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Explosion-proof actuators according to EU Directive 94/9/EC (ATEX)

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Explosion-proof actuators according to EU Directive 94/9/EC (ATEX)

Since July, 1, 2003 only explosion-proof devices which conform to the new EU Directive 94/9/EC, better known as the ATEX Directive, are introduced to the market. Especially the explosion protection of non-electrical equipment is a completely new task for many manufacturers. AUMA has qualified its electric actuators for the automation of industrial valves in accordance with the new regulations. In addition the design has been improved.



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What is explosion protection?

Three components are required for an explosion: a flammable substance, be it gas or dust, oxygen and a source of ignition taking the form of an ignition spark or a hot surface (**Figure 1**). The presence of flammable substances and oxygen in a certain mixture creates a hazardous atmosphere. If now, an ignition spark with sufficient spark energy or a hot surface with a correspondingly high temperature occurs, the result will be an explosion.

Explosion protection means eliminating one of the three above-mentioned elements from the plant. If this is successful, no explosion will occur. Ignitable mixtures cannot be avoided in many technical process plants, e. g. in the oil and gas or the petrochemical industry. Therefore the occurrence of ignition sources must be prevented by all means.

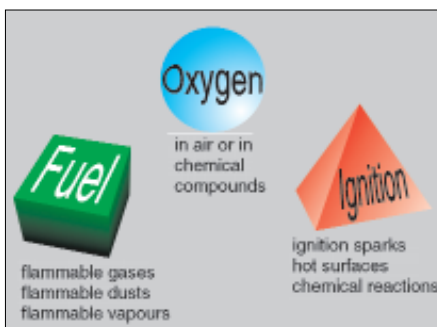


Fig. 1: Preconditions for an explosion

Table 1: Classification of gases and vapours as per CENELEC/IEC/NEC 505

explosion group	temperature classes (maximum permissible surface temperature)					
	T1 (450 °C)	T2 (300 °C)	T3 (200 °C)	T4 (135 °C)	T5 (100 °C)	T6 (85 °C)
I	methane	–	–	–	–	–
IIA	acetone, ethane, ammonia, benzol, acetic acid, methanol, propane, toluene, ...	ethyl alcohol, n-butane, n-butyl alcohol, dichlorethane	benzene, diesel fuel, n-hexane, fuel oil	acetaldehyde	–	–
IIB	town gas	ethylene, ethylene oxide		ethyl ether	–	–
IIC	hydrogen	acetylene	–	–	–	carbon disulfide

Electrical equipment is a potential source of ignition. Hot surfaces occur by heating up during operation. Electric voltages and currents can cause ignition sparks. The design of explosion-proof electrical equipment prevents the occurrence of high temperatures at the surface and of ignition sparks during operation. This also applies to AUMA actuators.

Explosion related figures

Potentially explosive gases and vapours are classified according to their minimum ignition energy or their maximum experimental safety gap width into explosion groups A, B, or C and according to their ignition temperature into the temperature classes T1 to T6 (**Table 1**).

This classification forms the basis for design requirements e. g. the maximum allowable gap widths and minimum gap lengths on different sections of the housing for housings in protection type ‘flameproof enclosure’.

Basically the following rule applies: The higher the explosion group and the lower the maximum permissible surface temperature, the greater are the design demands.

Division of areas into zones

Hazardous areas are divided into zones. These zones take the probability of a potentially explosive atmosphere occurring into account and enable the design of the explosion protection while considering safety related and economic

Table 2: Classification for explosion-proof equipment

Device group I	Category M 1 Category M2	Equipment for use in the mining industry	
Device group II	Category G 1 Category G 2 Category G 3	Equipment for use in all other applications which are endangered due to explosive atmosphere.	Areas endangered by gases, vapours or mists.
	Category D 1 Category D 2 Category D 3		Areas endangered by dust.

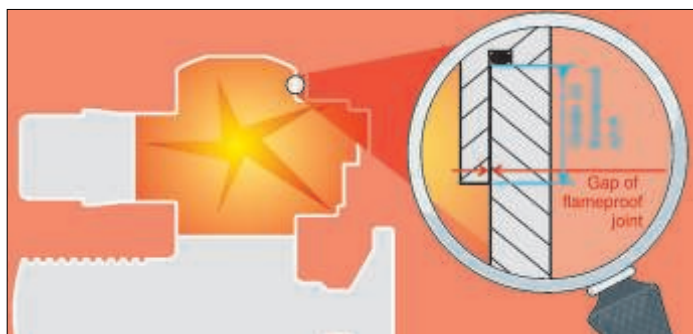


Fig. 2: Flameproof enclosure

aspects. Depending on the occurrence of potentially explosive atmospheres, hazardous areas are divided into three zones:

▷ **Zone 0:**

covers areas in which an explosive gas atmosphere is present continuously or for long periods.

▷ **Zone 1:**

covers areas, in which an explosive gas atmosphere can be expected to be present occasionally.

▷ **Zone 2:**

covers areas, in which an explosive atmosphere can only be expected very occasionally and if it does occur it will exist for a short period only.

In the course of the ATEX directive a new classification for explosion-proof equipment into safety categories was introduced (Table 2).

The categories and zones are assigned as follows

- ▷ Devices with safety category 1 approved for areas of zone 0
- ▷ Devices with safety category 2 approved for areas of zone 1
- ▷ Devices with safety category 3 approved for areas of zone 2

The newly certified AUMA actuators are approved for safety category 2, explosion group IIC and temperature class T4 (max. surface temperature 135 °C). This covers almost all common gases.

Protection types 'Flameproof enclosure' and 'Increased safety'

There are various possibilities for the design of electrical equipment for use in explosive areas. These measures are called protection types and are described in the standards EN 50 014 ff.

For the electric parts of AUMA actuators, protection types 'Flameproof enclosure' and 'Increased safety' are of major importance.

The protection type 'Flameproof enclosure' permits an explosion inside the electrical equipment. Joints of housing

parts are designed in such a way that a flame or flammable particles cannot reach the outside. This is achieved by adequate sizing of the gap widths and lengths on the different sections of the housing (Figure 2).

The housing is of rigid design so that it can withstand the pressure developed during an internal explosion without damage. For the newly certified AUMA actuators and actuator controls all housing compartments which contains electrical equipment, with the exception of the electrical connections, are designed in flameproof enclosure.

For the protection type 'Increased safety' suitable measures are taken which prevent the formation of ignition sparks, electric arcs or impermissibly high temperatures. In a compartment of increased safety, only explosion-proof components with their own test certificate may be used. For AUMA actuators in accordance with the ATEX directive, the protection type 'Increased safety' applies to the area of the electrical connection. The connection terminals, as such, are explosion-proof. All connection terminals are sized in such a way that no impermissible hot surfaces or sparks can occur.

Protection type „constructional safety – c“

This protection type, also called "Safe construction", has been newly introduced into the field of explosion protection. It is relevant for non-electrical equipment and also for non-electrical parts of electrical equipment e. g. the

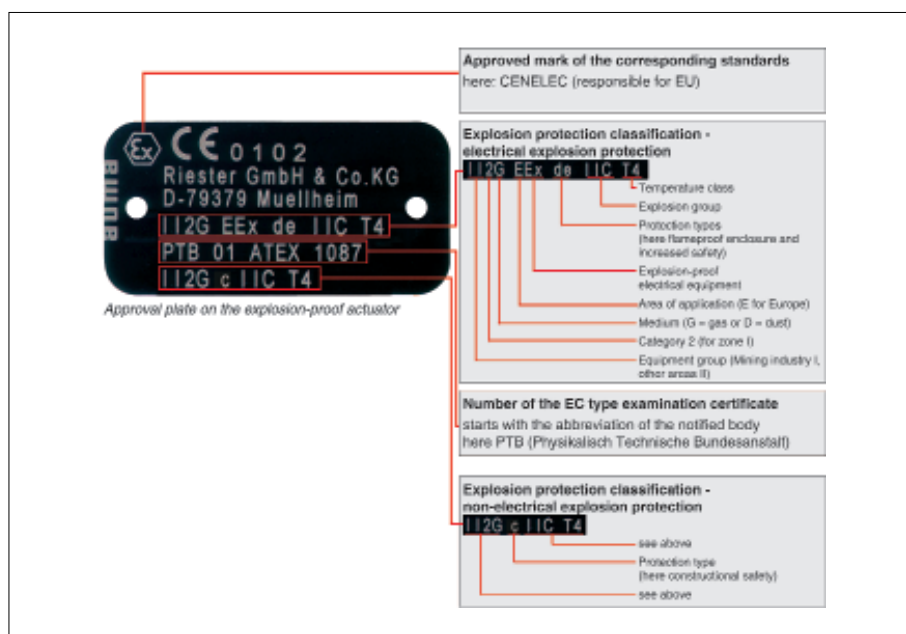


Fig. 3: Marking of an explosion-proof device



Fig. 4:
Electric multi-turn actuator SAExC 07.5 with actuator controls AUMA MATIC AMExC on wall bracket



Fig. 5:
Electric part-turn actuator SGExC 05.1 with directly mounted actuator controls AUMA MATIC AMExC

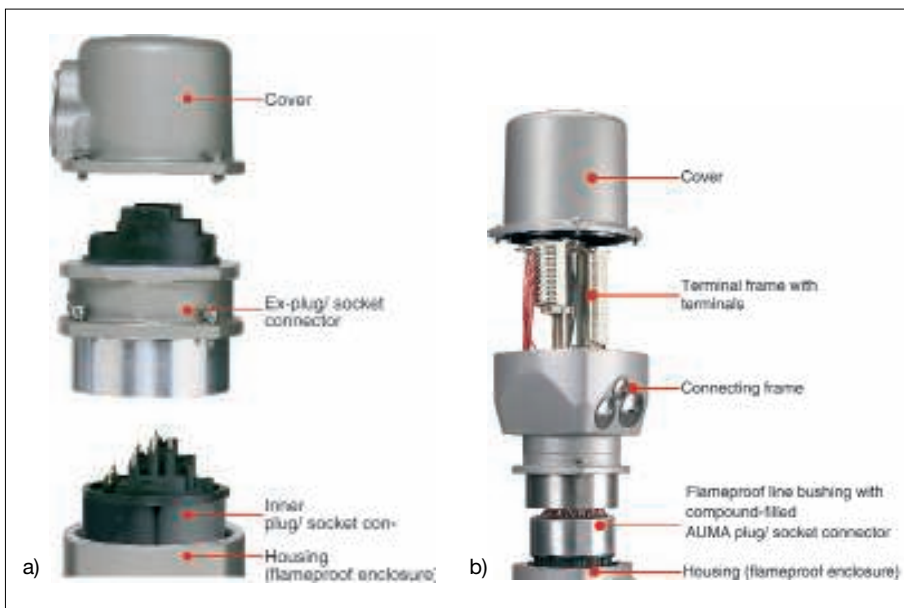


Fig. 6: Plug socket connector/terminal board with screw type terminals (a), plug-in terminal connection with cage clamps (b)

gearbox of electric valve actuators. In the final draft EN 13463-5, it 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, etc.“

The ignition hazard assessment provides an overview of potential ignition sources which are to be examined by the manufacturers in detail. The constructional safety is one of the protection types which – if applied – can control these potential ignition sources. Constructional safety is also applied with AUMA actuators and gearboxes.

Marking

The marking on the device nameplates should indicate the following (**Figure 3**):

- ▷ Manufacturer
- ▷ Device description (for AUMA on a separate nameplate)
- ▷ All explosion protection related characteristics
- ▷ National test authority issuing the test certificate
- ▷ Test seal of the corresponding area of application of standards
- ▷ Registration number of the EC type examination certificate

Explosion-proof actuators and actuator controls

AUMA has been manufacturing explosion-proof multi-turn and part-turn actuators for more than 20 years and has extensive know-how in this field. For this reason the new certification of the revised devices, i. e. the type ranges multi-turn actuators SA(R)ExC 07.1 – SA(R)ExC 16.1 (**Figure 4**) and part-turn actuators SGExC 05.1 – SGExC 12.1 (**Figure 5**) at the Physikalisch Technische Bundesanstalt (PTB) in Braunschweig was achieved without any problems. In the course of the implementation of the requirements of the ATEX Directive 94/9/EC the design was improved.

The most important technical changes are the following

- ▷ All newly revised actuators and controls have now been approved without restrictions for explosion group IIC.
- ▷ The devices are equipped with new electrical connections with plug and socket (see below)
- ▷ The actuator controls can be mounted separately from the actuator on a wall bracket. This is an advantage, e.g. if the actuator has been mounted in an inaccessible place (e. g. in a shaft) The controls may then be in-



Fig. 7: Parking frame for the removed electrical connection

stalled so that on site operation is possible without any problem. If used with heavily vibrating pipelines the electronics may thus also be protected against the vibrations.

- ▷ As an option non-intrusive setting of the actuator is now also be available. That means to make the complete adjustments without having to open the actuator and therefore without having to abolish explosion protection
- ▷ Approved for an ambient temperature range of -50 °C to +60 °C
- ▷ As an option, the devices may be equipped with a fire-proof housing which is occasionally required in the oil and gas industry. Even in case of fire the valve may be closed within a defined time. On request, AUMA offers various protection concepts which – depending on the version – ensure the function of the actuator up to 1,100 °C for at least 30 min.

Electrical connection with plug/socket

For weather-proof actuators AUMA has been using a plug/socket connector for the connection of control and supply cables for more than 20 years now.

Advantage of this design: Once con-

nected, the wiring remains undisturbed. If the actuator has to be removed from the valve, e. g. for maintenance purposes the wires must not be disconnected one after the other. During reinstallation, the electrical connection is simply connected and then screwed to the housing. In case of fault, the actuator may quickly be replaced by a spare actuator. Up to the present, this has not been possible for explosion-proof actuators.

During the technical revision two electrical connections with plug/sockets have also been developed which offer the above-mentioned advantage.

Furthermore, the connections are designed as 'double sealed' i. e. even if the cover to the terminal compartment is opened or if the cable glands leak, the housing compartment remains hermetically sealed and protected against the ingress of dust and moisture (**Figure 6**).

Once removed, the electrical connection may be sealed by means of a special parking frame (**Figure 7**) so that the plant can still be operated without any restriction of the explosion protection.