

# Explosion-proof actuators and EU Directive 94/9/EC (ATEX)

From July 1, 2003 only explosion-proof devices which conform to the new EU Directive 94/9/EC, better known as the ATEX Directive, may be introduced to the market. AUMA has already qualified its electric actuators for the automation of industrial valves in accordance with the new regulations. In addition, we have taken the opportunity to improve the design.

## 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. 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.

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 equip-

ment 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. (see table 1)

This classification forms the basis for design requirements e.g. the maximum permissible 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 max. permissible surface temperature, the greater are the design demands.

## Division of areas into zones

Hazardous areas are divided into zones. These

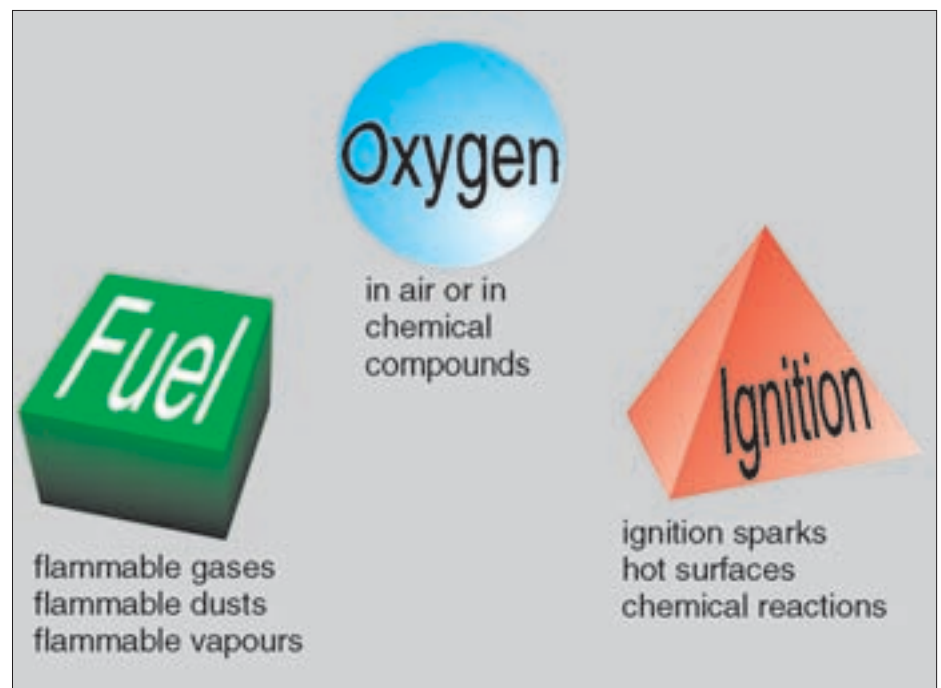


Figure 1: Preconditions for an explosion

|                        | T1<br>(450 °C) | T2<br>(300 °C)  | T3<br>(200 °C)   | T4<br>(135 °C)                                    | T5<br>(100 °C) | T6<br>(85 °C) |
|------------------------|----------------|---|--|---|----------------|---------------|
| <b>I</b>               | Methane        |   |  |   |                |               |
| <b>Explosion group</b> | <b>IIA</b>     | Acetone,<br>Ethane,<br>Ammonia,<br>Benzol,<br>Acetic acid,<br>Methanol,<br>Propane,<br>Toluene. | Ethyl alcohol,<br>n-Butane,<br>n-Butyl alcohol,<br>Dicloroethane | Benzene,<br>Diesel fuel,<br>n-Hexane,<br>Fuel oil | Acetaldehyde   |               |
|                        | <b>IIB</b>     | Town gas  | Ethylene,<br>Ethylene oxide                                      | Ethyl ether                                       |                |               |
|                        | <b>IIC</b>     | Hydrogen  | Acetylene  | Carbon disulphide                                 |                |               |

**Table 1. Temperature classes (max. permissible surface temperature)**

|                 |  |   |  |
|-----------------|--|---|--|
| Device group I  | Category M 1<br>Category M2                  | Equipment for use in the mining industry  |  |
| Device group II | Category G 1<br>Category G 2<br>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<br>Category D 2<br>Category D 3 |   | Areas endangered by dust.                    |

**Table 2. Safety categories for explosion-proof equipment**

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 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. The categories and zones are assigned as follows (see Table 2)

- 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 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. 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, with the exception of the electrical connections, are designed in flameproof enclosures. (See fig. 2)

For the protection type 'increased safety' suitable measures are taken which prevent the formation of ignition sparks, electric arcs or impermissible high temperatures. (See fig. 3) In a compartment of increased safety, only explosion-proof components with their own test certificate may be used. For AUMA actuators in accordance

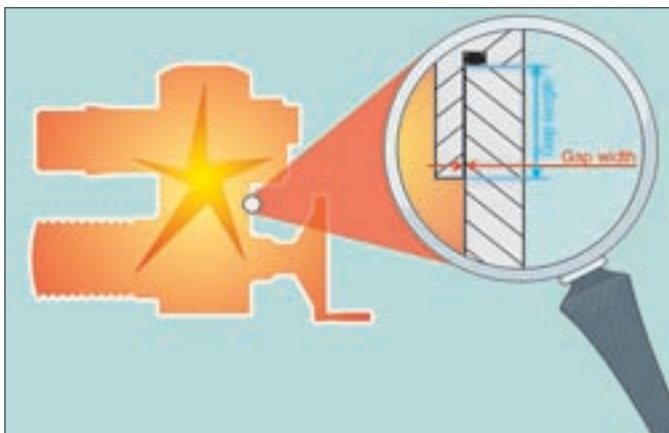


Figure 2. Flameproof enclosure



Figure 3. In contrast to the 'Flameproof enclosure' explosions in 'Increased safety' areas are impermissible.



Figure 4. Marking of an explosion-proof device. Test name plate of an AUMA actuator

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.

**Marking**

The marking on the device nameplates should indicate the following (See fig. 4):

- 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 AUMA 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)Ex 07.1 – SA(R)Ex 16.1 and part-turn actuators SGEx 05 – SGEx 12 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.

- For all explosion-proof AUMA actuators in accordance with the ATEX Directive the housing compartments are designed in the protection type ‘Flameproof enclosure’
- 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 installed 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.

- Approved for an ambient temperature

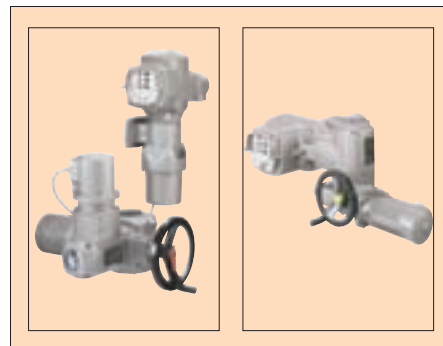


Figure 5a. Electric multi-turn actuator SAExC 07.5 with actuator controls AUMA MATIC AMExC on wall bracket

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

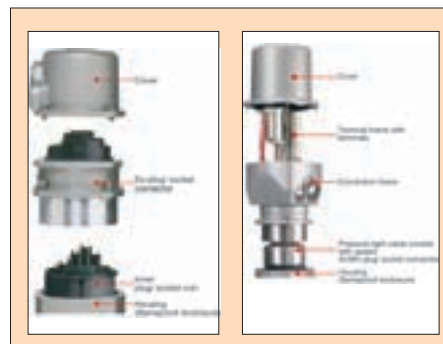


Figure 6a. Plug socket connector / terminal board with screw type terminals

Figure 6b. Plug-in terminal connection with cage clamps

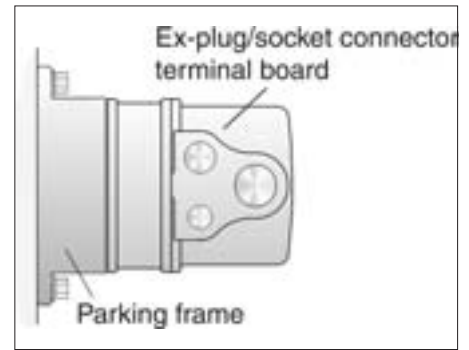


Figure 7. Parking frame for the removed electrical connection

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 – ensures 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 (See figs 6). Advantage of this design: Once connected, 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.

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.