

9.5 Explosion-protected actuator

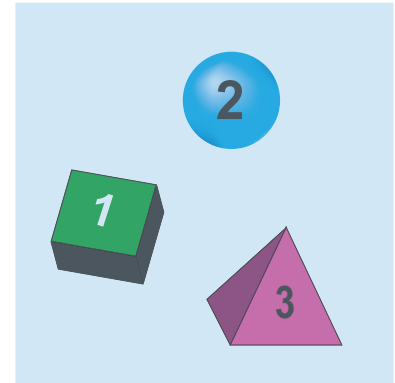
9.5.1. What is an explosion?

A flammable substance and oxygen, in a certain mixture, must be available to set off an explosion. With a suitable source of ignition it then leads to a chemical reaction. If the reaction velocity exceeds the acoustic velocity, this is defined as an explosion.

The destructive effect of an explosion is the result of the sudden expansion of the built-up flammable mixture in the form of a blast wave.

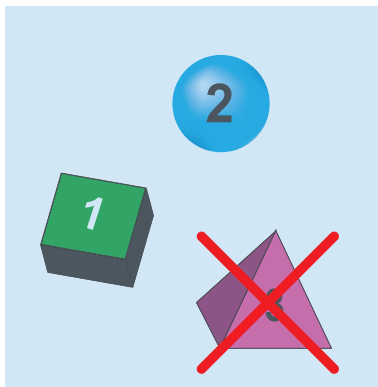
Three components are required to create an explosion:

1. Fuel (flammable gas, flammable dusts, flammable vapors)
2. Oxygen (in the air or as chemical compounds)
3. Ignition source (ignition sparks, hot surfaces, chemical reactions)



9.5.2. What is explosion protection?

An explosion hazard can safely be prevented if one of the



three mentioned components are successfully eliminated on site. Ignitable mixtures cannot be avoided at many installations. Therefore the occurrence of an ignition source must be prevented.

Electrical equipment is a potential ignition source, but also non-electrical equipment may produce potential ignition sources. Lost heat generates hot surfaces. Electrostatic charges or transient currents can cause ignitable sparks.

Explosion-protection on electrical and mechanical equipment signifies that the occurrence of high temperatures at the surface and of ignitable sparks during

operation are prevented by constructional measures. For this reason, the equipment will not be a potential ignition source.

9.5.3. ATEX Directive 94/9/EC

The Directive 94/9/EC is the European Directive for equipment in potentially explosive atmospheres. It defines the general protection objectives (protection of persons and property).

One of the most significant differences to the previous regulation is that non-electrical equipment has to be certified for the use in potentially explosive atmospheres.

The European Committee for Electrotechnical Standardization CENELEC revised and issued the technical guidelines for harmonizing the national standards on the basis of the ATEX Directive 94/9/EC.

ATEX requirements for AUMA products	
Electrical explosion protection	Non-electrical explosion protection
Electric multi-turn actuators Electric part-turn actuators	Multi-turn and part-turn actuator gearing Worm gearboxes Spur and bevel gearboxes Linear thrust units
ATEX Directive 94/9/EC EN 50014 – EN 50020	ATEX Directive 94/9/EC EN 1127-1 EN 13463-1 et seqq.
Equipment group 2 for use in ZONE 1 Group IIC Temperature class T4	Equipment group 2 for use in ZONE 1 Group IIC Temperature class T4
Type examination certificate by a notified body such as PTB, IBEXU, or DMT	Evaluation of the equipment by the manufacturer themselves, ignition hazard evaluation with reliability observation Risk analysis Filing of the documentation with a notified body.
Ex-audit by notified body -product quality assurance	
Declaration of Conformity/CE marking	

Table 9.5.3.-1: ATEX requirements for AUMA products

9.5.4. Classification of potentially explosive atmospheres

Exact knowledge of the conditions under which the devices are to be operated is important for the selection of the electrical equipment.

The description is designated by the following terms:

- Zone/equipment category
- Explosion group
- Temperature class

9.5.5. Zone/equipment category

Potentially explosive areas are divided into zones according to the presence of potentially explosive atmospheres.

The classification into equipment categories was introduced with the ATEX Directive 94/9/EC. It marks the equipment approved for the use in the respective zone.

Zones 0, 1, and 2 apply to explosive atmospheres consisting of gases and vapors; zones 20, 21, and 22 apply to atmospheres containing a cloud of combustible dust in air.

■ Zone 0, zone 20

Zone 0 or zone 20 are defined as zones, where an explosive atmosphere consisting of gases and/or vapors or dust is present “continuously or for long periods”. In this zone only category 1 equipment may be used.

■ Zone 1, zone 21

These are zones, where a dangerous, explosive atmosphere consisting of gases and/or vapors or dust is likely to occur in normal operation. In this zone only category 1 and 2 equipment may be used.

■ Zone 2, zone 22

These are zones, where a dangerous, explosive atmosphere consisting of gases and/or vapors or dust is not likely to occur in normal operation but, if it does occur, will persist for a short period only. In this zone only category 1, 2 and 3 equipment may be used.

Explosion-proof AUMA actuators and gearboxes correspond to equipment category II2G or II2D and are therefore appropriate for use in zones 1 and 2 as well as 21 and 22.

Furthermore, various actuator types are suitable for use in group I, category M2 in mines.

9.5.6. Explosion group/temperature class

The gases are classified into explosion groups and temperature classes according to their hazardous level.

The temperature class defines the permissible maximum surface temperature of the equipment.

The explosion group divides the gases according to minimum ignition current and maximum experimental safety gaps. Group I electrical equipment is for use in the mining industry (underground). Group II devices are for applications in all other areas.

The hazard level of gases ranges from IIA to IIC. More than 90 % of explosive gases and vapors are covered by explosion groups IIA and IIB.

Basically the following applies: Higher explosion groups and lower maximum permissible surface temperatures require greater levels of design for electrical equipment.

Temperature classes	Explosion groups			
	I	IIA	IIB	IIC
T1 (450 °C) ¹⁾	Methane	Acetone, Ethane, Ammonia, Benzol, Acetic acid, Methanol, Propane, Toluene, etc.	Town gas	Hydrogen
T2 (300 °C)		Thylalcohol, n-Butane, n-Butanol, Dichloroethane, etc.	Ethylene, Ethylene oxide	Acetylene
T3 (200 °C)		Benzine, Diesel fuel, Aircraft fuel, n-Hexane, Fuel oil...		
T4 (135 °C)		Ethanol	Ethyl ether	
T5 (100 °C)				
T6 (85 °C)				Carbon-disulphide
¹⁾ (max. permissible surface temperatures)				

Table 9.5.6.-1: Explosion groups

9.5.7. How to achieve explosion protection?

There are different possibilities to qualify electrical equipment and non-electrical equipment for the use in potentially explosive atmospheres. These measures are called protection types. They are described in the European Standards EN 50014 et seqq. for electrical equipment and EN 13463-1 et seqq. for non-electrical equipment.

Explosion-proof AUMA actuators are designed to protection types “Increased safety” (EEx e) “Flameproof enclosure” (EEx d), and “Constructional safety” (c). The protection type “Constructional safety” (c) applies to all AUMA valve gearboxes.

9.5.7.1 Increased safety (EEx e)

For the protection type “Increased safety”, measures are taken to increase protection against the occurrence of ignition sparks, electric arcs, and of the possibility of excessive temperatures. Special safety regulations for mounting electrical components must be observed.

In an increased safety compartment, only explosion-proof components with their own test certificate may be used.

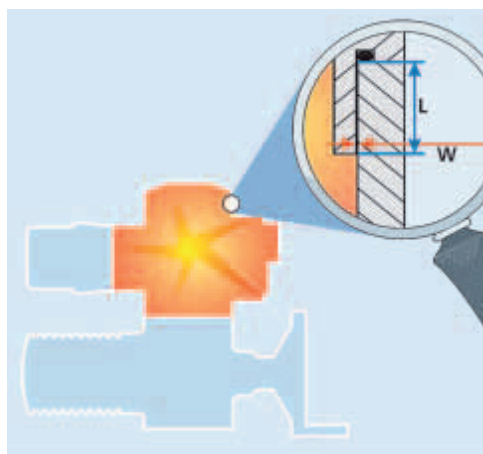
For AUMA actuators, this protection type is used for example for the electrical connection. All terminals are sized in such a way that no impermissible hot surfaces or sparks can occur.

9.5.7.2 Flameproof enclosure (EEx d)

The protection type “Flameproof enclosure” allows an explosion inside the electrical equipment. Flameproof joints of housing parts are designed in such a way that a flame or burning particles cannot reach the outside. This is achieved by accurate sizing of the gaps and widths of the flameproof joints. The housing is of a rigid design so that it can withstand the pressure developing during an internal explosion without damage.

The following parts of AUMA actuators are designed with a flameproof enclosure:

- Motor compartment
- Switch compartment
- Interior of integral controls AUMA MATIC and AUMATIC



L: Gap length, W: Gap width

9.5.7.3 Constructional safety (c)

This type of protection applies to non-electrical equipment or non-electrical parts of electrical equipment. It was introduced within the framework of the ATEX Directive 94/9/EC, which for the first time requires the examination of non-electrical equipment.

In the European Standard EN 13463-5, this protection type is described as follows: "a type of ignition protection in which constructional measures are applied so as to protect against the possibility of ignition from hot surfaces, sparks and adiabatic compression generated by moving parts."

Even before the ATEX Directive came into force, non-electrical equipment was used in potentially explosive atmospheres. By testing this equipment in compliance with the requirements of the constructional safety, it can often be certified for use in potentially explosives atmospheres without any problems or only with minor modification.

AUMA valve gearboxes and the gearing section of the actuators meet the requirements of the "Constructional safety".