Overview of Hazardous Locations/Explosive Atmospheres

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Hazardous Location

- What is a Hazardous Location?
- What are the causes of explosions?
- Typical ignition sources
- Understanding Certifications
- Classes versus Zones

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What is a Hazardous Location and what customers would need it.

- A Hazardous Location environment is commonly referred to as HAZLOC area

- Gas, vapors, liquids, dusts or small fibers may contain a potentially explosive atmosphere.

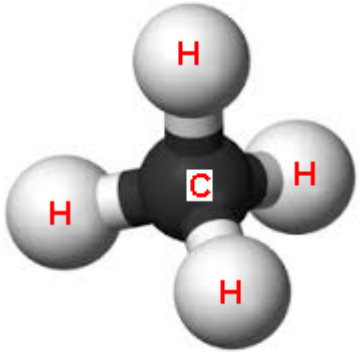
- Any industry that processes,

Typical Customers and Industries

Such industries/processes include:

Flammable Gases, Vapors or Liquids

- Automotive manufacturing and refueling stations
- Aviation, refueling and hangars
- Chemical processing plants
- Distilleries
- Gas pipelines and distribution centers
- Oil and Gas refineries, off-shore platform rigs
- Military
- Painting
- Petrochemical refining, processing and storage
- Pharmaceutical manufactures
- Power Generation plants
- Surface coating industries
- Waste treatment, sewerage plants



Combustible Dust, Fibers and Flyings

- Coal mining
- Food manufacturers
- Grain handling and storage

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How does an explosion occur?

- To create an explosion there has to be three elements present.
  - Fuel (explosive gas/vapors or fibers)
  - Oxidizer (e.g., the oxygen in air)
  - Source of ignition energy (a hot surface or electrical spark)

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Fuel Sources

- Fuel Sources
  - Gas (Hydrocarbon Gases)
  - Vapor (Hydrocarbon Gases)
  - Dust (Coal, Corn, Aspirin)
  - Fibers (Animal, Natural, and Synthetic)
- Gas and vapor are commonly used interchangeably.
  - Gas is the natural state of matter
  - Vapor is not the natural state of matter.
- Water is liquid in it's natural state of matter at room temperature. When heated, it becomes a gas and is referred to as water vapor.

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Dust and Fibers

- **Employee deaths, injuries, and destruction of entire buildings.**
  - U.S. Chemical Safety and Hazard Investigation Board identified 281 combustible dust incidents from 1980 to 2005 killing 119 workers, injured 718
  - 14 workers were killed in a 2008 sugar dust explosion in Georgia.

  - 3 workers were killed in a 2010 titanium dust explosion in W. Virginia
- **Any combustible material can burn rapidly when in a finely divided form.**
  - If such a dust is suspended in air in the right concentration, under certain conditions, it can become explosive.

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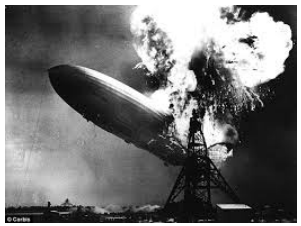
Potential Ignition Sources

- Open Flames



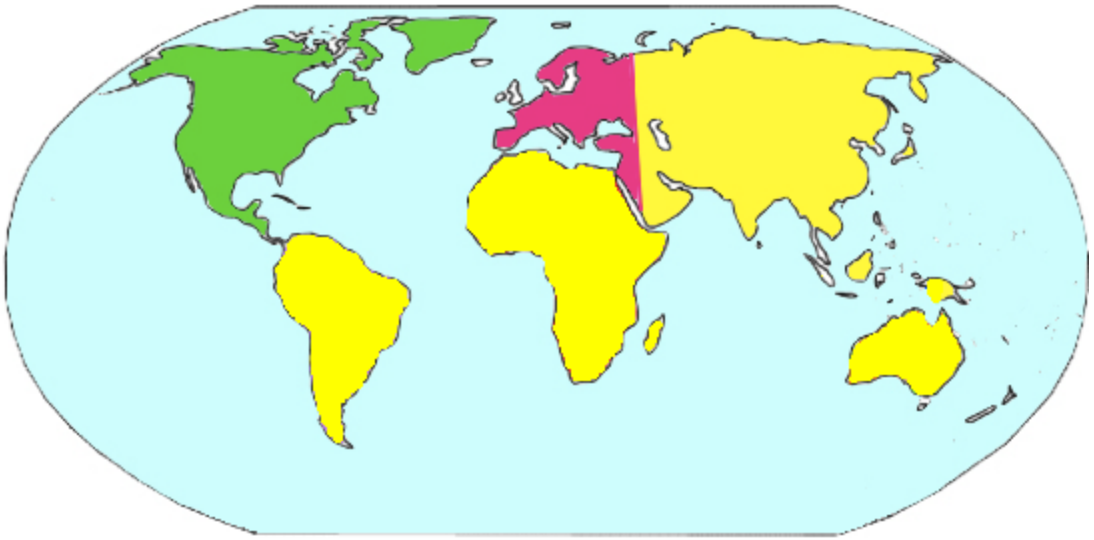
- Static/Lightning
- Stray electric currents

- Extreme surface temperatures

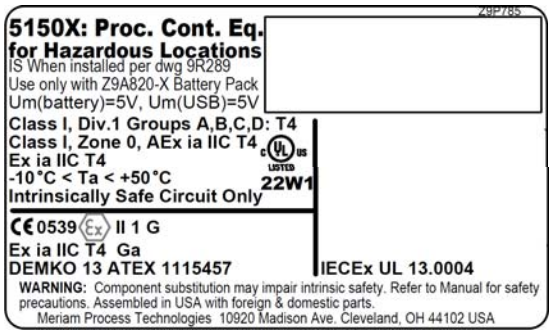
- Mechanically generated sparks

Understanding Certifications

- IECEx
- North America
- ATEX



- Markings
  - Groups
  - Category
  - Zone Definitions
  - Type of Protection
  - Gas Groups
  - Max Surface Temp



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Protection Schemes and NRTL

What certification does the customer need?

- International IEC (International Electrotechnical Commission)
  - IECEx (Explosive) IEC60079-0,-11,-26
- Europe CENELEC (European Committee for Electrotechnical Standardization)
  - ATEX (***AT****mosphères* ***Ex****plosives*) EN60079-0,-11,-26
    - Sira, Baseefa, Lloyd's, TUV, UL/Demko, FM

- North America ANSI-ISA/NEC-NFPA70 (American National Standards Institute), (International Society of Automation), (National Electric Code), (National Fire Protection Association), (Canadian Electrical Code)
  - ***UL, CSA, FM,*** MET, Intertek (ISA12.02.01) (NEC 500, 506)
    - US: UL913 --> UL60079-0,-11,-26
    - US: FM3610
    - NEC 500, 506
    - Canada: CSA 22.2 No. 157 (Canadian Standards Association)
    - CEC 18, 20 and 22

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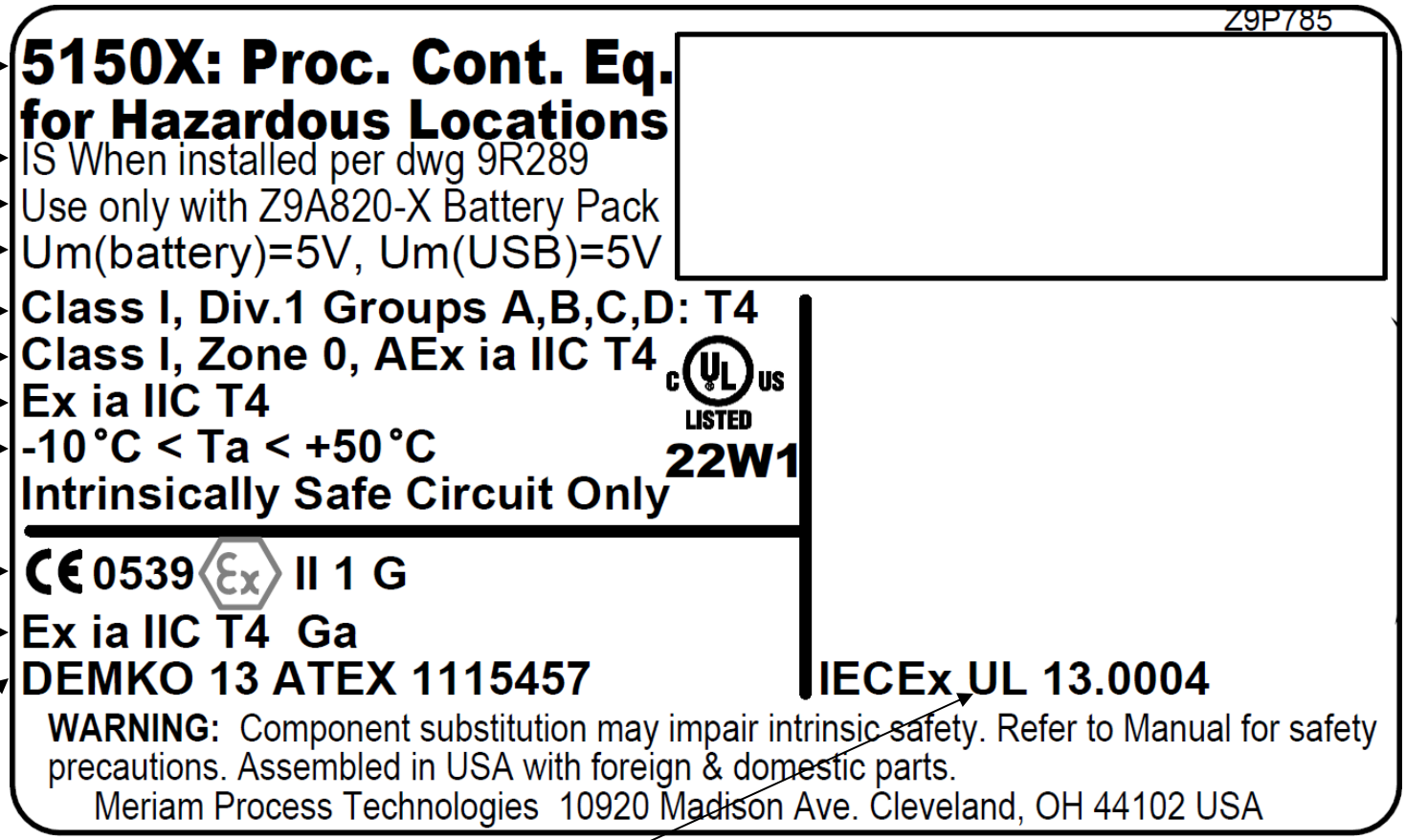
Reading a Product Marking/Label



ATEX File #
DEMKO=Agency
13=2013
ATEX 1115457=
UL Project #

IECEx File #
UL=Agency
13=2013
0004= 4th Project

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US ANSI/NEC500

Product Markings Class/Division

Hazard Class: **I**
Flammable Gases, Vapors or Liquids

Gas Groups: **A,B,C,D** (Class 1)
A: Acetylene
B: Hydrogen
C: Ethylene
D: Propane

Class I, Div. I, Groups A,B,C,D: T4

Area Classification: **I**
Hazard area all the time

Surface Temp Code: **T4**
135 Deg C

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Class and Division Definitions

Class I, Div. 1, Groups A,B,C,D: T4

- Locations shall be classified depending on the properties of the media in the air and likelihood that a flammable or combustible concentration is present.

Class I –Where flammable gas or vapor are or may be present in quantities sufficient to produce explosive or ignitable mixtures

Class II – Hazardous due to the presence of combustible dust in the air.

Class III – Hazardous due to the presence of easily ignitable fibers in the air, but quantities suspended sufficient in the air to produce ignitable mixtures

Division 1 - There may be an ignitable concentrations of flammable gases or vapors in normal operation.

- Frequently flammable vapors can be above flash points and exist due to maintenance of equip
- If equipment breaks it can release flammable gases/vapors or if electrical equip can ignite

Division 2 – Where flammable gas or vapor may be present due to an accidental rupture of container, failure of ventilation equipment or very uncommon incident.

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Gas Groups

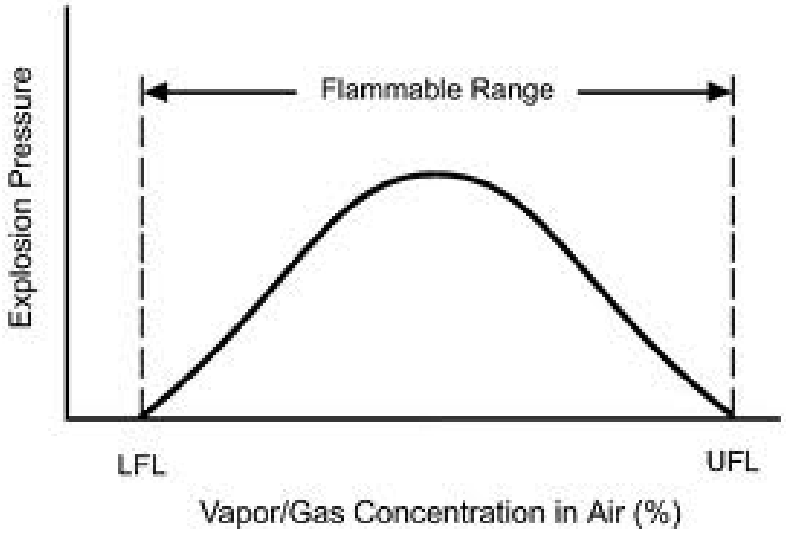
Class I, Div. 1, Groups A,B,C,D: T4

- Divisions 1, 2
  - Acetylene (A)
  - Hydrogen (B)
  - Ethylene (C)
  - Propane (D)
- Zones 0, 1, 2
  - Acetylene (IIC)
  - Hydrogen (IIC)
  - Ethylene (IIB)
  - Propane (IIA)

Fuel Properties of Gas

Class I, Div. 1, Groups A,B,C,D: T4

- Flammable Limits
  - Upper and Lower Concentration Limits
    - Propane (2-10%)
    - Ethylene (3-36%)
    - Hydrogen (4-75%)
    - Acetylene (3-82%)



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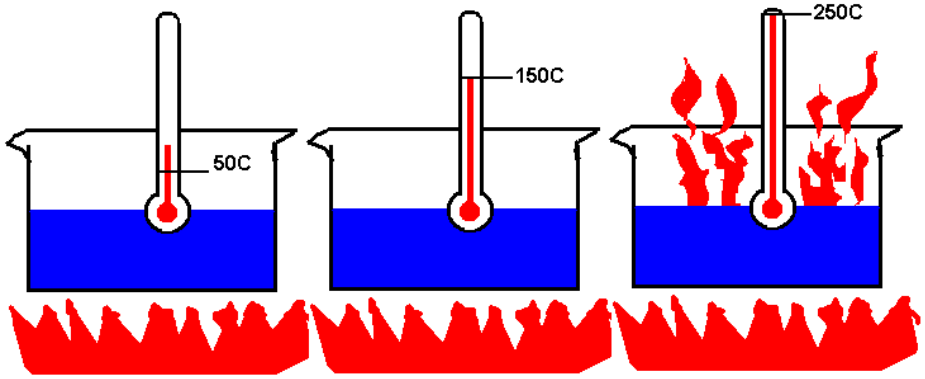
Fuel Properties of Gas

Class I, Div. 1, Groups A,B,C,D: T4

- Flammable Limits
  - Auto Ignition Temperature (AIT)

    from the MSDS Sheet
    - Propane (480 Deg C)
    - Ethylene (490 deg C)
    - Hydrogen (500 Deg C)
    - Acetylene (581 Deg C)
    - Diesel Fuel (210 Deg C)



- The energy required to ignite the flammable vapors decreases the closer you get to the AIT.
- Flash point is not to be confused with the AIT which does not require an ignition source, the temperature at which the vapor continues to burn after being ignited. Neither the flash point is dependent on the temperature of the ignition source, which is much higher.

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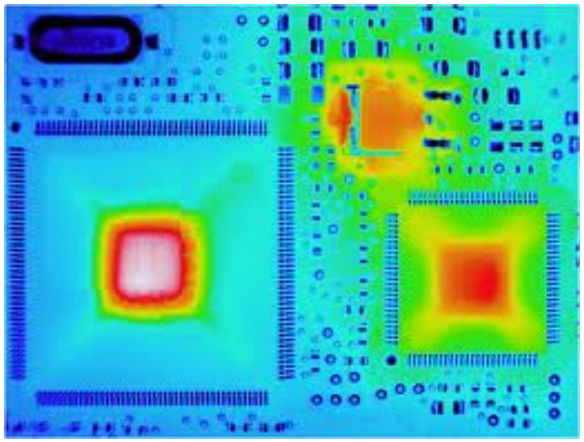
Temperature Classification

Class I, Div. 1, Groups A,B,C,D: T4

- Equipment is identified with a temperature class
- Either identified by a ‘T’ rating or by a temperature in degrees C.
- The temperature class identifies the hottest surface temperature of any component within the equipment can

Temperature Code & Temperature Class

Maximum Surface Temperature (°C)	US (NEC) Canada (CEC)	US (NEC) Canada (CEC) IEC, CENELEC
450	T1	T1
300	T2	T2
280	T2A	—
260	T2B	—
230	T2C	—
215	T2D	—
200	T3	T3
180	T3A	—
165	T3B	—
160	T3C	—
135	T4	T4
120	T4A	—
100	T5	T5
85	T6	T6



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US ANSI/NEC505

Product Markings Zones

Hazard Class: **I**
Flammable Gases, Vapors or Liquids

Conforms to US Standards: **A**
America

Type of Protection: **ia**
Intrinsic Safety

Surface Temp Code: **T4**
135 Deg C

Class I, Zone 0, AEx ia IIC T4

Area Classification: **0**
Zone 0, Hazard always present

Ex:
Explosion Protected

Gas Groups: **IIC**
Acetylene
Hydrogen
Ethylene
Propane

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Canada ANSI/CEC20

Product Markings Zones

Type of Protection: **ia Intrinsic Safety**

Surface Temp Code: **T4 135 Deg C**

Ex ia IIC T4

Ex: Explosion Protected

Gas Groups: **IIC**
Acetylene
Hydrogen
Ethylene
Propane

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Class and Zone Definitions

Class I, Zone 0, AEx ia IIC T4

- Locations shall be classified depending on the properties of the media in the air and likelihood that a flammable or combustible concentration is present.
  - **Class I** –Where flammable gas or vapor are or may be present in quantities sufficient to produce explosive or ignitable mixtures
  - **Class II** – Hazardous due to the presence of combustible dust in the air.
  - **Class III** – Hazardous due to the presence of easily ignitable fibers in the air, but quantities suspended sufficient in the air to produce ignitable mixtures
  - **Zone 0 -** An area in which an explosive mixture is continuously present or present for long periods of time.
    - Explosive atmosphere for more than 1000 hours/year
  - **Zone 1** –An area in which an explosive mixture is likely to occur in normal operation.
    - Explosive atmosphere for more than 10, but less than 1000 hours/year
  - **Zone 2** – An area in which an explosive mixture is not likely to occur in normal operation and if it occurs it will exist only for a short time.
    - Explosive atmosphere for less than 10 hours/year but still possible

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Protection Methods Ex”__“

Class I, Zone 0, AEx ia IIC T4

- Flameproof **–d** Contains Explosion (Zone 1)
  - Motors, lighting, junction boxes, electronics

- Increased Safety **–e** High Quality Robust Parts (Zone 1, 2)
  - Motors, lighting, junction boxes

- Oil Filled **–o** Electrical parts submerged in oil (Zone 1, 2)
  - Heavy current equipment

- Sand Filled **–q** Electrical parts covered with sand (Zone 1, 2)
  - Electronics, telephones, chokes

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Protection Methods Ex”__“

Class I, Zone 0, AEx ia IIC T4

- Encapsulation **–m** Equipment covered with potting (Zone 0, 1)
  - Electronics (no heat)

- Pressurized/Purged **–p** Positive internal pressure (Zone 1, 2)
  - Analyzers, motors, control boxes, computers

- Non Incendive **–n** Equipment is non sparking (Zone 2)
  - Motors, lighting, junction boxes, electronic equipment
- **Intrinsically Safe –i** Equipment has insufficient energy to ignite any flammable vapors (Zone 0, 1 and 2)
  - Instrumentation, measurement, control

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Gas Groups

Class I, Zone 0, AEx ia IIC T4

- Divisions 1, 2
  - Acetylene (A)
  - Hydrogen (B)
  - Ethylene (C)
  - Propane (D)
- Zones 0, 1, 2
  - Acetylene (IIC)
  - Hydrogen (IIC)
  - Ethylene (IIB)
  - Propane (IIA)

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ATEX Product Markings

Notified Body Number (NRTL): **DEMKO is our issuing QAN**

Equipment/ Apparatus Group: **II Non-Mining**

Environment: **G Gas**

Gas Group: **IIC Acetylene Hydrogen Ethylene Propane**

Equipment Protection Level: **Ga Very High Safe with 2 Faults**

CE 0539  II 1 G Ex ia IIC T4 Ga

EU Conformite Europeenne Symbol

EU Explosive Atmosphere Symbol

Equipment Category: **1 Very High Protection - Zone 0**

Ex: Explosion Protection

Type of Protection: **ia Intrinsic Safety**

Temp Code: **T4 135 Deg C**

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ATEX Product Markings

Equipment/Apparatus Group: **II**
I: Mining M1 Energized
I: Mining M2 De-Energized
II: Non-Mining

Equipment Protection Level: EPL **Ga**
Ga: Very High, Safe with 2 Faults
Gb: High, Safe with 1 Faults
Gc: Normal, Safe with 0 Faults

II 1 G Ex ia IIC T4 Ga

Equipment Category: **1**
1: Very High Protection-Zone 0
2: High Protection-Zone 1
3: Normal Protection-Zone 2

IECEx Product Markings

Gas Group: **IIC**
Acetylene
Hydrogen
Ethylene
Propane

Equipment Protection Level: **Ga**
Very High
Safe with 2 Faults

Ex ia IIC T4 Ga

Ex:
Explosion Protection

Type of Protection: **ia**
Intrinsic Safety

Temp Code: **T4**
135 Deg C

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Additional Items

- Ask the customer what standards they need to comply with
- Ask what level of protection is required
- For liability reasons, it is the customer’s responsibility to decide upon which HAZLOC rating is required for application
- ATEX vs. Intrinsic safety