Use of Electric Heaters
In Hazardous Locations

Introduction

Hazardous locations are those areas where a potential for explosion and fire exists due to the presence of flammable gases, vapors, pulverized dusts or ignitable fibers in the atmosphere. Hazardous locations are created from the normal processing of volatile chemicals, gases, coal, grains, etc., or from the accidental failure of storage systems for these materials.

Open flames are not permitted in these locations. The use of electric heating equipment is permitted with two major restrictions: 1) The surface temperature of the equipment cannot exceed the ignition temperature of the hazardous atmosphere and 2) all arc and spark producing devices must be isolated from the atmosphere in an appropriate enclosure.

National Electrical Code Classification

Articles 500 through 516 of the National Electrical Code deal with the definition of hazardous areas and the use or design of electrical equipment used in these locations. Electric heating equipment for hazardous areas is specified based on the NEC class, division, group and ignition temperature or the alternate class and zone classification.

Class

Hazardous locations are divided into the three general classes of vapors/gases, dusts and fibers.

Class I – Locations where the potential for explosion and fire exists due to the presence of flammable gases or vapors in the air. Typical Class I locations include oil or natural gas drilling rigs, petroleum refining or pumping facilities, petrochemical plants, wastewater/sewage treatment plants, solvent extraction plants, paint spraying booths, locations where open tanks or vats of combustible liquids are present and storage areas for flammable materials.

Class II – Locations where the potential for explosion exists because of finely pulverized flammable dusts suspended in the atmosphere. Typical locations would include coal fired power plants, coal preparation/coal handling facilities, coal mines, grain elevators, flour and feed mills, packaging and handling of pulverized sugar and processing and storage of magnesium and aluminum powder.

Class III – This third classification is primarily a fire hazard where fibers or flyings suspended in the air create a hazard. This would include small pieces of thread-like fiber, sawdust, lint, etc. Typical applications would include textile mills, woodworking plants, cotton gins, cotton seed mills and flax producing plants.

Division

Class I, Class II and Class III areas are further defined in terms of when the hazard occurs. Division 1 and Division 2 occurrences are summarized below.

Division 1 – If the hazard is expected to be present under normal conditions, such as a production or processing facility, the occurrence is designated Division 1. The hazardous atmosphere may be present continuously, intermittently, periodically, or during normal repair or maintenance operations. Division 1 occurrences also include locations where a breakdown in the operation of processing equipment results in the release of hazardous vapors.

Division 2 – If the hazardous material is normally expected to be contained within a closed area, system or container, and would enter the ambient atmosphere only under an abnormal failure, then it is referred to as a Division 2 occurrence.

Hazardous and Corrosive Area Applications

- Aircraft Hangars/Service Areas
- Battery Storage Areas
- Chemical Plants
- Chemical Storage/Handling Areas
- Coal Mines/Preparation Plants
- Control Rooms
- Dry Cleaning Plants
- Dusty Areas Subject to Washdown
- Food Processing Plants (Washdown Areas)
- Foundries
- Gasoline Fueling/Storage Areas
- Grain Elevators
- Hydrogen Atmospheres
- Marine/Shipboard and Landbase Facilities
- Natural Gas (Methane) Atmospheres
- Oil Refineries
- Offshore Drilling Rigs
- Paint Spraying/Storage Areas
- Parking Garages
- Petrochemical Plants
- Pipeline Pumping Stations
- Pulp and Paper Mills
- Sewage/Wastewater Treatment Plants
- Solvent Recovery/Storage Areas
- Utility Plants

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Group

The nature and explosive characteristics of the hazardous material are defined by the NEC group to which it is assigned.

Class I – Hazardous vapors/gas locations include chemicals and other materials that have been divided into four groups based on their ignition temperature and explosive characteristics. (Groups A, B, C and D)

Class II – Hazardous dust locations are divided into three groups based on their ignition temperature and electrical conductivity of the suspended particles.

Group E – Atmospheres containing metal dust, such as aluminum or magnesium.

Group F – Atmospheres containing coal, charcoal or coke dust.

Group G – Atmospheres with grain, flour, starch, combustible plastics or chemical dust.

Class III – Locations have no group definitions.

Ignition Temperature

All electrical equipment is designed not to exceed the ignition temperature of the hazardous atmosphere. The maximum surface temperature for electric heaters is defined by the NEC.

Class and Zone Classifications

Class I, Zone 0 – Locations in which ignitable concentrations of flammable gases or vapors are present continuously or for long periods.

Class I, Zone 1 – Locations in which ignitable concentrations of flammable gases or vapors are likely to exist, may exist frequently or exist as a result of equipment breakdown or faulty operation. Applies to locations adjacent to a Class I, Zone 0 location.

Class I, Zone 2 – Locations in which ignitable concentrations of flammable gases or vapors are not likely to occur under normal operation, exist only for a short period or exist only as a result of accidental failure, such as rupture or breakdown of the container or system, abnormal operation of equipment, failure or abnormal operation of the ventilation equipment. Applies to locations adjacent to a Class I, Zone 1 location.

Material Groups

Group IIC – Atmospheres containing acetylene or hydrogen. Equivalent to a combination of Class I, Group A and Class I, Group B as described in NEC Article 500.

Group IIB – Atmospheres containing acetaldehyde. Equivalent to Class I, Group C as described in NEC Article 500.

Group IIA – Atmospheres containing acetone, ammonia, ethyl alcohol, gasoline, methane or propane. Equivalent to Class I, Group D as described in NEC Article 500.

Product use depends on temperature class. The temperature code indicates the maximum temperature of the exposed surface of the product. For Zone classified dusts the explosion-proof temperature is the maximum surface temperature is shown as e.g. T80ºC

Class, Division Classification		Zone Classification	
Temperature Class (T Code)	Maximum Surface Temperature ºF (ºC)	Temperature Class (T Code)	Maximum Surface Temperature ºC
T1	≤ 842 (≤ 450)	T1	≤ 450
T2	≤ 572 (≤ 300)	T2	≤ 300
T2A	≤ 536 (≤ 280)	T3	≤ 200
T2B	≤ 500 (≤ 260)	T4	≤ 135
T2C	≤ 446 (≤ 230)	T5	≤ 100
T2D	≤ 419 (≤ 215)	T6	≤ 85
T3	≤ 392 (≤ 200)		
T3A	≤ 356 (≤ 180)		
T3B	≤ 329 (≤165)		
T3C	≤ 320 (≤ 160)		
T4	≤ 275 (≤135)		
T4A	≤ 248 (≤ 120)		
T5	≤ 212 (≤100)		
T6	≤ 185 (≤ 85)		

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Special Requirements for Electric Heating Equipment used in Hazardous Areas

Electric heating equipment can be economically designed and safely used in hazardous areas if the following special requirements are observed.

1. The surface temperature of the electric heating equipment cannot exceed the ignition temperature of the hazardous atmosphere. To insure that the proper heater has been selected, it is essential that the correct NEC Ignition Temperature Code be specified.

   If the temperature code selected is too high, the electric heating system may operate above the ignition point of the application, creating a potentially hazardous condition.

2. All arc and spark-producing control devices must be isolated from the hazardous atmosphere. If it is not economically feasible to locate the control devices in the non-hazardous area, they must be housed in an enclosure that will withstand the pressure of a potential explosion from within the enclosure.
3. All electrical supply connections must be made according to the latest NEC and local code requirements for hazardous locations. This includes the requirement that conduit entering the enclosures must be provided with seals at the enclosure.

CLASS I - HAZARDOUS GAS ATMOSPHERES

Group	Material	Ignition Temp. °F	Ignition Temp. °C	NEC Code
A	Acetylene	581	305	T2
B	Acrolein (Inhibited)	428	220	T2D
	Butadiene	788	420	T2
	Ethylene Oxide	804	429	T2
	Hydrogen	932	500	T1
	Propylene Oxide	840	449	T2
	Propyl Nitrate	347	175	T3B
C	Acetaldehyde	347	175	T3B
	Allyl Alcohol	713	378	T2
	Carbon Monoxide	1128	609	T1
	Cyclopropane	928	498	T1
	Ethylene	842	450	T1
	Hydrogen Cyanide	1000	538	T1
	Hydrogen Sulfide	500	260	T2B
	2-Nitropropane	802	428	T2
	Tetrahydrofuran	610	321	T2
D	Acetic Acid (Glacia)	867	463	T1
	Acetone	869	465	T1
	Ammonia, Anhydrous	1204	651	T1
	Benzene	928	498	T1
	Butane	550	287	T2A
	1-Butanol (Butyl Alcohol)	650	343	T2
	2-Butanol (Secondary Butyl Alcohol)	761	405	T2
	Ethane	882	472	T1
	Ethanol (Ethyl Alcohol)	685	363	T2
	Ethyl Acetate	800	427	T2
	Ethylene Dichloride	775	413	T2
	Gasoline (56-60 Octane)	536	280	T2A
	Gasoline (100 Octane)	853	456	T1
	Heptanes	399	204	T3
	Hexanes	437	235	T2D
	Isoprene	428	220	T2D
	Isopropyl Ether	830	443	T2
	Methane (Natural Gas)	900-1170	482-632	T1
	Methanol (Methyl Alcohol)	867	454	T1
	3-Methyl-1-Butanol (Isoamyl Alcohol)	662	350	T2
	Methyl Ethyl Ketone	759	404	T2

CLASS I - HAZARDOUS GAS ATMOSPHERES

Group	Material	Ignition Temp. °F	Ignition Temp. °C	NEC Code
D	Methyl Isobutyl Ketone	840	448	T2
	2-Methyl-1-Propanol (Isobutyl Alcohol)	780	415	T2
	Petroleum Naptha	550	288	T2A
	Pyridine	900	482	T1
	Octanes	403	206	T3
	Pentanes	500	260	T2B
	1-Pentanol (Amyl Alchohol)	650	343	T2
	Propane	842	450	T1
	1-Propanol (Propyl Alchohol)	775	412	T2
	2-Propanol (Isopropyl Alcohol)	750	399	T2
	Propylene	851	455	T1
	Styrene	914	490	T1
	Toluene	896	480	T1
	Vinyl Acetate	756	402	T2
	Vinyl Chloride	882	472	T1
	Xylenes	867-984	463-528	T1

CLASS II - HAZARDOUS DUST ATMOSPHERES

Group	Material	Ignition Temp. °F	Ignition Temp. °C	NEC Code
E	Aluminum, A422 Flake	608	320	T2
	Calcium Silicide	1004	540	T1
	Manganese	464	240	T2C
	Magnesium, Grade B, Milled	806	430	T2
F	Charcoal	356	180	T3A
	Coal, Kentucky Bituminous	356	180	T3A
	Coal, Pittsburgh Experimental	338	170	T3B
	Pitch, Petroleum	1166	630	T1
G	Alkyl Ketone Dimer Sizing Compound	320	160	T3C
	Corn	482	250	T2C
	Corn Starch, Modified	392	200	T3
	Polyurethane Foam, Fire Retardant	734	390	T2
	Shellac	752	400	T2
	Soy Flour	374	190	T3A
	Sugar, Powdered	698	370	T2
	Sulfur	428	220	T2D
	Wheat	428	220	T2D
	Wood Flour	500	260	T2B

The materials given are found in NFPA 497, 1991 and NFPA 325, 2001.