



Explosion Proof Motor Classifications by Hazardous Locations

Learn the commonly used terms and design criteria used to qualify equipment



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It is the responsibility of employers to protect employees who may be exposed to the risk of explosive atmosphere environments. The employer must assess the risk and classify potentially dangerous areas. Equipment and materials must also be suited for use in these dangerous areas.

Explosion proof requirements for servo motors are dictated in the United States by UL674 and in Europe under the acronym of ATEX. The following will provide definition to the terms that are commonly used within each of the directives. It will also provide information on the design criteria used to qualify equipment for use in these hazardous areas.

UL674

Hazardous locations are those areas where fire or explosion hazards may exist due to the presence of substances that are flammable, combustible, or ignitable. These locations are broken down into Classes and Divisions, and further defined by Groups and Temperature Classifications.

Class Definitions

Class I – Created by the presence of flammable **gases or vapors** in the air, or **flammable liquids**, in sufficient quantities to be explosive or ignitable. Class I locations are further categorized by Division (Refer to chart 1) and fall into Group A through D. (Refer to chart 2)

Class II – Created by the presence of combustible **dust**, suspended in the air, in sufficient quantities to be explosive or ignitable. Class II locations are further categorized by Division (Refer to chart 1) and fall into Group E through G. (Refer to chart 3)

Class III – Areas where there are easily ignitable **fibers or flyings** present. These include cotton lint, flax, and rayon as examples. The fibers in a Class III area are not likely to be in the air, but can collect around machinery or on lighting fixtures. A Class III location can be categorized as Division 1 or 2. (Refer to chart 1)

Chart 1: Divisions

Division	Definition
1	Normal conditions. Hazard is present in everyday production operations or during frequent repair and maintenance activity.
2	Abnormal conditions. Hazard is confined in closed containers, or closed systems (ventilation), and will be present only through accidental rupture, breakage, or unusual faulty operation.

Chart 2: Gas, vapor, and liquid groups

Relate to the Minimum Ignition Energy of the flammable substance and the location where it is installed. The lower the ignition energy required to ignite the gas, the more dangerous the environment.

Group	Gas	Minimum Ignition Energy	Location
A	Acetylene	17 μ J	Surface Industries
B	Hydrogen, etc.	17 μ J	
C	Ethylene, etc.	70 μ J	
D	Hydrocarbons, Propane, fuels, solvents, etc..	240 μ J	

Chart 3: Dust groups

Group	Dust Type
E	Metal dust
F	Coal, carbon dust
G	Grain, sugar, plastic, or chemical dust

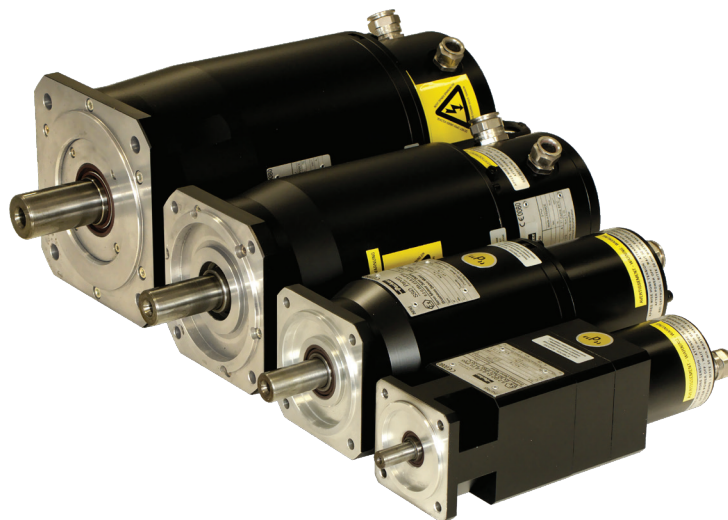


Temperature classification – “T-Codes”

The surface temperature or any part of the electrical equipment that may be exposed to the hazardous atmosphere should be tested so that it does not exceed 80% of the auto-ignition temperature of the specific gas, vapor or dust in the area where the equipment is intended to be used.

The temperature classification on the electrical equipment label will be one of the following (in degrees Celsius):

USA Degrees C Gas	
T1 - 450	T3A - 180
T2 - 300	T3B - 165
T2A - 280	T3C - 160
T2B - 260	T4 - 135
T2C - 230	T4A - 120
T2D - 215	T5 - 100
T3 - 200	T6 - 85



ATEX

ATEX consists of two European (EU) directives. They are:

- The ATEX 95 *equipment* directive 94/9/EC, equipment and protective systems intended for use in potentially explosive atmospheres;
- The ATEX 137 *workplace* directive 99/92/EC, minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres

ATEX derives its name from the French title of the 94/9/EC directive. *Appareils destinés à être utilisés en **AT**mmosphères **EX**plosibles*. ATEX defines the hazards into subgroups which are defined as zones, equipment groups, gas groups, dust groups and temperature classes. The following is a definition of each.

Zones – Broken into gas and dust groups. Zones 0, 1, and 2 relate to gas, and zones 20, 21, and 22 relate to dust.

Zone 0 – A place in which explosive atmosphere consisting of a mixture with air of flammable substances in the form of **gas, vapor, or mist** is present continuously or for long periods, or frequently.

Zone 1 - A place in which explosive atmosphere consisting of a mixture with air of flammable substances in the form of **gas, vapor, or mist** is likely to occur in normal operation occasionally.

Zone 2 - A place in which explosive atmosphere consisting of a mixture with air of flammable substances in the form of **gas, vapor, or mist** is not likely to occur, but if it does occur, will persist for a short period only.

Zone 20 – A place in which an explosive atmosphere in the form of a cloud of combustible **dust** is present continuously, or for long periods, or frequently.

Zone 21 - A place in which an explosive atmosphere in the form of a cloud of combustible **dust** is likely to occur in normal operation occasionally.

Zone 22 - A place in which an explosive atmosphere in the form of a cloud of combustible **dust** is not likely to occur in normal operation, but if it does occur, will persist for a short period only .



Equipment Groups – Broken into group I and II and further broken down by category. The category definition is based on equipment design for protection which will be discussed later.

Group I – Intended for use in underground mines as well as those parts of surface installations of such mines that are endangered by fire and/or combustible dust.

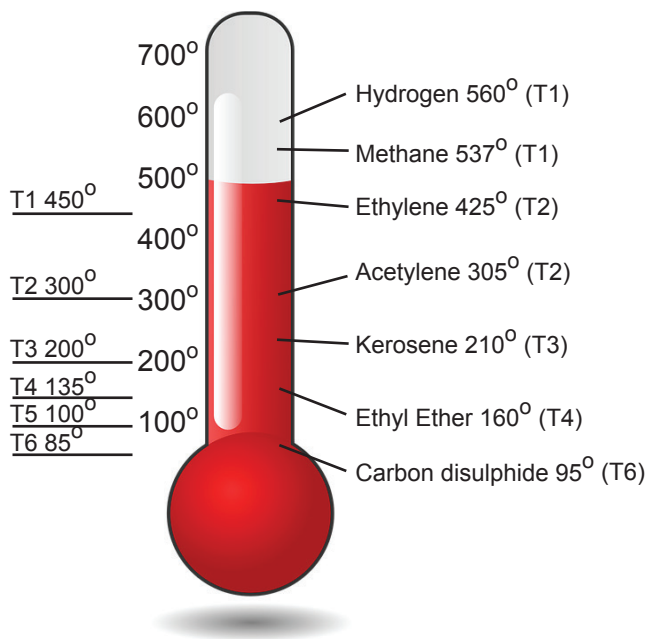
- Category M1 – Ensures a very high level of protection
- Category M2 – Ensures a high level of protection

Group II – Intended for use in surface equipment that is, or can be exposed to hazardous conditions (fire or explosion).

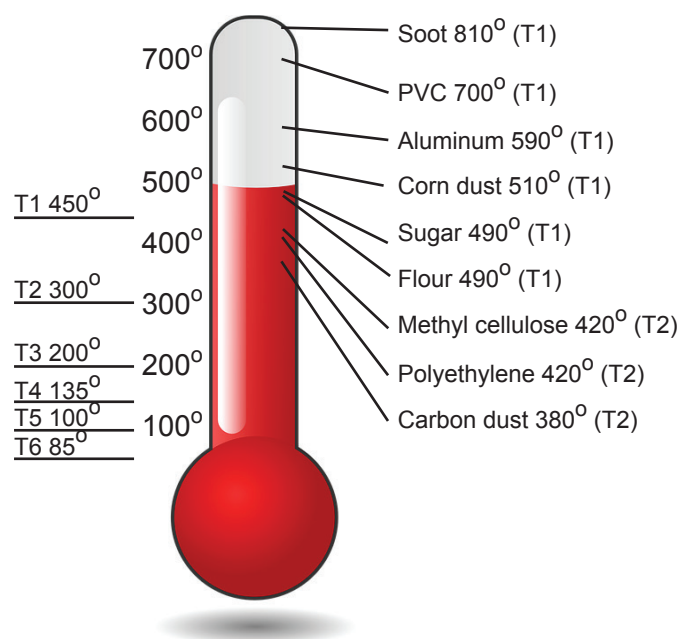
- Category 1 – Ensure a very high level of protection against gas, vapor, mists, and dust that are present continuously, frequently, or for long periods.
- Category 2 – Ensures a high level of protection for use in areas in which explosive atmospheres caused by gas, vapor, mists and dusts are likely to occur.
- Category 3 – Ensures a normal level of protection for use in areas in which explosive atmospheres caused by gas, vapor, mists, and dusts are unlikely to occur, or would happen infrequently.

Temperature Classes - Temperature classes relate to a flammable substance and its Auto Ignition Temperature.

Auto-ignition classes and temperatures for gas



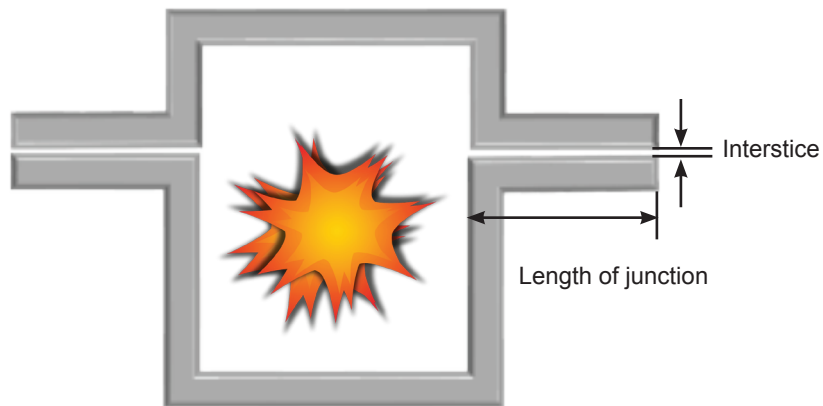
Classes and temperatures for suspended dust particle combustion



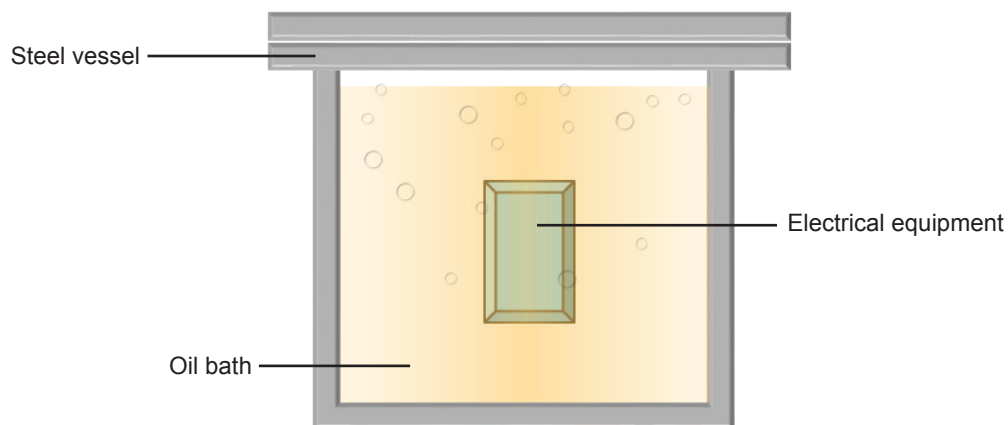
Design Characteristics for Explosion Proof Equipment (UL674 and ATEX)

There are various design criteria that the manufacturer can incorporate into their design. What is chosen will dictate the hazardous environment that the equipment can be used in. There are 4 “General Principles” of protection against explosion. They include:

- Explosion Containment - Allows the explosion to occur but confines it to a defined area. Structure cannot fail from the explosion



- Segregation - A method that attempts to separate or isolate the electrical parts from the explosive mixture. Practices include pressurization, encapsulation, oil immersion, and powder filling.



- **Prevention** - A method that limits the energy, both electrical and thermal, to safe levels under both normal and fault conditions. Practices include Increased Safety, Intrinsic Safety, Non-Incendive (simplified) and Special Protection.
 - **Increased Safety** – Must prevent the possibility of having excessive temperature or generations of arcs or sparks inside or outside the apparatus during normal operation. Accomplished by incorporating an elevated safety factor to all components that make up the apparatus (connections, wiring, degree of protection of enclosure, etc...)
 - **Intrinsic** - The most representative of the prevention concept and is based on the limitation of the energy stored in an electrical circuit (the circuit is incapable of generating arcs, sparks or combustible thermal effects). Intended for process instrumentation applications where the power required is less than 30 volts and 100 mA.
 - **Non-Incendive** – Similar to Intrinsic where the electrical apparatus is incapable of igniting a surrounding mixture during normal operation. They differ in that the non-incendive is not evaluated for safety under fault conditions, so as a result is not approved for Div. 1 environments.
 - **Special Protection** - Developed to allow certification of equipment that is not developed according to any of the existing protection methods. Can be considered safe for a specific hazardous location but must undergo appropriate tests and/or a detailed analysis of the design.

Typical locations for hazardous substances

Gases, liquids, and vapors

- Petroleum refineries, and gasoline storage and dispensing areas
- Dry cleaning plants where vapors from cleaning fluids can be present
- Spray finishing areas
- Aircraft hangars and fuel servicing areas
- Utility gas plants, and operations involving storage and handling of liquefied petroleum gas or natural gas

Dust

- Grain elevators
- Flour and feed mills
- Plants that manufacture, use or store magnesium or aluminum powders
- Producers of plastics, medicines and fireworks
- Producers of starch or candies
- Spice-grinding plants, sugar plants and cocoa plants
- Coal preparation plants and other carbon handling or processing areas

Fibers and filings

- Textile mills, cotton gins
- Cotton seed mills, flax processing plants
- Plants that shape, pulverize or cut wood and create sawdust or flyings

Reference Materials

OSHA Hazardous (Classified) Locations

http://en.wikipedia.org/wiki/ATEX_directive

ATEX Directive 94/9/EC and 1999/92/EC

automation.com – “Methods of Protection in Hazardous (Explosion Risk) Locations”

Contact Us

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