SIPOS AKTORIK

Operation instructions NMA 3943

Electric rotary actuators for nuclear applications

Series
R/S-SIWI
R/S-SIWI-AS

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1 General information

These electrical devices are intended for use in high voltage industrial installations. During electrical operation, this equipment has dangerous, uninsulated live parts as well as moving or rotating parts. In the event of unauthorized removal of the necessary covers, improper use, incorrect operator control or inadequate maintenance, they can cause serious damage to health or property.

Persons responsible for plant safety must therefore ensure that:

- Only qualified persons are authorized to work on the machines.
- These persons have constant access to the supplied operation instructions and the remaining product documentation for all related work and that they are instructed to comply with this documentation at all times.
- Unqualified persons are not permitted to work on the machines or in the vicinity of the machines.

1.1 Safety-related terms

The headings **DANGER, WARNING, CAUTION** and **NOTICE** are used in these operation instructions to draw attention to specific dangers or unusual information that requires special emphasis.

DANGER	indicates that non-observance can result in death and/or substantial property damage.
WARNING	indicates that non-observance can result in severe personal injury and/or substantial property damage.
CAUTION	indicates that non-observance can result in personal injury and/or property damage.

NOTICE	indicates that attention is being drawn to technical implications because they are not always self-explanatory even to qualified technical personnel.

Compliance with the other transport, installation, operating and maintenance instructions that are not specifically emphasized as well as with technical data (in the operating instructions, product documentation and on the equipment) is also essential in order to prevent faults that can directly or indirectly result in severe personal injury or property damage.

Correct transport, proper storage, mounting and installation, as well as careful commissioning are essential to ensure trouble-free and safe operation.

Qualified personnel are persons who as a result of their training and experience as well as knowledge of the pertinent standards, regulations, accident prevention regulations and operating conditions have been authorized by the person responsible for the safety of the installation to perform the respective tasks and to identify and prevent any associated dangers.

Knowledge of first aid and the local emergency services is also essential.

For work on power installations, prohibition of use of non-qualified persons or similar is stipulated in EN 50110-1 (formerly DIN VDE 0105) or IEC 60364-4-47 (VDE 0100 part 470).

1.2 General safety information

The devices referred to in this document are components of installations conceived for industrial applications. They are designed in accordance with the recognized engineering rules.

DANGER Due to its functional characteristics, this equipment may cause serious damage to health or property in the event of, for example, improper use, incorrect operator control, inadequate maintenance or unauthorized intervention by unqualified personnel.

WARNING It is assumed that the basic planning work for the installation, as well as all work involved in transport, assembly, installation, commissioning, maintenance and repair is carried out by qualified personnel or checked by responsible specialists.

Furthermore, the following has to be observed:

- the technical data and information concerning the permissible use (installation, connection, ambient and operating conditions) provided in the catalog, order documents, operation instructions, rating plate data and in the other product documentation;
- the general installation and safety guidelines;
- the local, plant-specific regulations and requirements;
- the proper use of tools and lifting and transport equipment;
- the use of personal protective clothing and equipment, especially in high noise levels, with high ambient temperatures and with high actuator surface temperatures (caused by frequent and long activation times) and when handling cleaning agents and lubricants, glues, paints or similar.
- For detailed information on individual products refer to the pertaining material safety data sheets of the manufacturer.

For the sake of clarity, not all details of all possible versions of the product are described in the operation instructions, nor can they cover all conceivable cases regarding installation, operation and maintenance. The operating instructions therefore only contain information that is required for the intended use of the devices or, in industrial applications, by qualified personnel (see above).

In special cases, if the devices are to be used in non-industrial areas where higher requirements are necessary (e.g. protection against the penetration of children's fingers), these requirements must be met by the customer on site by implementing additional protective measures.

In the event of doubt, especially in cases of lack of product-specific details, clarification must be obtained via your local SIPOS Aktorik sales department. Please specify device type and works number in any correspondence (see actuator rating plate). IT IS RECOMMENDED THAT THE SERVICES AND SUPPORT OF THE RESPONSIBLE SIPOS AKTORIK SERVICE CENTERS ARE UTILIZED FOR ALL PLANNING, INSTALLATION, COMMISSIONING AND SERVICE TASKS.

NOTICE

- For general tasks, e.g. for checking incoming deliveries (for transport damage) and for long-term storage and preservation of equipment, additional information is provided in the SIPOS Aktorik installation documents that can be obtained on request from the sales departments.
- The contents of these operation instructions and product documentation shall not become part of or modify any prior or existing agreement, commitment or legal relationship. The Sales Contract contains the entire obligations of SIPOS Aktorik. Any statements contained in this document do not create new warranties or restrict the existing warranty.

1.3 Transport

Only lift actuators by means of the transport lugs or wrap a rope around the motor and the spring cup. Never attach a rope to the handwheel or the changeover lever. Do not wrap a rope around external electrical cables or subject them to any other type of mechanical loading.

The transport instructions attached to the devices must be observed.

1.4 Storage

If an actuator is not installed immediately after delivery, it should be stored in a dry, vibration-free location.

If an actuator is stored in a damp environment, desiccant should be placed inside the housing and its effectiveness must be checked.

Take care not to damage the packaging of actuators sealed in plastic film and only remove it just before mounting the actuator to the valve.

The hoods covering the electrical control equipment and the cable feed-through holes must remain closed even during the interval between installing and commissioning the actuator. The build-up of condensation can be prevented by operating a heater inside the housing of the control equipment or by using a desiccant.

1.5 Disposal and recycling

1.5.1 Packaging

Our products are protected by special packaging for the transport ex works. The packaging consists of environmentally sound materials which can easily be separated and recycled.
For the disposal of the packaging material, we recommend recycling and collection centers.
We use the following packaging materials:
Wooden material boards (OSB) / cardboard / paper / PE-film.

1.5.2 Actuator

SIPOS actuators have an extremely long lifetime. However, there will come a time when you have to replace them.
Our actuators have a modular design and may therefore easily be disassembled, separated and sorted according to materials, i. e.:

- various metals
- plastics
- greases and oils

The following generally applies:

- Collect greases and oils during disassembly. As a rule, these are substances hazardous to water and must not be released into the environment.
- Arrange for controlled waste disposal of the disassembled material or for separate recycling according to materials.
- Observe the national/local regulations for waste disposal.

2 Description

2.1 Scope of supply

The scope of versions of available electric rotary actuators is exclusively specified in the catalogs or ordering data.

Electric rotary actuators	Type / Size [1] / Order no.	Series [2]
For standard actuators	M76361 - ..... - .... - Z ... M76371 - ..... - .... - Z ... M76371 - ..... - .... - Z … + R99 M76361 - ..... - .*.. - Z N.N M76361 - ..... - .*.. - Z N.K M76371 - ..... - .*.. - Z N.H	S - SIWI S - SIWI - AS S - SIWI - AS - LZ S - SIWI - C S - SIWI - CD S - SIWI - CAS
For modulating actuators	M76362 - ..... - .... – Z ... M76372 - ..... - .... – Z ... M76362 - ..... - .*.. - Z N.N M76362 - ..... - .*.. - Z N.K M76372 - ..... - .*.. - Z N.H	R - SIWI R - SIWI - AS R - SIWI - C R - SIWI - CD R - SIWI - CAS

1) The letter in position 7 (first character in second block) identifies the size:
C, E, F, G, M, N bzw. S, U

2) The abbreviations in the series designations are as follows:
S : for open-loop control equipment
R : for closed-loop control equipment
SIWI : relevant to safety
C : Letter identifying actuators for use in nuclear installations of type WWER
D : with a pressure-resistant housing for switching and signaling unit
AS : designed-fault resistant
LZ : long-term availability

2.2 Applications

The electrical rotary actuators are used to operate shut-off valves and control valves in pipe systems:

- **Standard actuators** of type M76361../ M76371.. (series S) are designed for standard equipment in nuclear installations.
- **Modulating actuators** of type M76362../ M76372.. (series R) are designed for modulating equipment in nuclear installations.

2.3 Mechanical construction and function

2.3.1 Motor operation

All actuators operate according to the same principle. The power is transmitted from the motor via a reduction gear with spur wheels and a worm gear to the actuator shaft.

For sizes "S" and "U", planetary gearing follows this combination of gears.

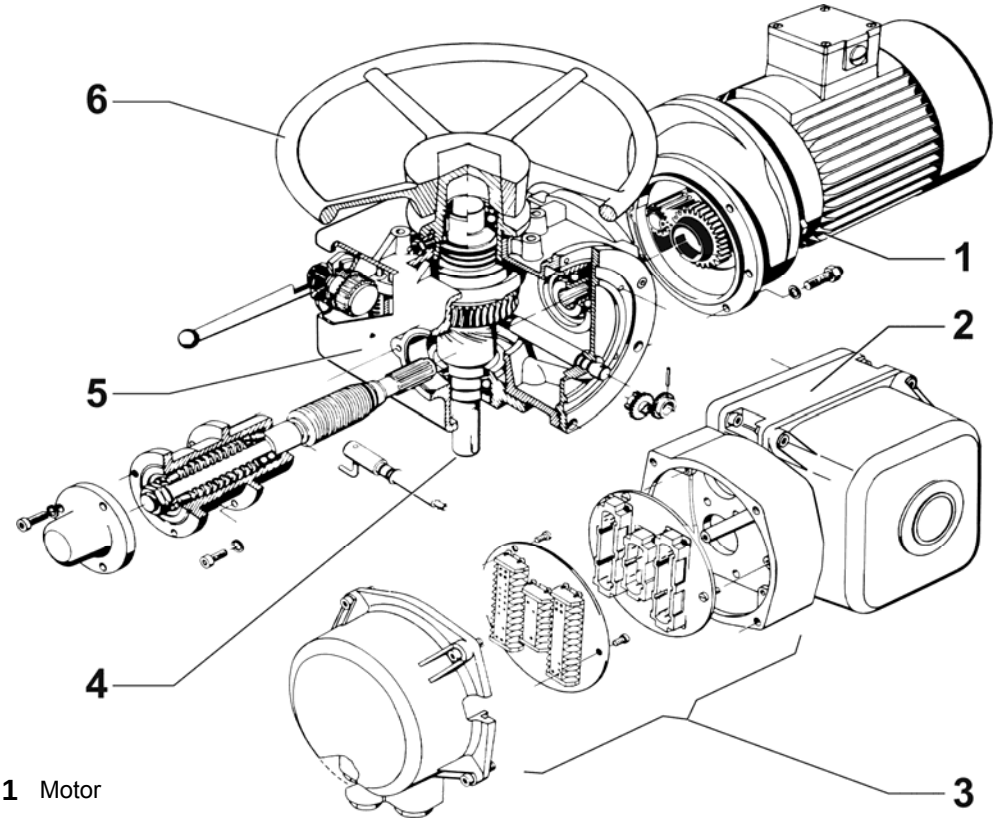
Different numbers of poles for the actuator motors and different reduction ratios for the reduction gear and the worm gear result in a wide speed range for the actuator shaft between 5 and 180 rpm. In order to obtain the same maximum tripping torque for all output speeds of a given size, motors of different output ratings are assigned to actuators of one size.

For torque measurement, the worm is held in the center of the worm wheel with cup springs. It can be moved axially to both sides. When a load torque is applied to the actuator shaft, the tangential force on the worm wheel pushes the worm shaft out of its central position and operates the torque switch within the switching and signaling unit via a system of levers. The torque switch provides a signal for switching the motor off.

The gears are filled with lubricant and sealed on all sides. All gear shafts in the power train run in roller bearings or in special friction-bearing bushes.

NOTICE relating to self-locking in motorized mode:

- All modulating actuators are self-locking
- Standard actuators with higher speeds (see catalog) are not self-locking. For these actuators, the switch-off signal must be kept active after torque-dependent switch-off by an electrical interlock.



1 Motor

2 Switching and signaling unit

3 Electrical connection via plugs

4 Output drive shaft (output shaft)

5 Gearing

6 Handwheel

2.3.2 Manual operation

All actuators can be operated by a handwheel which is disengaged in motorized mode. A changeover lever can be operated to disconnect the actuator motor from the actuator shaft and to connect the handwheel (see 4.2). This position is locked by a special mechanism. The handwheel is automatically disengaged without danger for the operator when the motor starts up and the motor is connected again. Motorized mode always has priority over manual mode.

NOTICE The changeover lever can only be used to switch from motorized mode to manual mode (see 4.2).

NOTICE Actuators of sizes M763..-F, -G, -M and -N can also be supplied with a reduction gear in which the handwheel shaft is at an angle of 90° to the actuator shaft.

CAUTION For actuators of sizes M763..-C, -E, -F, -G, -M and -N, when changing to manual mode, the handwheel is connected directly to the actuator shaft, i.e. the worm gear is not in the power train. This means that there is no self-locking in manual mode (see above).

Actuators of sizes M763..-S and -U are equipped with a handwheel reduction gear.

For these actuator types, the power train is diverted in manual operation via the helical shaft due to the high torque. Otherwise with direct action on the actuator shaft, it would not be possible to produce the necessary force using a suitable handwheel diameter.

The rule is that clockwise rotation of the handwheel produces clockwise rotation of the actuated valve or final control element shaft.

3 Installation

- **WARNING** General safety information and requirements concerning the permissible use of the equipment and the specialist knowledge necessary for working on high-voltage installations are provided in section 1.2. Complete compliance with these instructions is essential.
- Before starting installation work, ensure that the intended action (operation of valves, etc.) will not cause any danger to persons or interfere with the installation.
- Assembly work has to be performed by trained and qualified personnel.

3.1 Assembly with final control element

If operating conditions permit that injury can result from touching moving parts, these part must be covered appropriately.

The actuator can be mounted in any position. It is recommended that the actuator shaft is in the vertical position with the connecting flange downwards.

General mounting tasks:

- For actuators of type M763.. – G / M / N: fit handwheel to the hub, if required see 6.2
- Remove anti-corrosion coating from the connecting flange and cover; clean the connecting parts carefully.
- Grease the connecting parts.
- Place actuator with connecting flange on the final control element, check for correct centering and sliding seating of the connecting parts.
- Do not apply force!
- Attach the actuator to the final control element with screws of type 8.8 and secure with spring washers. Screwing depth: ≥ 1.25d.
- If the protective tube for the spindle is to be installed:
  - Remove the end cover from the hollow shaft.
  - Apply sealant to the winding and sealing surfaces (e.g. “Silastic” RTV 732 by Dow Corning, D-65201 Wiesbaden).
  - Mount the supplied protective tube for the spindle and fix it in place.
- Check actuator and valve for damage. Repair any damage, touch up any damage to the coating.

3.1.1 Additional measures after installing the actuator

The following measures have to be carried out for actuators installed inside containment.

The pressurized reactor includes the containmant (PWR/BWR) and the main steam valve station/valve chamber (PWR).

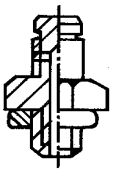
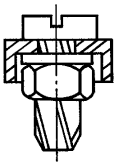
The measures according to item 3.2.1.1 to item 3.2.1.3 have not to be carried out for actuators mounted outside containment (e.g. in annulus).

This is valid for actuators working only for a short time (< 5 h) under following conditions in the case of worst operation mode: absolute pressure : ≤ 1.2 bar; temperature ≤ 100 °C.

If a. m. conditions (p > 1.2 bar and / or T > 100° C) are exceeded, suitable measures have to be carried out after consulting SIPOS Aktorik GmbH.

For all series:

- on the gear housing filled with lubricant:
  - depending on the mounting angle of the actuator, remove the screw painted in red located at the highest point of the gear housing casing
  - insert the supplied pressure balance screw depending on the type (C.. U) (refer to table 3.2): Tighten pressure balance screw with a torque of M = 4.5 Nm.

M763.. – C [1)]	M763 .. – E / F / G / M / N	M763.. – S / U
		
Fig. 3.2.1.1 a:	**Fig. 3.2.1.1 b**	**Fig. 3.2.1.1 c**

1) Alternatively, the pressure balance screw according to fig. 3.2.1.1 **a** can also be used for the actuator of type M763 .. – E .

Table 3.2: Pressure balance screw

- also for types M763.. - S and - U :
  Attach the supplied pressure balance screw to the housing of the motor reduction gearing, see Figure 3.2.1.1 b. The pressure balance screw must be tightened with a torque of 4.5 Nm.

Series: S-SIWI, S-SIWI-C, R-SIWI, R-SIWI-C:

- on the housing of the switching and signaling unit:
  - remove the screw painted in red,
  - insert the supplied pressure balance screw (see figure 3.2.1.2.**a**).

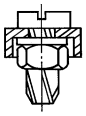


Fig 3.2.1.2.a: Pressure balance screw

3.2.1.3 Series: S-SIWI-AS, S-SIWI-CAS (Caution: not for S-SIWI-AS-LZ)

- on the motor:
  - depending on the mounting angle of the actuator, the condensation drain holes at the lowest point on the motor (on the motor flange and on the fan cover / non-drive side) must be opened.
  - for this purpose, remove the screws at the lowest point.

3.2.1.4 Series: S-SIWI-AS, S-SIWI-AS-LZ, R-SIWI-AS, S-SIWI-CD, S-SIWI-CAS, R-SIWI-CD, R-SIWI-CAS

- on the housing of the switching and signaling unit:
  - after the switches, position indicators, etc. have been set, fit the hood carefully and seal it tightly.
  - for this purpose, the O-ring and its contact surface must be cleaned and Parker O-Lube by Parker Hannifin GmbH, D-74383 Pleidelsheim, or an equivalent sealant must be applied to the O-ring.
  - replace damaged O-rings.

NOTICE These measures are necessary if the tightness test is to be passed successfully (see 3.5.3).

3.2 Electrical connection

The motor and the modules of the switching and signaling equipment must be connected in accordance with the wiring diagrams attached to the inside of the hood of the switching and signaling unit.

3.2.1 Additional connection measures are necessary in the case of the following series:

Series: S-SIWI-AS, S-SIWI-AS-LZ, R-SIWI-AS, S-SIWI-CD, S-SIWI-CAS, R-SIWI-CD, R-SIWI-CAS

- Tightly seal the housing for the electrical connection.
- Only use cable grommets which have been tested for fault-proof sealing at the points of entry of the control and motor cables in the housing for the electrical connection.
- Install cable grommets in the same manner as for qualification.
- Seal unused cable openings with blind metal plugs, insert the threaded rod with "Silastic" RTV 732 by Dow Corning, D-65201 Wiesbaden, or with an equivalent silicon sealant.
- Protect wires against damage from the sharp edges of the connector hood using heat-shrink tubing (material to DIN ISO 1629: FPM), see figure 3.3.1 a.
- For the electronic position indicator (ESR) shielded control wires for signal transmission have to be used which are earthed on both sides (please refer to operating instructions or see 3.4.3.2).

For the switching and signaling unit, the installation instructions of section 3.2.1.4 must be observed and if necessary, the tightness test should be carried out in accordance with section 3.5.3.

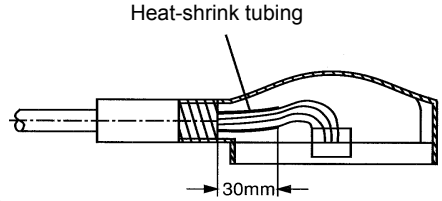


Fig. 3.3.1 a: Tubing for wire protection

3.2.2 Motor connection

The motor has to be connected in accordance with the connection diagram attached inside the actuator.

3 Installation

3.2.3 Circuit for versions with brake motor

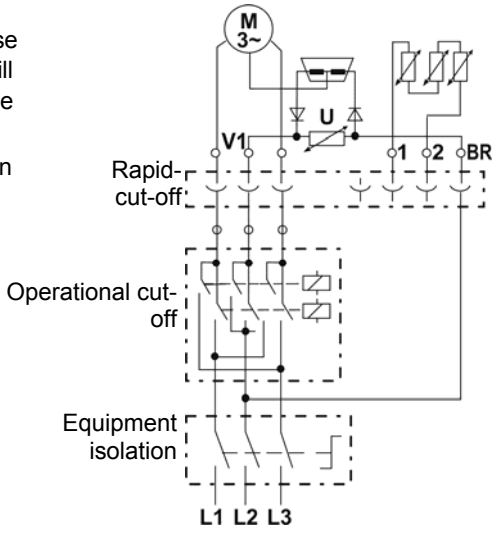
Series: R-SIWI and R-SIWI-C

The brake motor of type 1L; if fitted, is used for rapid cut-off. The brake connection (BR) must be connected before the reversing contactor unit on outer main phase L2 (see terminal drawing in the connection compartment).

> **DANGER:** In the circuit for rapid cut-off, equipment isolation is only possible via the main switch because even with a tripped contactor, the equipment can still be live via the "BR" feeder branched off ahead of the contactor!
>
> It is only permitted to change the direction of rotation by exchanging phases L1 and L3!

The brake motor wiring on the right is only valid for motors of type **1LC** … (by Siemens AG).

Brake motors type OLB … / Q28 (by Emod Motoren GmbH) are to be connected in accordance with the terminal plan in the connection compartment or the motor terminal box (refer to pertaining operation instructions of the brake motor).



3.3 Adjusting switching and signaling equipment

3.3.1 Torque-dependent switching mechanism (DSW)

The standard settings are made in the factory.

Series R

The torque-dependent switches (S1 and S2, in figure 3.4.1 a) are permanently set to the rated positioning torque. These settings must not be changed!

Series S

The cut-off torque is only permitted to be changed within the adjustment range and with test bench testing.

- Adjust switch S1 for clockwise rotation of the actuator shaft (view on the final control element) e.g. closing of the final control element:
  - Compare the scale (3 in figure 3.4.1 a) notched into the clamping piece (4) and the associated auxiliary scale (7) on the sticker (adjustment range is marked) and determine which notch on the clamping piece corresponds to the required cut-off torque.
  - To change the cut-off torque, press the adjustment knob (1) on switch S1 and rotate it until the setting pointer (2) points to the notch determined as described above. The adjustment knob latches in place automatically when it is released.

NOTICES:

- Screws 5 on clamping pieces 4 and 6 must not be released!
- Cam discs 8 must not be moved so far that switch S1 or S2 are pressed when the actuator is not under load.
- It is neither possible and nor permissible to turn cam disc 8 beyond notch 13.
- Measure cut-off torque on the test bench and record the values on the test certificate and on the rating plate.

- Perform the same steps to set switch S2 (for counterclockwise rotation of the output drive shaft).

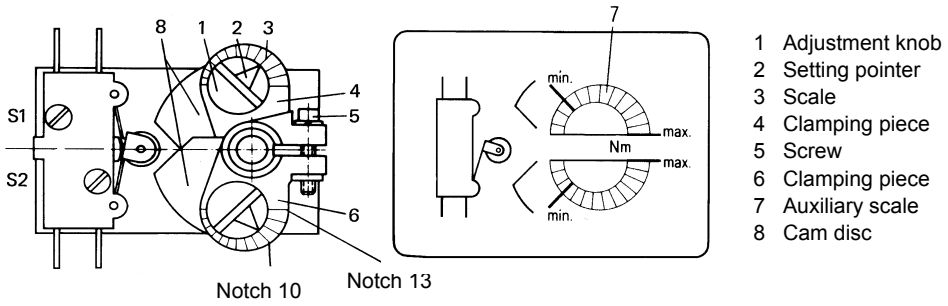


Fig. 3.4.1 a: Torque-dependent switching mechanism with 2 switches and associated sticker with auxiliary scale

3.3.2 Travel-dependent switches

Determining and compensating the overrun:

For travel-dependent switch-off, the overrun has to be determined for the actuator with connected final control element. Then the travel limit switch has to be adjusted so that the final control element just reaches the final position when the motor comes to a standstill.

Compliance with the installation checks is essential (see 3.5.1).

Travel-dependent roller switching mechanism (RSW)

Adjusting the switches:

Rotate the handwheel clockwise (closing direction) or counterclockwise (opening direction) until the final control element reaches the required position.

Directions of rotation

Switch S3 (fig. 3.4.2.1 a):

Clockwise rotation of the handwheel

- Clockwise rotation of the output drive shaft (view on the final control element)
- Clockwise rotation of the switching cam (3)

Switch S4:

Counterclockwise rotation of the handwheel

- Counterclockwise rotation of the output drive shaft
- Counterclockwise rotation of the switching cam 5

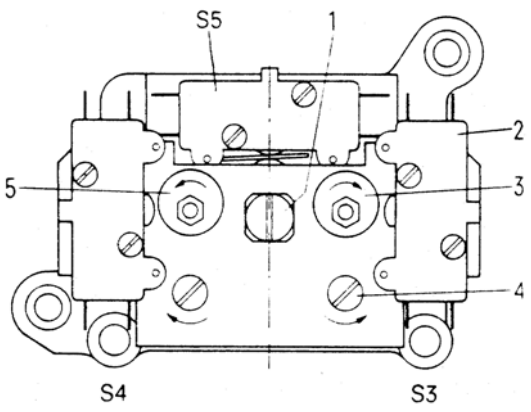


Fig. 3.4.2.1 a: Roller switching mechanism (plan view)

S5 Flasher switch

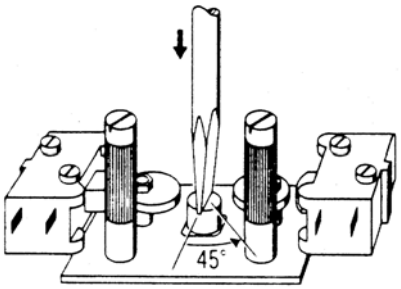


Fig. 3.4.2.1 b: Disengaging the central drive

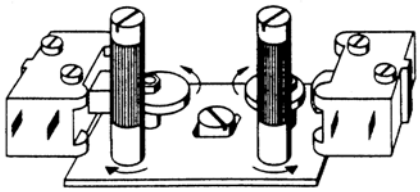


Fig. 3.4.2.1 c: Adjusting the switching point

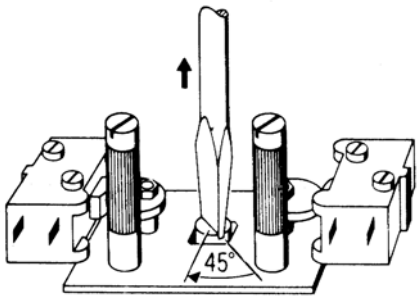


Fig. 3.4.2.1 d: Re-engaging the central drive

- Disengage central drive by pressing down pin 1 (fig. 3.4.2.1 a) and rotating it by 45° (fig. 3.4.2.1 b); central drive is now disengaged (fig. 3.4.1.2 c.).
- Adjust switching point on switch S3 (Fig. 3.4.2.1 a); Rotate the roller axle (4) using a screwdriver or by hand in the direction of the arrow until the cam (3) just operates the micro switch (2). Determine the switching point with the indicator light.

NOTICE:
- Do not rotate the roller axle beyond the switching point; otherwise the setting will be incorrect.
- Do not rotate the handwheel while central drive is disconnected.

- Re-engage central drive (figure 3.4.2.1 d)
- For counterclockwise handwheel rotation (switch S4, figure 3.4.2.1 a), e.g. for the opening direction, proceed as described
- Operate actuator across the entire travel range using the motor.
  At the same time, check adjustment of the switching points and correct if necessary.

Travel-dependent cam switching mechanism (NSW)

This switching mechanism is installed if additional switches are required.

Adjusting the switches:

- Operate actuator into the required position and note the direction of rotation for cam disc to be adjusted (figure 3.4.2.2 c)!
- Loosen knurled nut 3 (fig. 3.4.2.2 c), locking nut 4 must not be moved.
- Adjust switching point: On the appropriate cam disc, rotate the upper or lower fan disc (see table) in the direction of rotation determined as described above until microswitch 1 just operates.

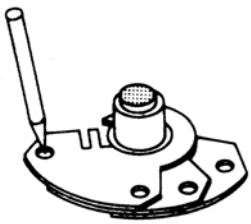


Fig. 3.4.2.2 a: Cam disc comprising 3 fan discs

Direction of rotation of the cam disc on approaching the switch position	Switching with make contact (fig. 3.4.2.2 b left)	Switching with break contact (fig. 3.4.2.2 b right)
Clockwise	Adjustment with upper fan disc	Adjustment with lower fan disc
Counterclockwise	Adjustment with lower fan disc	Adjustment with upper fan disc

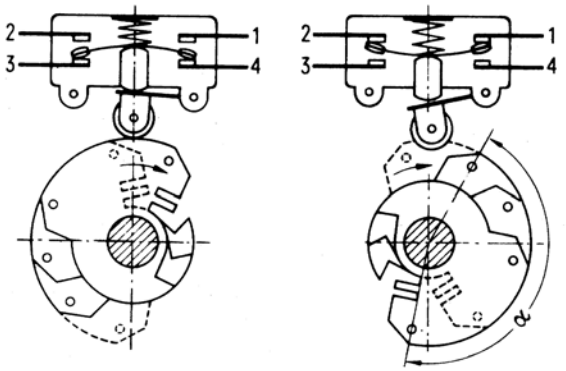
- Spread the remaining fan discs to ensure that the required switching state is retained across the remaining travel.

☞ The central fan disc must not protrude beyond the upper or lower fan discs!

- Tighten the knurled nut again by hand.

☞ If the knurled nut is loose, the fan discs might move out of position.

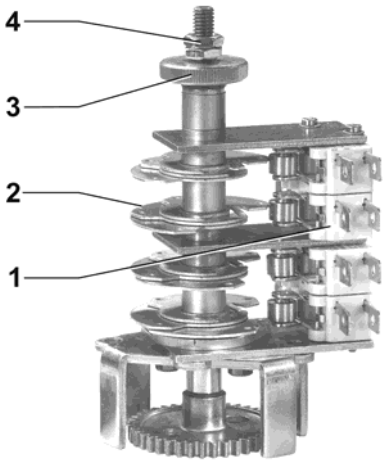
Once all switches have been set, operate the actuator over the entire travel range using the motor; check adjustment of the switching points and correct if necessary



Switching with make contact
Contact made 3 - 4

Switching with break contact
Contact made 1 – 2

Fig. 3.4.2.2 b: Switching with the cam disc



1 Micro switch
2 Fan disc
3 Knurled nut
4 Locking nut

Fig. 3.4.2.2 c: Switching with 4 travel-dependent switches

3.3.3 Position transmitter

Potentiometer (POT)

This component is used for remote electrical signaling of the actuator position.

Operate actuator into both end positions. This causes the potentiometer to adjust itself via the integral friction clutch.

Electronic position transmitter (ESR)

The electronic position indicator (ESR) is used for remote signaling and feedback signaling of the actuator position. Please refer to the operating instructions for the ESR (Y070.191/GB).

Mechanical position indicator (SA)

- Operate actuator into end position "CLOSED"; set the red, movable pointer (2 or 3) to the fixed pointer (1) on the edge of the disc (see figure 3.4.4.3 a).
- Operate actuator into end position "OPEN"; set the green, movable pointer (2 or 3) to the fixed pointer.
- The position pointer can be removed; bend the fixed pointer 1 to one side and lift the axle (4) from the drive pin 5.

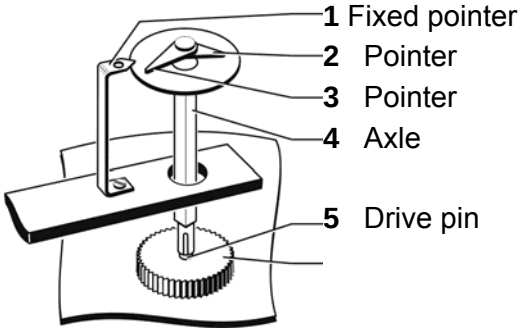


Fig. 3.4.3.3 a: Structure of the mechanical position indicator SA

3.4 Commissioning

3.4.1 Checks to be performed prior to commissioning

After installation, check and ensure that

- the actuator is correctly installed and aligned.
- all fixing screws and connecting elements as well as the electrical connections are tightened.
- grounding and equipotential bonding is correctly implemented.
- electrical connection of both motor and control corresponds to the wiring diagram.
- any additional devices are connected and function correctly.
- control is implemented such that an actuator possibly switched off by a temperature sensor cannot start up again automatically after cooling down.
- all protection measures against accidental contact have been implemented for moving or live parts.
- All plant-specific safety measures have been complied with.

This list cannot include all conceivable cases. Further checks may be necessary in accordance with the plant-specific conditions.

3.4.2 Switching on

WARNING: Consult the responsible plant personnel to obtain authorization and to ensure that the commissioning work to be performed cannot result in a plant disturbance or injury to staff.

After the mains voltage has been applied to the control, check and ensure that

- the direction of rotation is correct. For this purpose, operate the actuator using the handwheel approximately to the middle of the travel range and briefly activate open and close commands. Check at the same time that the actuator moves in the required direction.
  If this is not the case, interchange two connection cables (phases L1 and L3) and repeat the check.
- the signals from the limit switches are issued correctly when the two limit positions are approached;
- the motor is disconnected from the mains supply by the control as soon as the limits are reached;
- the assignment of the torque switches and travel switches with the specified direction of rotation is correct;
- the automatic control operates correctly.

3.4.3 Tightness test of the housing of the switching and signaling unit as well as the electrical connection

for series: – S-SIWI-AS, S-SIWI-AS-LZ, S-SIWI-CAS,
– R-SIWI-AS, R-SIWI-CAS

This check has to be performed after completion of actuator installation as well as after removing the switching and signaling unit from the gear housing, after removing cable grommets, after replacing hoods or connectors and following inspection work:

Permissible leakage rate q_{per}:

- during repeated tests in the plant $q_{per} = 2 \times 10^{-2}$ mbar*l/s
- during the final acceptance test $q_{per} = 1 \times 10^{-2}$ mbar*l/s

Test method:

- Underpressure time measurement (pressure rise)
- Apart from the test method that is described below, other approved methods can be used ensuring calculation of the permissible leakage rate.

Test circuit (refer to figure 3.5.3 a):

1 Housing of switching and signaling unit and electrical connection (test specimen)

2 Micronanometer of pressure transducer for underpressure, resolution < 0.1 mbar

3 Vacuum pump

4 Test connection, M6 with sealing ring, H1, H2 stopcock

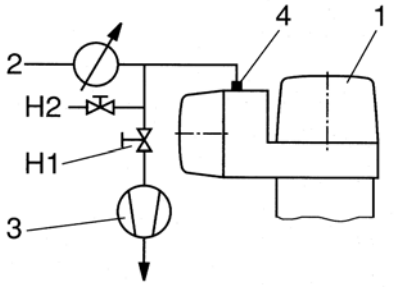


Fig. 3.5.3 a: Test circuit

Method:

- Set up the test circuit as shown in figure 3.5.3 a.
- Evacuate the test specimen with stopcock H1 open and stopcock 2 closed to a residual pressure of between 50 and 100 mbar.
- Close stopcock H1.
- Allow 15 – 20 min settling time. During the settling time, the residual pressure must not exceed 120 mbar abs., otherwise repeat evacuation.
  Determine pressure rise Δp within the test specimen over a test time $\Delta t \geq 5$ min, open stopcock H2, remove test supports and seal test hole with a new seal.

Evaluation:

Leakage rate $q = \frac{V \times \Delta p}{\Delta t}$ [mbar*l/s]

Δp = Pressure rise [mbar]

Δt = Test time [s]

Test time	Perm. pressure rise
5 min	66 Pa = 0.66 mbar
10 min	133 Pa = 1.33 mbar

} For high connector hood (V2 negligible)

V = V1 + V2
V1 = Specimen volume = 8 l for low connector hood, 9 l for high connector hooed
V2 = Test equipment volume

NOTICE The test specimen must be at ambient temperature. Temperature changes are not permitted during the test.

4 Operation

4 Operation

4.1 Safety instructions

WARNING:
Covers which prevent touching live or moving parts must not be opened during operation. See "Safety measures" in the "Maintenance" section.

Changes compared to normal operating conditions (higher power consumption, changes in temperature or vibration, unusual noises or smells, signals from the monitoring equipment, etc.) indicate that equipment function is impaired.

In order to prevent faults which can cause serious personal injury or damage to property either directly or indirectly, the responsible maintenance personnel must be informed immediately.

If a fault is suspected, immediately switch off the relevant equipment and, if necessary, operate the final control element into a safe position using the handwheel. The plant-specific conditions must be complied with in this instance!

4.2 Operating modes

Manual or motorized operation of the actuator is possible (see section 2.3.2).

- **Motorized mode:** Under normal operating conditions, the motor of the actuator is remote controlled.
- **Manual mode:** Only switch the actuator to manual operation when the motor is at standstill. Move the switching lever in the direction of the arrow until it latches. If resistance is felt, rotate the handwheel slowly to the left or right until the change-over mechanism is able to latch in place.

NOTICE Following torque-dependent cut-off, a greater force is required to switch over to "manual mode" for self-locking actuators, due to the pre-tension within the actuator.

WARNING If the motor is switched on, the actuator automatically resets to motorized mode, i.e. manual operation is disengaged. Do not use the handheld lever to reset the actuator. This is not permitted and would damage the change-over mechanism!

5 Maintenance

5.1 Safety measures

WARNING:
General requirements regarding the specialist knowledge necessary for operation and maintenance of systems and installations of this type are provided in section 1.2 of these operating instructions and require special attention.

Before any work is carried out on the actuator, ensure that

- the intended action (operation of valves, etc.) cannot cause any injury to persons or interfere with the installation;
- the actuator or plant section is properly disconnected. Apart from the main circuits, also ensure that any additional or auxiliary circuits, especially standstill heating circuits, are also isolated!

General safety rules:

- Disconnect all poles (see section 3.3.3)
- Prevent automatic switch-on
- Check that equipment is not live.
- Fit barriers or covers to neighboring live components.
- Ground and short-circuit equipment.

After work on/changes of the electrical part of the actuator (motor, switching and signaling unit), an insulation resistance test and protective earthing test in accordance with the applicable regulations have to be performed.
The tests have to be performed and recorded by qualified and trained personnel.

5.2 Inspections

It is recommended that under normal circumstances, the actuator is subjected to a general inspection following commissioning, in order to ensure that

- the equipment complies with its technical specifications and the automatic control operates correctly;
- the running smoothness of the actuator has not deteriorated;
- the fixing components have not become loose;
- no impermissible leakages have occurred.

This list cannot include all conceivable cases. Further checks may be necessary in accordance with the plant-specific conditions. Any impermissible deviations or changes detected during inspection must be rectified immediately.

The operating conditions may vary considerably, so the maintenance intervals must be adapted to the local conditions (taking into account the switch-on frequency, loading, etc.).

Under normal operating conditions, the following actions are necessary for maintenance purposes and therefore to guarantee correct functioning of the actuators:

- Monitoring: all actuators annually (plant tour, visual inspection).
- Inspection: all actuators, once every 8 years (detailed internal and external checking of condition, functioning, wear and lubrication).
- all actuators, once every 8 years (replacement of seals and lubricant, including functional checks).

The operating instructions for the motor must be observed when work is carried out on the motor.

All work carried out on the actuator and motor must be documented.

5 Maintenance

In the event of malfunction or overload, the appropriate inspections must be carried out earlier.

☞ It is recommended that the appropriate and trained specialists from the responsible SIPOS Aktorik service center are consulted in this case.
Please direct any inquiries to:
SIPOS Aktorik GmbH, Im Erlet 2, D-90518 Altdorf, Tel.: +49 9187 9227-5215,
Fax: +49 9187 9227-5122

5.3 Lubrication intervals and checks

Under normal operating conditions, the following intervals are recommended for the actuators (for type and quantity of lubricant, see table 5.3 b).

After approximately 8 years:

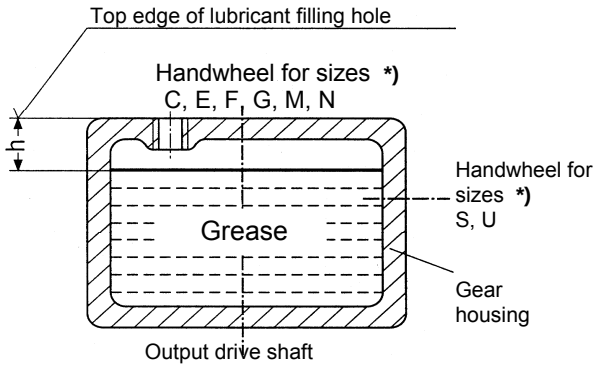
- Replace the lubricant in the gear housing and the reduction gear housing. For the type and quantity of lubricant, see table 5.3 b. The necessary filling level is listed in table 5.3 a.
- Slightly lubricate gear cogs and bearings of the switching and signaling equipment.
- Regrease handwheel and output shaft inserts. For the type and quantity of lubricant, see table 5.3 b.
- Regrease motor bearing, see table 5.3 c. Observe the following notes:
  - Clean bearings and grease with the specified bearing grease or completely replace the bearing if necessary.
  - Fill the gaps in the bearing and the spaces adjoining the bearings 50 % full with bearing grease.
  - For the sealant to seal the motor end shield, see table 5.3 c.
- Replace all seals.
- Replace radial sealing rings of the motor (contrary to the operating instructions for the motor).

In the case of increased loading, the maintenance intervals should be shortened accordingly.

⚠
- Whenever covers and hoods are removed, ´seals should be checked for damage and replaced and greased if necessary.
- When seals are replaced on actuator motors of type 11LP 3/5...-..-Z Q29, Q18 + AS3, Q19 + AS3, Q21 + AS3, Q31, Q32, Q33, or OL 56 .. 160 / … / Q29, Q31, Q32, Q33, or when work is carried out on these motors that can affect the tightness of the seals, they must be checked (test schedule: see page 22)

Actuator Type	h [mm]
M763.. - C	20 + / - 5
M763.. - E	20 + / - 5
M763.. - F / G	35 + / - 10
M763.. - M / N	35 + / - 10
M763.. - S	35 + / - 10
M763.. - U	35 + / - 10

Table 5.3 a: Filling level of lubricant in the gear housing



***)** Handwheel for sizes C, E, F, G, M, N fitted above for sizes S and U fitted on the side

Lubrication point / **Lubricant**	**Quantity of lubricant** according to size *) - C	- E	- F	- G	- M	- N	- S	- U
Gear enclosure Vehicle gear oil SAE 90 to DIN 51512 c)	1.5 dm³	2.5 dm³	6.0 dm³	6.0 dm³	13.0 dm³	13.0 dm³	11.5 dm³	16.5 dm³
Reduction gear enclosure Mobilux EP 004 a) (by Mobil Oil)	--	--	--	--	--	--	2,5 dm³	3,0 dm³
Handwheel reduction gear Vehicle gear oil SAE 90 to DIN 51512 c)	--	--	--	--	0.6 dm³		--	--
> Mobilgrease Special b) (by Mobil Oil)			0,2 dm³		--	--	0,2 dm³	
Handwheel reduction gear Roller bearing: Shell Gadus S2 V100 3 d) e) (Shell Dt. Schmierstoffe GmbH)	--	--	0.1 dm³		--	--	0.1 dm³	
Output drive shafts High-performance, long-lasting grease AR-1 EP (W. Zepf, Constance)	0.1 dm³				0.5 dm³		--	--
Switching and signaling unit Mobiltemp SHC 100 (Mobil Oil)	7 cm³							

*) The quantities of lubricants listed are for guidance only; compliance with the filling levels listed in table 5.3 a is essential

a) Replaces **Schmierfett S** / MOBIL OIL (used until 01.01.1999)
b) Replaces **Molylube 8626 EP 2** / BEL-RAY (used until 01.01.1999)
c) or alternatively CLP Lubricating Oil ISO VG 220 acc. to DIN 51517, Part 3
d) Replaces **Shell Alvania G3** / Dt. Shell GmbH (used until 01.10.2003)
e) Replaces **Shell Alvania RL3** / Shell Deutschland Schmierstoffe GmbH (used until 31.12.2011)

Table 5.3 b: Lubricant types and quantities according to lubrication point

Overview: Greases and sealants for nuclear power plant motors

Motor type	**Lubricant**	**Sealant for centering edges**
1LA 3 / 5 ... - Z Q08 - Z Q09 - Z Q20	Aeroshell Grease 16	----
1LA 3 / 5 ... - Z Q18 - Z Q19 - Z Q21 OL 56 .. 160 / .. / Q18 / Q19 / Q21	Castrol NUCLEOL G121 c)	Loctite 510
1LP 3 / 5 ... - Z Q31 1) - Z Q32 2) - Z Q33 3) OL 56 .. 160 / .. / Q31 / Q32 / Q33	Castrol NUCLEOL G121 c)	Loctite 510
1LP 3 / 5 ... - Z Q07 1LC 3 / 5 … - Z Q28 OLB 56 .. 132 / .. / Q28	Aeroshell Grease 16 Castrol NUCLEOL G121 c)	Fluid D or Loctite 510 ----
1LP 3 / 5 ... - Z Q29 OL 56 .. 132 / .. / Q29	Castrol NUCLEOL G121 c)	Loctite 510

1) also applies for Q18 + AS3 **2)** also applies for Q19 + AS3 **3)** also applies for Q21 + AS3

c) Replaces **Shell APL 701** / Shell (used until 01.09.2001)
As an alternative, Shell **APL 700** or **PLA 100** / Christol (France) can also be used.

Table 5.3 c: Greases and sealants for nuclear power plant motors

Test schedule for tightness test of motors (with add. order codes Q29, Q31, Q32, Q33):

Test procedure after motor installation and sealing the terminal box:

- Screw plug for test hole (M5 or M6) on the drive-side end shield must be removed.
- The motor compartment must be pressurized with an overpressure of 0.2 bar via the test hole.
- The motor and the air infeed must then be completely submerged in water for 30 seconds. The top of the motor must be just below the water level.
- After the test, the test hole must be sealed again with the screw plug and the "USIT sealing washer". Apply a small quantity of sealant to the thread. Use the same sealant that is used for sealing the centering edges. Only original spare parts should be used.

Test criteria for underwater test:

No air escape is permitted. This would be detected by air bubbles in the water. No ingress of water into the terminal box.

- Anti-corrosive substances must be added to the water.
- If a water bath is not available, a soap solution can be applied to the sealed joints for the purpose of determining the appearance of bubbles.
- Replacement of the radial shaft sealing ring on the drive-end of the motor must be recorded.
- If the measured insulation resistance is less than the critical insulation resistance (R_{crit} = 10 MΩ at a measuring voltage of 500 V DC), the fan must be removed and the windings must be cleaned and dried. Repeat and record insulation resistance measurement.

5.4 Repairs and modifications

Diagrams and parts lists are provided with the appropriate spare parts lists. These diagrams usually contain useful information for the specialist concerning the technical design of standard devices and modules.

Customized designs and design variants may differ with respect to technical details. In the event of any uncertainty, it is therefore imperative to check immediately with SIPOS Aktorik, indicating details of the device type and works number. Any repairs or modifications should be carried out by the responsible SIPOS Aktorik Service point (for inquiries, see 5.2).

During reassembly, it must be ensured that all sealing surfaces are in perfect order. Ensure that they are undamaged, uncoated and greased.

When the equipment has been reassembled, the instructions given in section 3 "Installation" must be observed for the work carried out at the installation site.

5.5 Spare parts and graphical representation

Only the spare parts lists pertaining to the actuator type are valid for ordering spare parts:

Type range	Spare parts list no.
M763..-C and -E	NMA 3949 DER
M763..-F and -G	NMA 3950 DER
M763..-M and -N	NMA 3951 DER
M763..-S and -U	NMA 3952 DER

Order examples are shown in the respective lists.

6 Appendix

6.1 Supplementary instructions

Any special installation and operation instructions furnished by the suppliers of subcontracted components, attachments or fitments are attached to the set of instructions and have to be observed.

6.2 Instructions for handwheel assembly

For actuators of type: M763.. – G / M / N

- Fit the handwheel (**1**) to the hexagonal hub with the rim on the top of the actuator.
- Add shims (**2**) so that they are flush with the top of hub.
- Fasten handwheel including shims with the attached screws and washers (**3**) (see figure 6.2).

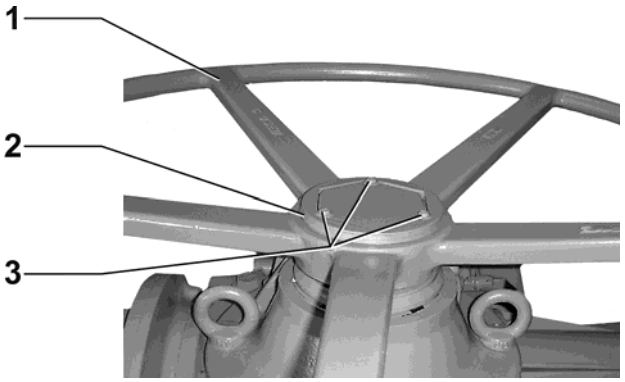


Figure 6.2: Handwheel - assembled state