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Solutions for a world in motion

# Fail safe unit

## FQM 05.1 – FQM 12.1

## FQMEx 05.1 – FQMEx 12.1

Operation instructions

Assembly and commissioning

**Read operation instructions first.**

- Observe safety instructions.
- These operation instructions are part of the product.
- Store operation instructions during product life.
- Pass on instructions to any subsequent user or owner of the product.

**Target group:**

This document contains information for assembly, commissioning and maintenance staff.

## Table of contents

# 1. Safety instructions

## 1.1. Prerequisites for the safe handling of the product

The end user or the contractor must ensure that all legal requirements, directives, guidelines, national regulations and recommendations with respect to assembly, electrical connection, commissioning and operation are met at the place of installation.

They include among others standards and directives such as IEC 60079 “Explosive atmospheres"

- Part 14: Electrical installations design, selection and erection.
- Part 17: Electrical installations inspection and maintenance.

**Safety instructions/warnings**

All personnel working with this device must be familiar with the safety and warning instructions in this manual and observe the instructions given. Safety instructions and warning signs on the device must be observed to avoid personal injury or property damage.

**Qualification of staff**

Assembly, electrical connection, commissioning, operation, and maintenance must be carried out by suitably qualified personnel authorised by the end user or contractor of the plant only.

Prior to working on this product, the staff must have thoroughly read and understood these instructions and, furthermore, know and observe officially recognised rules regarding occupational health and safety.

Work performed in potentially explosive atmospheres is subject to special regulations which have to be observed. The end user or contractor of the plant are responsible for respect and control of these regulations, standards, and laws.

**Commissioning**

Prior to commissioning, it is important to check that all settings meet the requirements of the application. Incorrect settings might present a danger to the application, e.g. cause damage to the valve or the installation. The manufacturer will not be held liable for any consequential damage. Such risk lies entirely with the user.

**Operation**

Prerequisites for safe and smooth operation:

- Correct transport, proper storage, mounting and installation, as well as careful commissioning.
- Only operate the device if it is in perfect condition while observing these instructions.
- Immediately report any faults and damage and allow for corrective measures.
- Observe recognised rules for occupational health and safety.
- Observe national regulations.
- During operation, the housing warms up and surface temperatures > 60 °C may occur. To prevent possible burns, we recommend checking the surface temperature using an appropriate thermometer and wearing protective gloves, if required, prior to working on the device.

**Protective measures**

The end user or the contractor are responsible for implementing required protective measures on site, such as enclosures, barriers, or personal protective equipment for the staff.

**Maintenance**

Maintenance and service actions must be exclusively performed by appropriately trained and authorised staff.

During maintenance intervention on the fail safe unit, the references regarding maintenance specified in the operation instructions pertaining to actuator must be obeyed.

Any device modification requires prior written consent of the manufacturer.

Opening covers or unfastening screws is only permitted if the pertaining description is available in the operation instructions.

## 1.2. Range of application

The FQM fail safe unit is designed for emergency operation of industrial valves, e.g. globe valves, butterfly valves, and ball valves. The unit is operated in combination with an AUMA part-turn actuator.

Other applications require explicit (written) confirmation by the manufacturer.

The FQMEx devices are approved for use in the potentially explosive atmospheres of zones 1, 2, 21, and 22.

The following applications are not permitted, e.g.:

- Buried service
- Continuous submersion (observe enclosure protection)
- Potentially explosive areas of zones 0 and 20
- Potentially explosive areas of group I (mining)
- Radiation exposed areas in nuclear power plants
- pulling loads (such as shutter weirs, fish-belly flap gate, and sluice gates, etc.)

No liability can be assumed for inappropriate or unintended use.

Observance of these operation instructions is considered as part of the device's designated use.

**Information** These instructions apply to the standard version “clockwise closing”, i.e. the driven shaft turns clockwise to close the valve.

## 1.3. Warnings and notes

The following warnings draw special attention to safety-relevant procedures in these operation instructions, each marked by the appropriate signal word (DANGER, WARNING, CAUTION, NOTICE).

**DANGER** **Indicates an imminently hazardous situation with a high level of risk. Failure to observe this warning results in death or serious injury.**

**WARNING** **Indicates a potentially hazardous situation with a medium level of risk. Failure to observe this warning could result in death or serious injury.**

**CAUTION** **Indicates a potentially hazardous situation with a low level of risk. Failure to observe this warning could result in minor or moderate injury. May also be used with property damage.**

**NOTICE** **Potentially hazardous situation. Failure to observe this warning could result in property damage. Is not used for personal injury.**

Safety alert symbol ⚠ warns of a potential personal injury hazard.

The signal word (here: DANGER) indicates the level of hazard.

## 1.4. References and symbols

The following references and symbols are used in these instructions:

**Information** The term **Information** preceding the text indicates important notes and information.

Symbol for CLOSED (valve closed)

Symbol for OPEN (valve open)

➥ **Result of a process step**

Describes the result of a preceding process step.

## 1.5. Safety instructions for the handwheel

⚠ CAUTION

**Turning handwheel at actuator following a fail safe operation!**

*Risk of hand injury for handwheels equipped with ball handle.*

→ Following a fail safe operation, do NOT activate manual operation.

→ This means, for all interventions, the push button at the actuator handwheel must NOT be pressed prior to initialisation.

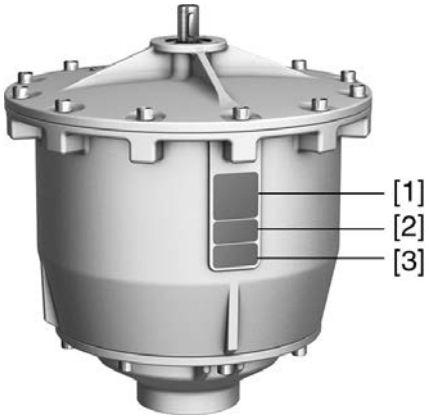
**Information**

Successful initialisation is indicated with FQM FS ready on the actuator display. The FS symbol is displayed in the status bar (top). Further information on initialisation: ⇨ page 24, Initialisation

# 2. Identification

## 2.1. Name plate

Figure 1: Arrangement of name plates




[1] Fail safe unit name plate
[2] Additional plate, e.g. KKS plate (Power Plant Classification System)
[3] Explosion protection approval plate

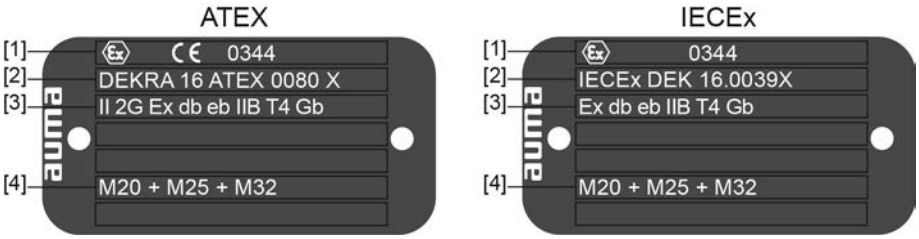
### Actuator name plate

Figure 2: Fail safe unit name plate (example)


[1] Name of manufacturer
[2] Address of manufacturer
[3] **Type designation**
[4] **Order number**
[5] **Actuator serial number**
[6] Nominal operating time in [s] for a part-turn movement of 90°
[7] Max. torque in direction OPEN/CLOSE
[8] Type of lubricant
[9] Permissible ambient temperature
[10] Mains voltage, mains frequency
[11] Control
[12] Can be assigned as an option upon customer request
[13] Power
[14] Enclosure protection
[15] **FQM fail safe direction**
[16] Data Matrix code

## Approval plate in explosion-proof version

Figure 3: Approval plates in explosion-proof version (examples)




[1] Ex symbol, CE mark, ID of test authority

[2] Ex certificate (number)

**Classification:**

[3] Electrical gas explosion protection

[4] Threads for cable entries at electrical connection

## Description referring to name plate indications

### Type designation

Figure 4: Type designation (example)


1. Type and size of fail safe actuator
2. Flange size
3. Ex marking

#### Type and size

These instructions apply to the following devices types and sizes:

Fail safe unit of FQM type, sizes 05.1, 07.1, 10.1, 12.1

Fail safe unit of FQMEx type, sizes 05.1, 07.1, 10.1, 12.1

#### Ex marking

Table 1:

| **Marking for explosion protection (with example /– – 3 – –)** | | | | | | |
|---|---|---|---|---|---|---|
| / | – | – | 3 | – | – | |
| | – | Not used | | | | |
| | | – | Not used | | | |
| | | | 3 | **Protection type of electrical connection**<br>3 = Terminal compartment Ex **e** increased safety<br>4 = Terminal compartment Ex **d** flameproof enclosure | | |
| | | | | – | Not used | |
| | | | | | – | Not used |

### Order number

The product can be identified using this number and the technical data as well as order-related data pertaining to the device can be requested.

Please always state this number for any product inquiries.

On the Internet at **http://www.auma.com** > Service & Support >myAUMA, we offer a service allowing authorised users to download order-related documents such as wiring diagrams and technical data (both in German and English), inspection certificate and the operation instructions when entering the order number.

**Serial number of**

Table 2:

| Description of serial number (example of 0518WQ12345) | | | |
|---|---|---|---|
| 05 | 18 | WQ12345 | |
| 05 | **Assembly in week**: 05 = week 5 | | |
| | 18 | **Year of manufacture** ; 18 = 2018 | |
| | | WQ12345 | Internal number for unambiguous product identification |

**FQM fail safe direction**

Direction of rotation of FQM output drive shaft or the driven valve shaft when safety function is triggered.

- CW = Clockwise rotation
- CCW = Counterclockwise rotation

Fail safe OPEN and fail safe CLOSE safety functions result from the overall combination of actuator (gearbox), FQM and valve.

Table 3:

| Safety function | | | |
|---|---|---|---|
| Valve closing direction (actuator)[1)] | FQM fail safe direction | | Safety function |
| Clockwise closing | CW | Clockwise | Fail safe CLOSE |
| Clockwise closing | CCW | Counterclockwise | Fail safe OPEN |
| Counterclockwise closing | CW | Clockwise | Fail safe OPEN |
| Counterclockwise closing | CCW | Counterclockwise | Fail safe CLOSE |

1) For identical closing direction of valve and actuator

**Data Matrix code**

When registered as authorised user, you may use our **AUMA Assistant App** to scan the Data Matrix code and directly access the order-related product documents without having to enter order number or serial number.

Figure 5: Link to AUMA Assistant App:

For further Service & Support, Software/Apps/... refer to www.auma.com

## 2.2. Short description

In emergencies, the fail safe unit is capable of closing or opening the valve autonomously relying on mechanical functions. No electrical power is required for such a fail safe operation. The torque required for opening or closing the valve is generated by a constant force spring motor, providing a constant torque across the total travel during fail safe operation. Consequently, the torque value for a fail safe operation is determined by the available torque of the fail safe unit and is independent from the actuator torque range.

For standard valve operation, the FQM fail safe unit is combined with an AUMA SQ part-turn actuator. The required torque is transmitted directly from the actuator through the fail safe unit to the valve. During standard operation, the constant force spring motor of the fail safe unit is disengaged and is not operated.

The operating speed for the fail safe operation can be set in the factory. Furthermore, the actuator operates the valve into the defined end position at reduced speed. This avoids pressure peaks within the pipeline and protects the valve.

# 3. Transport, storage and packaging

## 3.1. Transport

For transport to place of installation, use sturdy packaging.

DANGER

**Suspended load!**

*Death or serious injury.*

→ Do NOT stand below suspended load.

→ Attach lifting accessories for the purpose of lifting by hoist only to housing and NOT to handwheel.

→ Check eyebolts for tight seat in housing (verify reach of the screws).

→ Observe manufacturer specifications for fixing lifting straps and round slings.

→ Heed total weight of arrangement.

Figure 6: Example, fixing FQM 07.1 with actuator and actuator actuator controls

Table 4:

| **Weights for fail safe unit** | |
|---|---|
| Type | approx. [kg] |
| FQM 05.1/FQMEx 05.1 | 61 |
| FQM 07.1/FQMEx 07.1 | 64 |
| FQM 10.1/FQMEx 10.1 | 135 |
| FQM 12.1/FQMEx 12.1 | 137 |

Table 5:

| **Weights for actuators and actuator controls**[1)] | |
|---|---|
| Type | approx. [kg] |
| **Part-turn actuator** | |
| SQ 05.2/SQEx 05.2 | 21/29 |
| SQ 07.2/SQEx 07.2 | 21/29 |
| SQ 10.2/SQEx 10.2 | 26/34 |
| SQ 12.2/SQEx 12.2 | 35/42 |
| **Actuator controls** | |
| AC01.2/ACExC 01.2 | 7/12 |

1) Indicated weights apply to actuators with 3-phase AC motors, standard output drive and standard electrical connection. Weights for actuator controls with standard electrical connection.

## 3.2. Storage

NOTICE

**Risk of corrosion due to inappropriate storage!**

→ Store in a well-ventilated, dry room (maximum humidity 70 %).
→ Protect against floor dampness by storage on a shelf or on a wooden pallet.
→ Cover to protect against dust and dirt.
→ Apply suitable corrosion protection agent to uncoated surfaces.

NOTICE

**Risk of damage due to excessively low temperatures!**

→ Actuator controls may only be stored permanently down to –30 °C.
→ On request, actuators controls may be transported in specific cases and for short duration at temperatures down to –60 °C.

**Long-term storage**

For long-term storage (more than 6 months), observe the following points:

1. Prior to storage:
   Protect uncoated surfaces, in particular the output drive parts and mounting surface, with long-term corrosion protection agent.
2. At an interval of approx. 6 months:
   Check for corrosion. If first signs of corrosion show, apply new corrosion protection.

## 3.3. Packaging

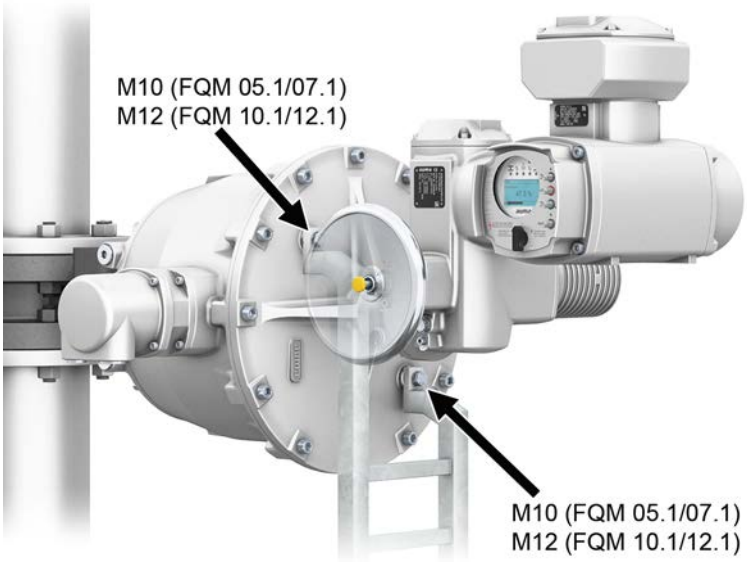
Our products are protected by special packaging for transport when leaving the factory. The packaging consists of environmentally friendly materials which can easily be separated and recycled. We use the following packaging materials: wood, cardboard, paper, and PE foil. For the disposal of the packaging material, we recommend recycling and collection centres.

# 4. Assembly

## 4.1. Mounting position

The product described in this document can be operated in vertical and horizontal mounting position. The mounting position pointing downward is not permitted. For horizontal mounting position, the fail safe unit requires reinforcement to relieve the flange connection to the valve.

Figure 7: Reinforcement for horizontal mounting position (example)




The reinforcement is made at both threads provided for transport. For FQM 05.1/07.1 = M10 thread; for FQM 10.1/12.1 = M12 thread.

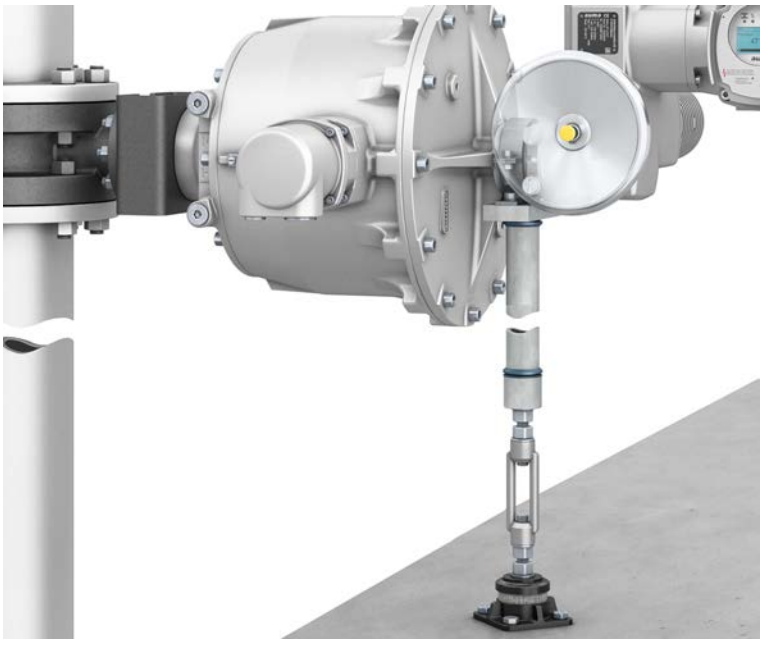
We recommend glueing the screws using thread sealing material to avoid contact corrosion in the thread.

To compensate for vibration, we recommend using additional all-metal cushions as available with Stop-Choc ®.

**Support by AUMA**

AUMA offers an own support. The support is fixed at the output drive flange using suitable fastening clamps. It includes all-metal dampers to compensate for vibration.

Figure 8: Support by AUMA (example)



## 4.2. Actuators for fail safe units

An AUMA actuator with integral controls combination is required to operate the valve via fail safe unit. On delivery, the actuator is already mounted to the fail safe unit.

**Information**

- The actuator is exactly aligned with regard to the fail safe unit to ensure safe unit function. In addition, the screws are fastened in the factory with a high torque to avoid any lateral movement. **Assembly or disassembly of actuators may only be performed by the AUMA Service.**
- The mounted SQ part-turn actuator is not equipped with end stops. The part-turn actuator screw plugs do not have any function and should not be opened.

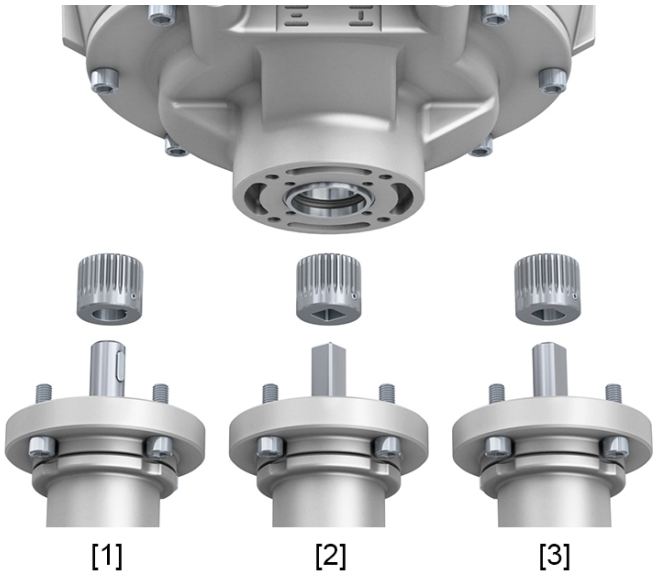
## 4.3. Fail safe unit: mount to valve

The fail safe unit is mounted to the valve using a coupling placed onto the valve shaft.

### 4.3.1. Overview on coupling variants

**Design**

Figure 9: Valve attachment via coupling




[1] Bore with keyway
[2] Square bore
[3] Bore with two-flats

**Application**

- For valve attachments according to EN ISO 5211
- For rotating, non-rising valve stem

#### 4.3.1.1. Fail safe unit to valve: mount

Unbored couplings or couplings with pilot bore must be machined to match the valve shaft prior to mounting the fail safe unit to the valve (e.g. with bore and keyway, two-flat or square bore).

**Information**

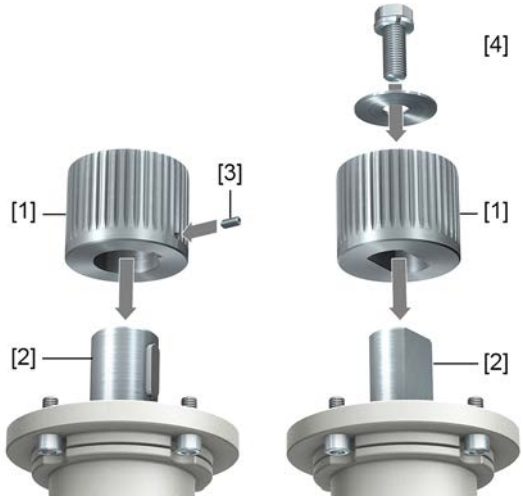
- Assemble valve and fail safe unit in the same end position (OPEN/CLOSED).
- Only mount fail safe unit with unwound constant force spring. Make sure that unit is not live.
- While constant force spring is unwound, the fail safe unit is set to the end position of the fail safe direction indicated on the name plate:
  - CW ≙ end position CLOSED (for clockwise rotating valve)
  - CCW ≙ end position OPEN (for clockwise rotating valve)

**Assembly steps**

1. Clean and thoroughly degrease mounting surfaces of output mounting flanges.
2. Apply a small quantity of grease to the valve shaft [2].

3. Place coupling [1] onto valve shaft [2] and secure against axial slipping by using a grub screw [3] or a washer and a screw [4]. Thereby, ensure that dimensions X, Y or L are observed (refer to figure and table <Mounting positions for coupling>).

Figure 10: Examples: Fit coupling




[1] Coupling
[2] Valve shaft
[3] Grub screw
[4] Screw with washer

Figure 11: Mounting positions for coupling

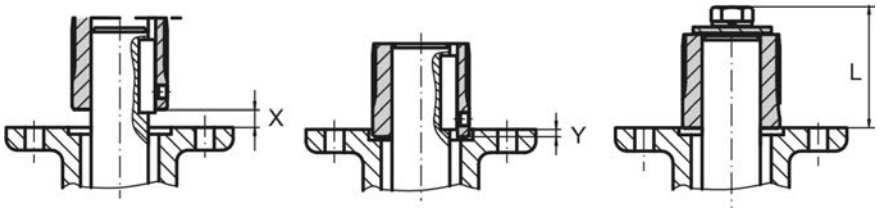



Table 6:

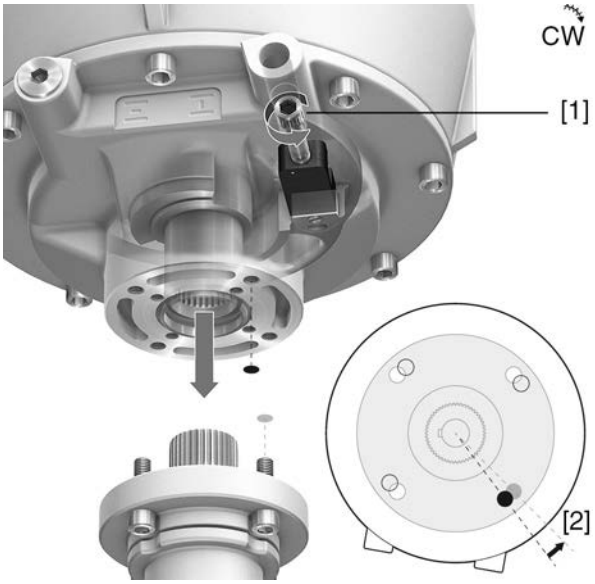
| Dimensions [mm] | FQM 05.1 | FQM 07.1 | | FQM 10.1 | | FQM 12.1 | |
|---|---|---|---|---|---|---|---|
| EN ISO 5211 | F07 | F07 | F10 | F10 | F12 | F12 | F14 |
| X max. | 5 | 5 | 5 | 6 | 6 | 6 | 6 |
| Y max. | 5 | 5 | 5 | 10 | 10 | 10 | 10 |
| L max. | 45 | 45 | 45 | 100 | 60 | 60 | 100 |

4. Apply non-acidic grease at splines of coupling (e.g. Gleitmo by Fuchs).

5. Place fail safe unit onto valve coupling and make sure that the screws match the bores provided.

➥ For CW version, the FQM bores [●] should overlap the bores of the valve flange [●] rather **in** clockwise direction.

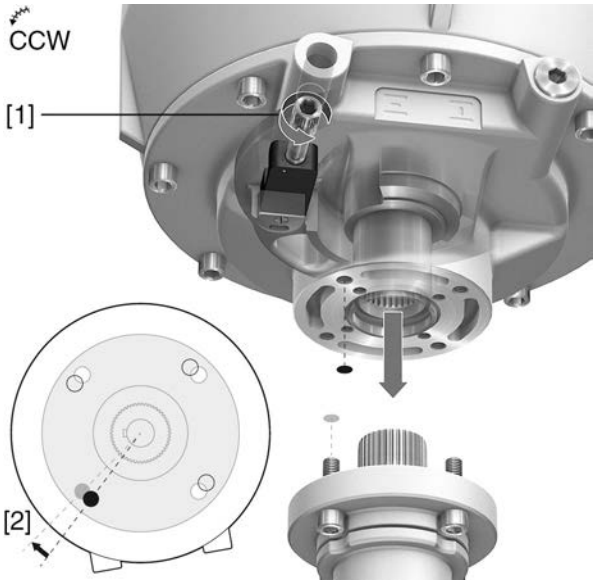
Figure 12: Place FQM on valve coupling (CW version)




[●] FQM bore
[●] Valve flange bore
[1] Setting screw
[2] View on valve flange and rotary movement of FQM when unfastening the setting screw.

➥ For CCW version, the FQM bores [●] should overlap the bores of the valve flange [●] rather **in** counterclockwise direction.

Figure 13: Place FQM on valve coupling (CCW version)




[●] FQM bore
[●] Valve flange bore
[1] Setting screw
[2] View on valve flange and rotary movement of FQM when unfastening the setting screw.

6. Should the bores for the screws not align:
   → Remove screw plug and **sightly** unfasten setting screw [1] for end stop OPEN/CLOSED at fail safe unit **counterclockwise** until bores [●●] line up. When unfastening the setting screw, the FQM moves back in direction of the valve flange bore [●].

CAUTION

**Risk of setting screw falling out!**

→ Avoid excessive unscrewing of setting screws. Observe dimension $T_{min.}$! Refer to: Risk of damage to end stop if setting screw is turned against the spring force. page 25, End stops in the fail safe unit

CAUTION

→ Do NOT unscrew setting screw **clockwise** against the spring force (fastening).

7. Fasten fail safe unit with screws.
   **Information:** We recommend glueing the screws using thread sealing material (e.g. LOCTITE 243) to avoid thread contact corrosion and to ensure vibration resistance.
8. Fasten screws crosswise to a torque according to table.

Table 7:

| **Tightening torques for screws** | |
|---|---|
| Threads | Tightening torque [Nm] |
| | Strength class A2-80/A4–80 |
| M6 | 10 |
| M8 | 24 |
| M10 | 48 |
| M12 | 82 |
| M16 | 200 |
| M20 | 392 |

**Information**

If the bores [●●] are not yet aligned for dimension $T_{min.}$, the mounting procedure must be aborted. The following steps have to be performed:

1. Remove fail safe unit from valve.
2. Establish electrical connection and connect to power supply.
   Once the power supply is connected, initialisation is started provided all pre-requisites are fulfilled. ➪ page 24, Initialisation
3. After initialisation, screw the setting screw to dimension $T_{(at\ 90)}$ (without tolerance margin indicated). ➪ page 25, End stops in the fail safe unit
4. Then, switch off power supply again (de-energize).
   The actuator performs a fail safe operation and moves to the configured fail safe end position.
5. Now, re-place the valve onto the fail safe unit and mount to the valve as described in the present chapter.
   When mounting the fail safe unit onto the valve coupling, select splines as to ensure that bores of the screws for the FQM and the valve flange are as close as possible.

# 5. Electrical connection

## 5.1. Basic information

DANGER

**Electric shock due to presence of hazardous voltage!**

*Death or serious injury.*

→ Disconnect device from the mains before opening.

→ When operating in potentially explosive atmospheres: Prior to opening, ensure absence of gas and voltage.

WARNING

**Electric shock due to incorrect electrical connection!**

*Risk of death or serious injury!*

→ The electrical connection must be carried out exclusively by suitably qualified personnel.

**Wiring diagram/terminal plan**

The pertaining wiring diagram/terminal plan (in German or English) is attached to the device in a weather-proof bag, together with these operation instructions. It can also be requested from AUMA (state order number, refer to name plate) or downloaded directly from the Internet (http://www.auma.com).

**Protection on site**

For short-circuit protection and for disconnecting from the mains, fuses and disconnect switches have to be provided by the customer.

The current values for respective sizing are derived from the current consumption of the motor (refer to electrical data sheet), the current consumption of the actuator controls, plus the current consumption of the fail safe unit. Please refer to the operation instructions pertaining to the actuator for information on the current consumption of actuator controls.

When providing joint protection for actuator, actuator controls and fail safe unit, the maximum power consumption of 360 W for the fail safe unit has to be accounted for. In case separate power supply for the fail safe unit is provided, 360 W have to be accounted for FQM protection.

Consider increased power supply starting current when selecting the circuit breaker characteristic. We recommend tripping characteristics D or K for circuit breakers in accordance with IEC 60947-2. To avoid spurious action, fuses with values below 2 A are not recommended.

## 5.2. Electrical connection/actuator controls

The customer connection for valve control during standard operation (power connection and signal cables) is made via the electrical connection of the actuator or the actuator controls. Any procedures for opening/closing the terminal compartment and for connecting the cables are described in the Operation instructions pertaining to the actuator.

## 5.3. Electrical connection for fail safe unit

On delivery, the electrical connection of the fail safe unit is already equipped with the power supply cable for FQM and the signal cable for actuator controls.

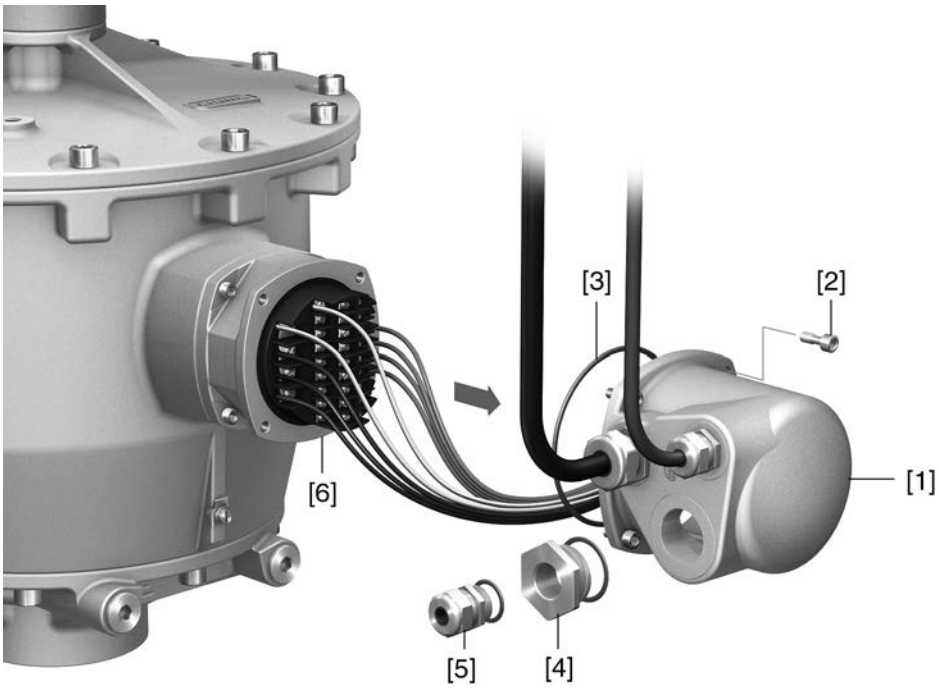
The tripping signal (ESD) for a fail safe operation as well as direct feedbacks (e.g. LSO/LSC end position switch signals) have to be connected in compliance with the wiring diagram at the customer's.

Depending on the application, either an S type electrical connector (weatherproof environment) or a KP type electrical connector (explosion-proof environment) will be provided.

## 5.3.1. KP/KPH electrical connection

### 5.3.1.1. Terminal compartment: open

Figure 14: Open terminal compartment




[1] Cover (figure shows KP version)
[2] Screws for cover
[3] O-ring
[4] Reducing socket
[5] Cable gland
[6] Flameproof frame

**DANGER**

**Electric shock due to presence of hazardous voltage!**

*Death or serious injury.*

→ Disconnect device from the mains before opening.

1. Loosen screws [2] and remove cover [1].

   **Information:** The terminal compartment is designed in protection type Ex e (increased safety). The interior of the flameproof enclosure (Ex d) of connected housing remains closed when removing the cover [1].

2. Insert cable glands suitable for connecting cables.

   **Information:** When selecting cable glands observe type of protection (with Ex e approval) and enclosure protection IP.
   The enclosure protection IP… stated on the name plate is only ensured if suitable cable glands are used.
   Figure 15: Name plate, example with enclosure protection IP68


3. Seal unused cable entries with approved plugs suitable for the required protection type.

### 5.3.1.2. Cable connection

Table 8:

| Terminal cross sections and terminal tightening torques | | |
|---|---|---|
| Designation | Terminal cross sections | Tightening torques |
| Power contacts (U1, V1, W1)<br>Protective earth connection ⏚ (PE) | With small clamp washers:<br>1.5 – 4.0 $mm^2$ (flexible or solid) | 0.9 – 1.1 Nm |
| | With large clamp washers:<br>2.5 – 6 $mm^2$ (flexible or solid) | |
| Control contacts<br>(1 to 24, 31 to 40, 47 to 50, PE) | 0.75 – 1.5 $mm^2$ (flexible or solid) | 0.5 – 0.7 Nm |

1. Remove cable sheathing in a length of 120 – 140 mm.
2. Insert the cable into the cable glands.
3. Fasten cable gland with the specified torque to ensure required enclosure protection.
4. Remove wire sheathing in a length of approx. 8 mm.
5. For flexible cables: Use end sleeves according to DIN 46228.
6. Connect cables according to order-related wiring diagram.
   **Information:** Two wires for each connection permitted.

⚠ WARNING

**In case of a fault, electric shock due to presence of hazardous voltage if the PE conductor is NOT connected!**

*Risk of death or serious injury!*

→ Connect all protective earth conductors.

→ Connect PE connection to external protective earth conductor of connecting cables.

→ Start running the device only after having connected the protective earth conductor.

7. Firmly tighten protective earth at PE connection of KP electrical connection.
8. Connect equipotential earth bonding at external earth connection for equipotential compensation (U-bracket with symbol ⏚)

   Figure 16: External earth connection

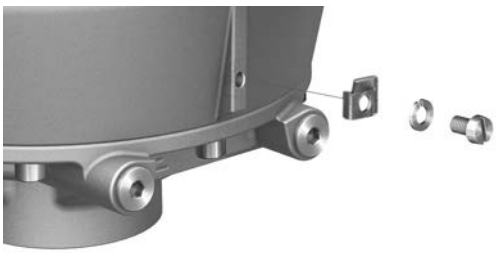
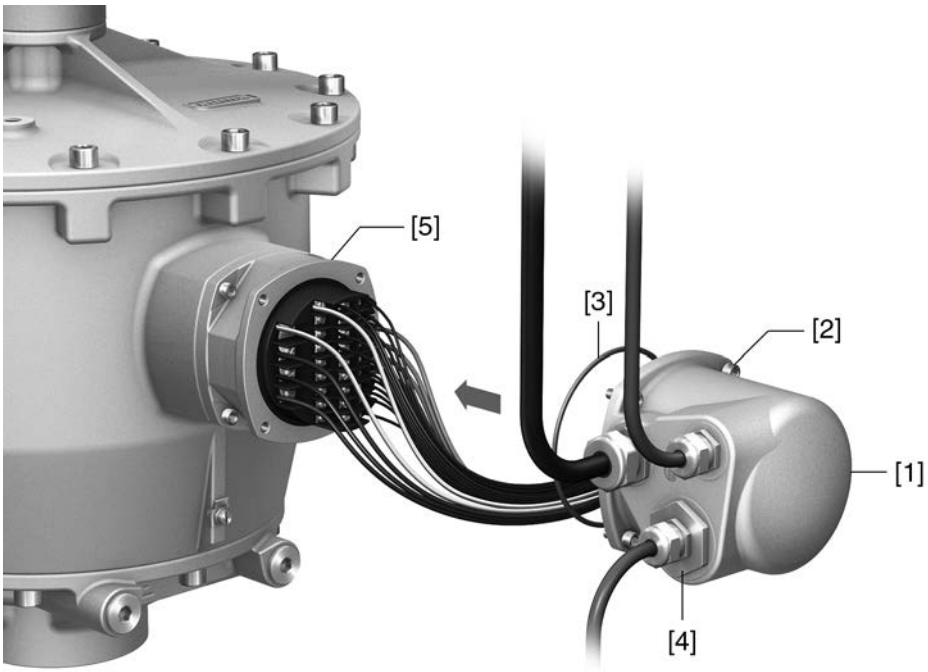


Table 9:

| Terminal cross sections and earth connection tightening torques | | |
|---|---|---|
| Conductor type | Terminal cross sections | Tightening torques |
| Solid wire and stranded | 2.5 $mm^2$ to 6 $mm^2$ | 3 – 4 Nm |
| Fine stranded | 1.5 $mm^2$ to 4 $mm^2$ | 3 – 4 Nm |
| For fine stranded (flexible) wires, connection is made via cable lugs/ring terminals. When connecting two individual wires with a U-bracket, cross sections have to be identical. | | |

### 5.3.1.3. Terminal compartment: close

Figure 17: Close terminal compartment




[1] Cover (figure shows KP version)
[2] Screws for cover
[3] O-ring
[4] Cable gland
[5] Flameproof frame

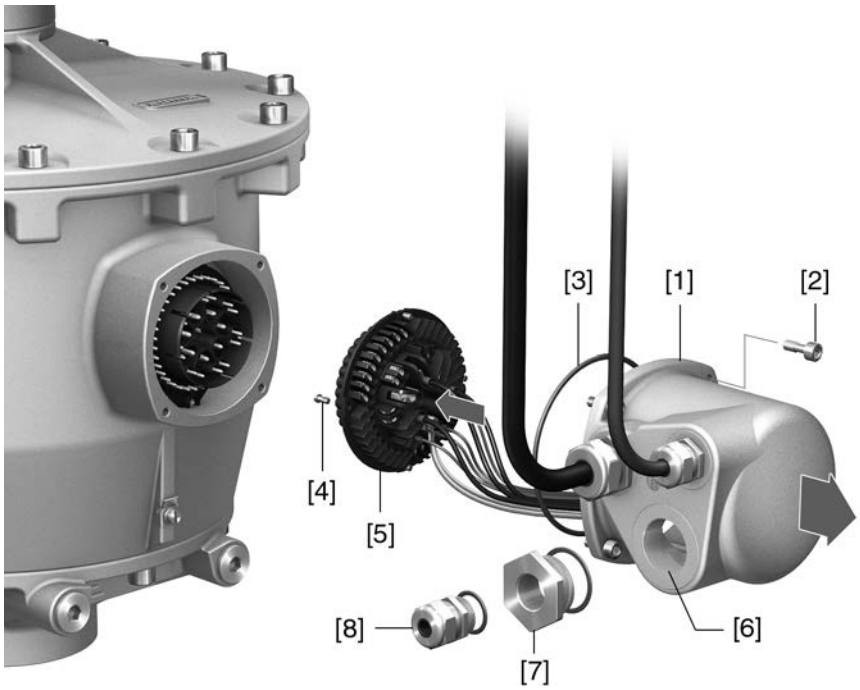
1. Clean sealing faces of cover [1] and frame [5].
2. Check whether O-ring [3] is in good condition, replace if damaged.
3. Apply a thin film of non-acidic grease (e.g. petroleum jelly) to the O-ring and insert it correctly.
4. Fit cover [1] and fasten screws [2] evenly crosswise.
5. Fasten cable glands and blanking plugs applying the specified torque to ensure the required enclosure protection.

Once the power supply is connect, initialisation is started provided all prerequisites are fulfilled. ➪ page 24, Initialisation

## 5.3.2. S/SH electrical connection (AUMA plug/socket connector)

### 5.3.2.1. Terminal compartment: open

Figure 18: Open terminal compartment




[1] Cover (figure shows S version)
[2] Screws for cover
[3] O-ring
[4] Screws for socket carrier
[5] Socket carrier
[6] Cable entry
[7] Reducing socket
[8] Cable gland (not included in delivery)

**DANGER**

**Electric shock due to presence of hazardous voltage!**

*Death or serious injury.*

→ Disconnect device from the mains before opening.

1. Loosen screws [2] and remove cover [1].
2. Loosen screws [4] and remove socket carrier [5] from cover [1].
3. Insert cable glands suitable for connecting cables.

➥ The enclosure protection IP… stated on the name plate is only ensured if suitable cable glands are used.

Figure 19: Name plate, example with enclosure protection IP68


4. Seal unused cable entries with suitable and approved plugs.

### 5.3.2.2. Cable connection

Table 10:

| Terminal cross sections and terminal tightening torques | | |
|---|---|---|
| Designation | Terminal cross sections | Tightening torques |
| Power contacts<br>(U1, V1, W1, U2, V2, W2) | 1.0 – 6 $mm^2$ (flexible)<br>1.5 – 10 $mm^2$ (solid) | 1.2 – 1.5 Nm |
| Protective earth connection ⏚ (PE) | 1.0 – 6 $mm^2$ (flexible) with ring lugs<br>1.5 – 10 $mm^2$ (solid) with loops | 1.2 – 2.2 Nm |
| Control contacts<br>(1 to 50) | 0.25 – 2.5 $mm^2$ (flexible)<br>0.34 – 2.5 $mm^2$ (solid) | 0.5 – 0.7 Nm |

1. Remove cable sheathing.
2. Insert the wire into the cable glands.
3. Fasten cable gland with the specified torque to ensure required enclosure protection.
4. Remove wire sheathing in a length of approx. 6 mm.
5. For flexible cables: Use end sleeves according to DIN 46228.
6. Connect cables according to order-related wiring diagram.

⚠ WARNING

**In case of a fault, electric shock due to presence of hazardous voltage if the PE conductor is NOT connected!**

*Risk of death or serious injury!*

→ Connect all protective earth conductors.

→ Connect PE connection to external protective earth conductor of connecting cables.

→ Start running the device only after having connected the protective earth conductor.

7. Tighten PE conductors firmly to PE connection at socket carrier using ring lugs (flexible cables) or loops (solid cables).
8. Connect equipotential earth bonding at external earth connection for equipotential compensation (U-bracket with symbol ⏚)

Figure 20: External earth connection

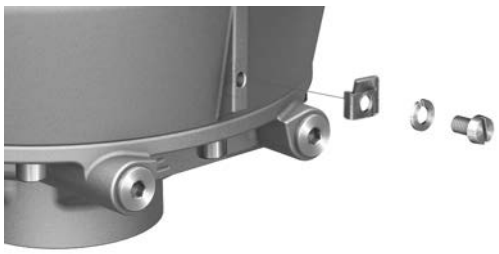
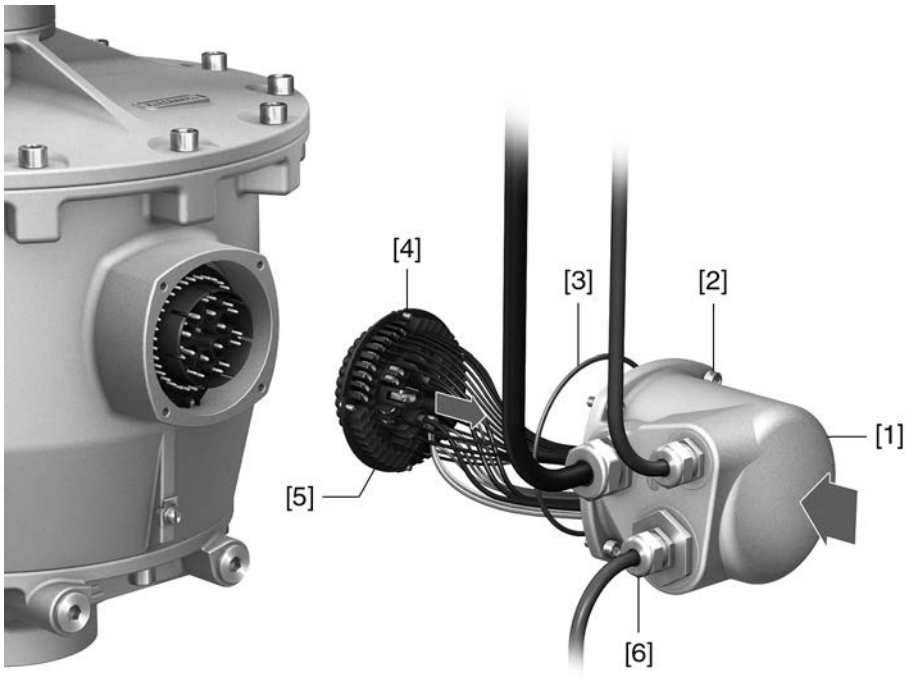


Table 11:

| Terminal cross sections and earth connection tightening torques | | |
|---|---|---|
| Conductor type | Terminal cross sections | Tightening torques |
| Solid wire and stranded | 2.5 $mm^2$ to 6 $mm^2$ | 3 – 4 Nm |
| Fine stranded | 1.5 $mm^2$ to 4 $mm^2$ | 3 – 4 Nm |
| For fine stranded (flexible) wires, connection is made via cable lugs/ring terminals. When connecting two individual wires with a U-bracket, cross sections have to be identical. | | |

### 5.3.2.3. Terminal compartment: close




**WARNING**

**Short-circuit and electric shock due to pinching of cables!**

*Risk of death or serious injury!*

→ Carefully fit socket carrier to avoid pinching the cables.

1. Insert the socket carrier [5] into the cover [1] and fasten with screws [4].
2. Clean sealing faces of cover [1] and housing.
3. Check whether O-ring [3] is in good condition, replace if damaged.
4. Apply a thin film of non-acidic grease (e.g. petroleum jelly) to the O-ring and insert it correctly.
5. Fit cover [1] and fasten screws [2] evenly crosswise.
6. Fasten cable glands and blanking plugs applying the specified torque to ensure the required enclosure protection.

Once the power supply is connect, initialisation is started provided all prerequisites are fulfilled. ➪ page 24, Initialisation

# 6. Commissioning

Conditions:

- The fail safe unit was mounted to the valve:
  ➪ page 34,
- All electrical cables are connected:
  ➪ page 34,
- The type of seating (limit or torque seating) and the tripping torque (torque switching) have been set in the actuator to suit the mounted valve.
  - For detailed information on the customer-specific version, refer to the order-related data sheet.
  - The “Type of seating” and “Torque switching” settings are described in the operation instructions pertaining to the actuator.

Commissioning of the overall combination of actuator (gearbox), FQM and valve is made as follows:

1. Perform initialisation:
   ➪ page 24, Initialisation
2. Set end stops:
   ➪ page 25, End stops in the fail safe unit
3. Perform reference operation (adaptive end position setting):
   ➪ page 26, Reference operation (adaptive end position setting)

## 6.1. Initialisation

If all prerequisites starting the initialisation phase are fulfilled, initialisation starts automatically to put the combination consisting of actuator (gearbox), FQM and valve in ready for operation state.

Further information: ➪ page 29, Indications during and after initialisation.

### Prerequisites for starting initialisation:

- Power supply applied.
- Actuator controls are ready for operation (booted after power supply connection).
- +24 V DC is applied at ESD input (refer to wiring diagram).
- Actuator controls are in operation mode Local or Remote (selector switch position on **Local control** or **Remote control**).
- The fail safe unit is in the configured fail safe end position.
  (The end position switch LSO/LSC of fail safe unit must be operated.)

### Sequence for initialisation

A constant force spring is wound within the fail safe unit thanks to the electric motor acting as mechanical energy buffer for the fail safe operation. Simultaneously, the actuator runs into the configured fail safe end position to make sure that both actuator and FQM fail safe unit are in the same position as the valve.

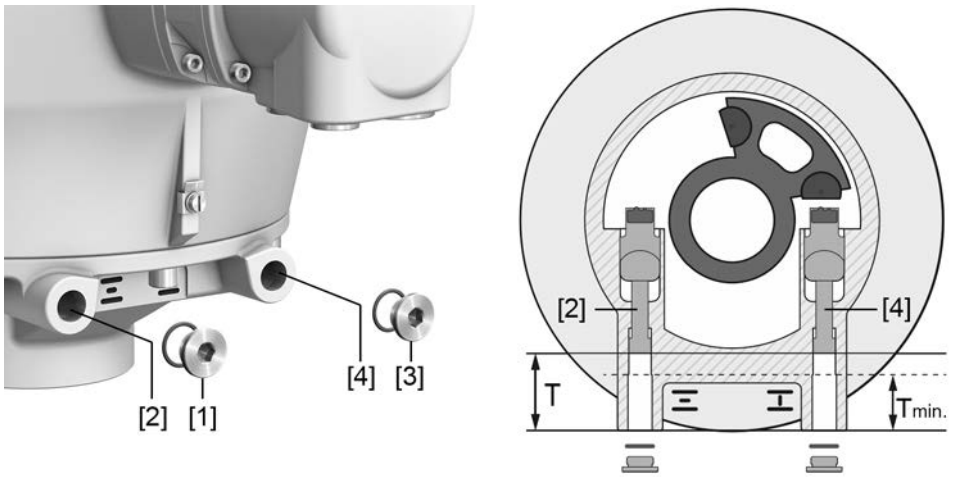
**Information**

- Clicking noises during initialisation or the fail safe operation are normal and do not represent a fault.
- For repeated FQM tripping (fail safe operation), a pause of minimum 15 minutes must be obeyed after the fourth fail safe operation to allow motor cool down.

After successful initialisation, the FQM fail safe unit is ready for further commissioning, for standard operation as well as for fail safe operation.

## 6.2. End stops in the fail safe unit

Figure 21: FQM end stops




[1/3] Screw plugs

[2/4] Setting screws for end stops

Next to symbol = setting screw for end position OPEN

Next to symbol = setting screw for end position CLOSED

Table 12:

| Dimension T in [mm][1)] | FQM 05.1/FQM 07.1 | FQM 10.1/FQM 12.1 |
|---|---|---|
| T (for 90°) | 55 ±9 | 31 ±13 |
| $T_{min.}$ | 46 | 18 |

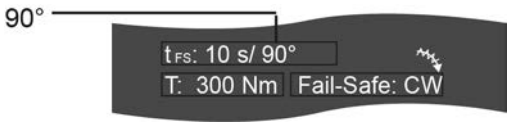
1) ΔT = 1 mm ≈ 1.0° (one turn at setting screw ≈ 1.5°)

FQM end stops limit the swing angle. They are used as limit switches and protect the valve in the event of a fail safe operation.

No end stops are provided within the AUMA part-turn actuator when combined with an FQM. The end stops of the fail safe unit exclusively limit the swing angle.

The swing angle set in the factory is indicated on the name plate of the fail safe unit.

Figure 22: Name plate (example)




⚠ CAUTION

**Exposed, rotating parts (discs/balls) at the valve!**

*Pinching and damage by valve or actuator.*

→ End stops should be set by suitably qualified personnel only.

→ Avoid excessive unscrewing of settings screws. Observe dimension $T_{min.}$!

The setting sequence depends on the application. As a general rule, the end position of the fail safe function (fail safe position) is set first.

- Recommendation for safety function Fail safe CLOSE:
  → Set first end stop CLOSED with symbol.
- Recommendation for safety function Fail safe OPEN:
  → Set first end stop OPEN with symbol.

### 6.2.1. End stop CLOSED: set

1. Operate valve in mid-position, respectively in sufficient distance from the end position.
2. Remove screw plug next to ⊥ symbol.
3. Unscrew setting screw **counterclockwise** until reaching dimension $T_{min}$.
4. Operate the valve in end position CLOSED to ensure that valve is safely closed.

   **Information:** In motor operation: Interrupt travel in time prior to reaching the end stop and continue the last fraction of the travel in manual operation to prevent damage.
5. Turn setting screw **clockwise** until LSC end position switch signals that the FQM has reached end position CLOSED:

➥ Signal FQM end pos. CL; or LED ⊥ at local controls is illuminated.

6. Check settings: Use motor operation to operate the vale with actuator a fraction of travel back in direction OPEN. Then operate until end position in direction CLOSE.

➥ The end position CLOSED is correctly set, if the end position switch LSC signals that the FQM has reached end position CLOSED: Signal FQM end pos. CL; or LED ⊥ is illuminated.

7. Check O-ring in screw plug and replace if damaged.
8. Fasten and tighten screw plug next to ⊥ symbol.

### 6.2.2. End stop OPEN: set

1. Operate valve in mid-position, respectively in sufficient distance from the end position.
2. Remove screw plug next to ⊤ symbol.
3. Unscrew setting screw **counterclockwise** until reaching dimension $T_{min}$.
4. Move valve to end position OPEN.

   **Information:** In motor operation: Interrupt travel in time prior to reaching the end stop and continue the last fraction of the travel in manual operation to prevent damage.
5. Turn setting screw **clockwise** until LSO end position switch signals that the FQM has reached end position OPEN:

➥ Signal FQM end pos. OP; or LED ⊤ at local controls is illuminated.

6. Check settings: Use motor operation to operate the vale with actuator a fraction of travel back in direction CLOSED. Then operate until end position in direction OPEN.

➥ The end position OPEN is correctly set, if the end position switch LSO signals that the FQM has reached end position CLOSED: Signal FQM end pos. OP; or LED ⊤ at local controls is illuminated.

7. Check O-ring in screw plug and replace if damaged.
8. Fasten and tighten screw plug next to ⊤ symbol.

## 6.3. Reference operation (adaptive end position setting)

**After first initialisation and after end stop setting in the fail safe unit, each end position must be approached and left during standard operation to make sure that the actuator adopts these end positions. Imperatively perform this “reference operation” whenever an end stop resetting has been performed in the fail safe unit.**

**Information** In standard operation, the ESD signal (+24 V DC) must be applied at ESD input (refer to wiring diagram). The valve can be operated via the actuator (handwheel) or via actuator controls (motor operation).

# 7. Fail safe operation and standard operation

**The fail safe operation is an emergency function. Depending on the fail safe trigger via ESD or via power failure, an initialisation operation is required. In standard operation, the valve is electrically operated via the part-turn actuator.**

## Trigger signal for fail safe operation

A fail safe operation is triggered if the ESD (**E**mergency **S**hut **D**own) input is open (0 V DC).

**Switching behaviour of ESD input:**

- ESD input = Low level (0 V DC or input open)
  = fail safe operation is being executed
- ESD input = High level (+24 V DC)
  = the valve can be operated in standard mode via actuator

Depending on the configuration, the fail safe operation can be initiated by power loss at actuator controls. The factory configuration of the fail safe unit is configured at assembly and is specified in the order-related technical data sheet.

## Operating time configuration for fail safe operation

The operating time is preset in the factory. In order to modify the operating time, 4 different operating speeds can be selected via `FS speed configuration` (refer to wiring diagram) (level 1 – level 4).

**We recommend contacting the AUMA Service prior to modifying the operating time for a safe fail operation.**

## After a fail safe operation

CAUTION

**Turning handwheel at actuator following a fail safe operation!**

*Risk of hand injury for handwheels equipped with ball handle.*

→ Do NOT press the push button at actuator handwheel.

→ Following a fail safe operation, manual operation may only be re-engaged after successful initialisation (FQM FS ready signal).

# 8. Indications

## 8.1. Indications on display

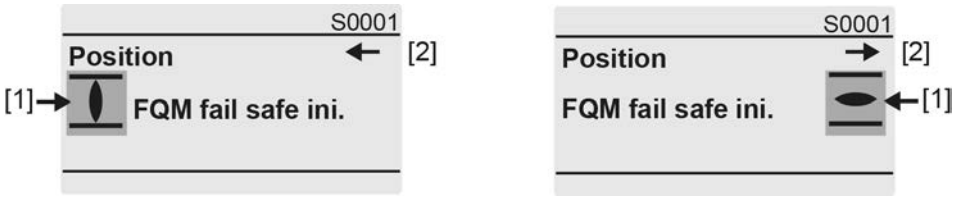
The indications described hereafter exclusively apply to the functions of the fail safe unit. For further indications of actuator controls, refer to the operation instructions pertaining to the actuator or to the Manual (Operation and setting) pertaining to actuator controls.

### 8.1.1. Indications during and after initialisation

**Information** Actuator controls cannot be actuated during initialisation.

FQM fail safe ini. During initialisation, the actuator controls display shows the following message in status indication S0001: FQM fail safe ini.

Figure 23: Example left: Fail safe CLOSE, right: Fail safe OPEN




[1] End position of FQM fail safe unit

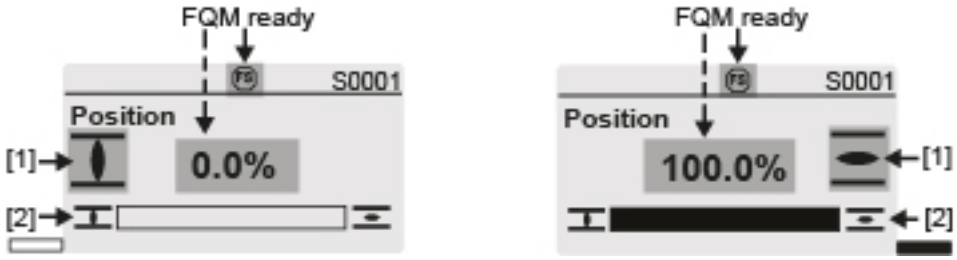
FQM (valve) is in end position CLOSED

FQM (valve) is in end position OPEN

[2] A small arrow points into the operational direction of the actuator during initialisation.

FQM FS ready After successful initialisation, actuator and valve are in the same end position. In the status line (top), the FS symbol is displayed, i.e. the constant force spring is wound, the FQM is ready for fail safe operation. At the same time, the display indicates the actuator position as figure (default setting %). For valve operation, the actuator is now ready to operate in standard mode.

Figure 24: Example of standard operation




[1] End position of FQM fail safe unit

= FQM fail safe unit (valve) is in end position CLOSED

= FQM fail safe unit (valve) is in end position OPEN

[2] Actuator position

Bar chart empty = Actuator is in end position CLOSED (0.0 %)

Bar chart black = Actuator is in end position OPEN (100 %)

**Information** FQM fail safe ini. and FS (FQM FS ready) indications can be supplied as signals via digital outputs. ➪ page 31, Signals (output signals)

### 8.1.2. Indications during fail safe operation

**Information** Actuator controls cannot be actuated during fail safe operation.

FQM fail safe act.

If a fail safe operation is triggered by ESD signal failure, the display of actuator controls indicates the following message in status indication S0001: FQM fail safe act.

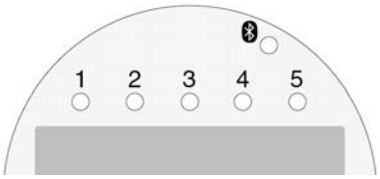
Figure 25: Example


[1] FQM fail safe act. = fail safe unit operates to defined end position

## 8.2. Indication lights of local controls

Different indications can be assigned to LEDs 1 – 5.

Figure 26: Arrangement of indication lights




In combination with a fail safe unit, additional setting values (indications) are available.

### 8.2.1. Indication lights (indications): modify

Required user level: Specialist (4) or higher.

M ▷ Device configuration M0053
Local controls M0159
Indication light 1 (left) M0093
. . .
Indicat. light 5 (right) M0097

**Possible setting values for fail safe function:**

FQM FS ready — The constant force spring is wound, the FQM is ready for fail safe operation.

FQM FS-ESD request — Fail safe function of FQM (fail safe) is requested (ESD requested).

FQM end pos. OP — FQM (valve) is in end position OPEN

FQM end pos. CL — FQM (valve) is in end position CLOSED

We recommend not to change the indication lights Indication light 1 (left) M0093 and Indicat. light 5 (right) M0097. When leaving the factory, the setting is made to indicate the end positions of the FQM fail safe unit.

We recommend assigning two indication lights with signals FQM FS ready and FQM FS-ESD request to detect the state of the fail safe unit.

For further setting values,refer to the operation instructions pertaining to the actuator or to the Manual (Operation and setting) pertaining to actuator controls.

# 9. Signals (output signals)

## 9.1. Status signals via output contacts (digital outputs)

Output contacts within actuator controls are used to send status signals (e.g. reaching the end positions, selector switch position, failures ...) as binary signals from actuator controls e.g. to the control room.

In combination with a fail safe unit, additional setting values (signals) are available.

### 9.1.1. Assignment of outputs

Required user level: Specialist (4) or higher.

M ▷ Device configuration M0053
I/O interface M0139
Digital outputs M0110
Signal DOUT 1 M0109
. . .
Signal DOUT 12

**Possible setting values for fail safe function:**

FQM FS ready — The constant force spring is wound, the FQM is ready for fail safe operation.

FQM FS-ESD request — Fail safe function of FQM (fail safe) is requested (ESD requested).

FQM end pos. OP — FQM (valve) is in end position OPEN

FQM end pos. CL — FQM (valve) is in end position CLOSED

We recommend assigning two outputs with signals FQM FS ready and FQM FS-ESD request to detect the state of the fail safe unit.

For further setting values,refer to the operation instructions pertaining to the actuator or to the Manual (Operation and setting) pertaining to actuator controls.

### 9.1.2. Direct feedback signals from the fail safe unit

These feedback signals can be directly issued by the fail safe unit and transmitted to the control room, for example.

Table 13:

| Feedback signal | Designation in the wiring diagram | |
|---|---|---|
| **FQM end position OPEN/CLOSED reached** | LSC | End position switch, closing, clockwise rotation |
| | LSO | End position switch, opening, counterclockwise rotation |
| | 1 NC and 1 NO (standard) each<br>Automatic setting when setting the end stops within the fail safe unit | |
| **Fail safe function ready** | FS ready | |
| | 1 NC and 1 NO (standard) | |

**Information**

The precise version is indicated in the wiring diagram or on the order-related technical data sheet.

All output signals must be supplied with the same potential.

# 10. Servicing and maintenance

CAUTION

**Damage caused by inappropriate maintenance!**

→ Servicing and maintenance must be carried out exclusively by suitably qualified personnel having been authorised by the end user or the contractor of the plant. Therefore, we recommend contacting our service.

→ Only perform servicing and maintenance tasks when the device is switched off.

**AUMA Service & Support**

AUMA offers extensive service such as servicing and maintenance as well as customer product training. For the contact addresses, refer to our website (www.auma.com).

## 10.1. Maintenance intervals

**Recommendation for plants subject to strong vibration**

- For plants subject to strong vibration, 6 months after commissioning and then once a year: Check fastening screws between fail safe unit and valve for tightness. If required, fasten screws while applying the tightening torques as indicated in chapter <Assembly>.
- In case supports are mounted, we recommend checking all support screws for fast tightening. For screws sealed and secured with e.g. thread sealing material, this action is not required.

**Recommendation for areas with explosion hazards:**

When deployed in areas where dust formation represents a potential explosion hazard, perform visual inspection for deposit of dirt or dust on a regular basis. Clean devices if required.

**Recommendation for maintenance:**

- In standard operation (valve opening/closing via the part-turn actuator), no further actions are required during operation, e.g. grease change. Maintenance intervals in standard operation depend on the overall combination between actuator (gearbox), FQM and valve and must be followed according to the operation instructions of the mounted components.
- Generally, the fail safe unit can be operated without maintenance when respecting the specified number of fail safe operations according to the technical data (opening/closing the valve via spring force). Thereafter, we recommend calling the AUMA Service for maintenance.

# 11. Technical data

**Information** The following tables include standard and optional features. For detailed information on the customer-specific version, refer to the order-related data sheet. The technical data sheet can be downloaded from the Internet in both German and English at **http://www.auma.com** (please state the order number).

## 11.1. Technical data fail safe unit

| Type | Fail safe operation in s/90°[1] | Min. torque | Suitable part-turn actuator | | Valve attachment | | Valve shaft | | | Weight[2] |
|---|---|---|---|---|---|---|---|---|---|---|
| | Configurable in factory | [Nm] | Type | Possible operating times s/90° | Standard EN ISO 5211 | Option EN ISO 5211 | Cylindrical Max. [mm] | Square Max. [mm] | Two-flat Max. [mm] | approx. [kg] |
| FQM 05.1 | 9 to 34 | 150 | SQ 05.2 | 5.6 to 32 | F07 | F10 | 25.4 | 22 | 22 | 63 |
| FQM 07.1 | 8 to 26 | 300 | SQ 07.2 | 5.6 to 32 | F07 | F10 | 25.4 | 22 | 22 | 66 |
| FQM 10.1 | 15 to 54 | 600 | SQ 10.2 | 11 to 63 | F10 | F12 | 50 | 36 | 36 | 137 |
| FQM 12.1 | 13 to 39 | 1,200 | SQ 12.2 | 22 to 63 | F12 | F14 | 50 | 36 | 36 | 140 |

1) Operating time increases when higher torque is required.
2) The weights of SQ .2 actuators and AC .2 actuator controls must be added.

| **Features and functions** | | |
|---|---|---|
| Type of duty | Standard: | FQM: Short-time duty S2 - 15 min, classes A and B according to EN 15714-2 |
| | Option: | FQMR: Intermittent duty S4 - 25 %, class C according to EN 15714-2<br>(not available in SIL version) |
| Mains voltage, mains frequency | Refer to name plate<br>Permissible variation of mains voltage: ±10 %<br>Permissible variation of mains frequency: ±5 % | |
| ESD input | 24 V DC, current consumption: approx. 1 A<br>Permissible voltage variation: +20 %/–15 % | |
| Status signals | Single switches (1 NC and 1 NO) for each end position: max. 0.1 A at 30 V DC<br>Output contact for fail safe function ready signal: max. 0.1 A at 30 V DC<br>All output signals must be supplied with the same potential. | |
| Swing angle | Adjustable between 80° and 96° | |
| Electrical connection | Standard: | FQM = AUMA plug/socket connector with screw-type connection<br>FQM**Ex** = Ex plug/socket connector with screw-type terminals (KP), max. 38 control terminals / max. power supply 525 V AC |
| | Options: | FQM = Terminals or crimp-type connection<br>FQM**Ex** = Ex plug/socket connector with terminal blocks (KES) |
| Threads for cable entries | Standard: | Metric threads |
| | Option: | Pg-threads, NPT-threads, G-threads |
| Terminal plan | Terminal plan according to order number enclosed with delivery | |
| Splined coupling for connection to the valve shaft | Standard: | Coupling without bore |
| | Option: | Machined coupling with bore and keyway, square bore or bore with two-flats according to EN ISO 5211 |
| Valve attachment | Dimensions according to EN ISO 5211 without spigot | |

| **Service conditions** | | |
|---|---|---|
| Use | Indoor and outdoor use permissible | |
| Mounting position | Vertical and horizontal position (for horizontal mounting position, a support is required)<br>Pointing downward is not permitted | |
| Installation altitude | ≤ 2 000 m above sea level<br>> 2 000 m above sea level on request | |
| Ambient temperature | Standard: | –30 °C to +70 °C |
| | Option: | –60 °C to +60 °C |
| | For exact version, refer to actuator name plate. | |
| Humidity | Up to 100 % relative humidity across the entire permissible temperature range | |
| Enclosure protection according to EN 60529 | IP68 | |
| | According to AUMA definition, enclosure protection IP68 meets the following requirements:<br>• Depth of water: maximum 8 m head of water<br>• Duration of continuous immersion in water: Max. 96 hours | |
| Pollution degree according to IEC 60664-1 | Pollution degree 4 (when closed), pollution degree 2 (internal) | |
| Vibration resistance according to IEC 60068-2-6 | FQM 05.1/07.1 with valve attachment F07 = 0.3 g, 10 to 200 Hz<br>FQM 05.1/07.1 with valve attachment F10 = 0.5 g, 10 to 200 Hz<br>FQM 10.1/12.1 with valve attachment F10 = 0.3 g, 10 to 200 Hz<br>FQM 10.1/12.1 with valve attachment F12 = 0.5 g, 10 to 200 Hz<br>Resistant to vibration during start-up or for failures of the plant. However, a fatigue strength may not be derived from this. | |
| Corrosion protection | Standard: | KS: Suitable for use in areas with high salinity, almost permanent condensation, and high pollution. |
| | Option: | KX: Suitable for use in areas with extremely high salinity, permanent condensation, and high pollution. |
| Coating | Double layer powder coating<br>Two-component iron-mica combination | |
| Colour | Standard: | AUMA silver-grey (similar to RAL 7037) |
| | Option: | Available colours on request |
| Lifetime | 500 fail safe operations (ESD cycles)<br>AUMA fail safe units meet or even exceed the lifetime requirements of EN 15714-2 in motor operation. Detailed information can be provided on request. | |

| **Special features for use in potentially explosive atmospheres** | | |
|---|---|---|
| Explosion protection | ATEX: | II 2G Ex db eb IIB T4 Gb, or<br>II 2G Ex d IIB T4 Gb |
| | IECEx: | Ex db eb IIB T4 Gb, or<br>Ex d IIB T4 Gb |
| | For exact version, refer to actuator name plate. | |
| Certificates and standards | ATEX: | DEKRA 16 ATEX 0080 X |
| | IECEx: | IECEx DEK 16.0039X |
| | All standards applied and their respective issues are indicated on the certificates supplied. | |

| Further information | |
|---|---|
| EU Directives | • ATEX Directive: (2014/34/EU)<br>• Electromagnetic Compatibility (EMC): (2014/30/EU)<br>• Machinery Directive: (2006/42/EC) |

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