and hose directed water; undamaged by the external formation of ice on the enclosure
<b>Type 4X</b>	Indoor or outdoor use to provide a degree of protection against corrosion, windblown dust and rain, splashing water, and hose-directed water; undamaged by the formation of ice on the enclosure	Indoor or outdoor use to provide a degree of protection against splashing water, windblown dust and rain, and hose directed water; undamaged by the formation of ice on the enclosure; resists corrosion	Watertight enclosure; indoor or outdoor use to provide a degree of protection against rain, snow, blown dust, splashing and hose directed water; undamaged by the external formation of ice on the enclosure; resists corrosion
<b>Type 5</b>	Indoor use to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids	Not typically used by UL.	Indoor use, so constructed that dust, readily ignitable fibers or combustible flyings cannot enter the enclosure

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<b>NEMA Designation</b>	<b>Underwriters Laboratories Inc. UL 50 and UL 508</b>	<b>Canadian Standards Association CSA Standard C22.2 No 94</b>
<b>Type 6</b> Indoor or outdoor use to provide a degree of protection against the entry of water during occasional temporary submersion at a limited depth	Indoor or outdoor use to provide a degree of protection against the entry of water during temporary submersion at a limited depth; undamaged by the formation of ice on the enclosure	No CSA equivalent
<b>Type 6P</b> Indoor or outdoor use to provide a degree of protection against the entry of water during prolonged submersion at a limited depth	Indoor or outdoor use to provide a degree of protection against the entry of water during prolonged submersion at a limited depth	No CSA equivalent
<b>Type 7</b> For use in indoor locations classified as Class I, Groups A, B, C and D, as defined in the National Electrical Code	Not typically used by UL	Similar to NEMA designation; refer to Canadian Electric Code C22.1 Sec. 18 (C22.2 No. 30)
<b>Type 8</b> For use in indoor or outdoor locations classified as Class I, Groups A, B, C and D, as defined in the National Electrical Code – oil immersed	Not typically used by UL	Similar to NEMA designation; refer to Canadian Electric Code C22.1 Sec. 18 (C22.2 No. 30)
<b>Type 9</b> For use in indoor locations classified as Class II, Groups E, F and G, as defined in the National Electrical Code	Not typically used by UL	Similar to NEMA designation dust tight (hazardous dust); refer to Canadian Electric Code C22.2 No. 25
<b>Type 10</b> Mining enforcement safety administration approved	Not typically used by UL	No CSA equivalent specified for industrial control applications (See C22.5 for use of electricity in mines)
<b>Type 11</b> Indoor use to provide, by oil immersion, a degree of protection to enclosed equipment against corrosive effects of liquids and gases	Indoor use to provide, by oil immersion, a degree of protection of the enclosed equipment against corrosive effects of corrosive liquids and gases	No CSA equivalent; similar to Type 4
<b>Type 12</b> Indoor use to provide a degree of protection against dust, falling dirt and dripping non-corrosive liquids No knockouts	Indoor use to provide a degree of protection against dust, falling dirt and dripping non-corrosive liquids No knockouts	Indoor use to provide a degree of protection against circulating dust, lint, fibers, dripping and light splashes of non-corrosive liquids
<b>Type 12K</b> Indoor enclosure with knockouts to provide a degree of protection against dust, falling dirt and dripping non-corrosive liquids other than at knockouts	Indoor use to provide a degree of protection against dust, falling dirt, and dripping non-corrosive liquids With knockouts	No CSA equivalent
<b>Type 13</b> Indoor use to provide a degree of protection against lint, dust, seepage, external condensation and spraying of water, oil and non-corrosive coolant	Indoor use to provide a degree of protection against dust and spraying of water, oil and non-corrosive coolants	Indoor use to provide a degree of protection against circulating dust, lint, fibers, seepage and spraying of non-corrosive liquids including oils and coolants

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### EUROPEAN STANDARDS

Type of Protection	Method of Protection	CENELEC Designation
Flameproof Enclosure	Containment	'd'
Increased Safety	Mechanical	'e'
Intrinsically Safe	Electrical	'i'

These designations are typically preceded by EEx, the designation indicating an apparatus built to a European standard.

#### European Classification of Hazardous Locations

<b>Zone 0</b>	Explosive gas present continuously
<b>Zone 1</b>	Explosive gas present occasionally under normal operating conditions
<b>Zone 2</b>	Explosive gas present for short period
<b>Zone 20</b>	Explosive dust present continuously
<b>Zone 21</b>	Explosive dust present occasionally under normal operating conditions
<b>Zone 22</b>	Explosive dust present for short period

#### Explosion Groups

Group I	Electrical equipment for mining applications
Group II	Electrical equipment for all remaining hazardous areas

Ingress Protection (IP rating) defines the degree of protection

#### Scope of Protection for the IP protection classes

Digit	Physical protection	First Digit Foreign body protection	Digit	Second digit Water protection
0	No protection	No protection	0	No protection
1	Protection against back of hand contact	Protection against solid foreign bodies 50 mm diameter	1	Protection against water drops falling vertically
2	Protection against finger contact	Protection against solid foreign bodies 12.5 mm diameter	2	Protection against water drops falling at an angle (15°)
3	Protection against contact from tools	Protection against solid foreign bodies 2.5 mm diameter	3	Protection against water-spray at an angle up to 60°
4	Protection against contact with a wire	Protection against solid foreign bodies 1.0 mm diameter	4	Protection against water-spray from all directions
5	Protection against contact with a wire	Protection against dust	5	Protection against water jets
6	Protection against contact with a wire	Dust-tight	6	Protection against strong water jets
7			7	Protection against intermittent immersion in water
8			8	Protection against continuous immersion in water

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### CLASSIFICATION BY GROUP AND CATEGORY ACCORDING TO INTENDED USE (Surface Industry)

Area	Category of Equipment	Presence or Duration of Explosive Atmosphere	Inflammable Substances	Level of Protection Faults to Allow for	Comparison with Present Practice
Equipment Group II (surface)	1	Continuous Presence Long Periods Frequent	Gas, Vapors, Mist, Dust	<b>Very High Level of Protection</b> 2 types of protection or 2 Independent faults	Group II <b>Zone 0</b> (gas) Zone 20 (dust)
	2	Likely to Occur	Gas, Vapors, Mist, Dust	<b>High Level of Protection</b> 1 Type of Protection Habitual frequent malfunction	Group II <b>Zone 1</b> (gas) Zone 21 (dust)
	3	Unlikely to Occur Present for a Short Period	Gas, Vapors, Mist, Dust	<b>Normal Protection</b> Required Level of Protection	Group II <b>Zone 2</b> (gas) Zone 22 (dust)

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## TEMPERATURE RATING

The maximum surface temperature of the exposed surface of electrical apparatus must always be lower than the ignition temperature of the gas or vapor mixture.

Temperature Class	Maximum Surface Temperature	Ignition Temperature of Combustible Material
T1	450 C	>450 C
T2	300 C	>300 C
T3	200 C	>200 C
T4	135 C	>135 C
T5	100 C	>100 C
T6	85 C	>85 C

### Safety characteristics of flammable gases and vapors

Medium	Ignition temperature °C	Temperature class	Explosion group
Acetaldehyde	140	T 4	II A
Acetic acid	485	T 1	II A
Acetic anhydride	330	T 2	II A
Acetone	540	T 1	II A
Acetylene	305	T 2	II C
Ammonia	630	T 1	II A
Amylacetate	380	T 2	II A
Benzene	220	T 3	II A
Benzol	555	T 1	II A
Carbon disulfide	95	T 6	II C
Carbon monoxide	605	T 1	II A
Cyclohexene	430	T 2	II A
1,2-Dichlorethane	440	T 2	II A
Diesel fuel	220 up to 300	T 3	II A
Ethane	515	T 1	II A
Ethylacetate	460	T 1	II A
Ethylalcohol	425	T 2	II B
Ethylchloride	510	T 1	II A
Ethylene	425	T 2	II B
Ethylenoxide	440	T 2	II B
Ethylether	180	T 4	II B
Ethyl glycol	235	T 3	
Fuel oil	220 up to 300	T 3	II A
Hydrogen	560	T 1	II C
Hydrogen disulfide	270	T 3	II B
Methane	595 (650)	T 1	II A
Methanol	455	T 1	II A
Methyl chloride	625	T 1	II A
n-Butane	365	T 2	II A
n-Butylalcohol	340	T 2	II A
n-Hexane	240	T 3	II A
n-Propylalcohol	405	T 2	
Naphthaline	520	T 1	II A
Oleic acid	360	T 2	
Phenol	595	T 1	II A
Propane	470	T 1	II A
Tetraline	425	T 2	
Toluole	535	T 1	II A

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