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1. General

In state-of-the-art vacuum chlorination installations according to DIN 19606, the chlorine gas flow is hardly controlled by hand. Mostly the concentration of free chlorine in the water is monitored by an electronic controller which sets the required chlorine gas quantity by means of an electrically operated valve.

For this purpose the control valve C7700 has been developed. It is a plastic valve for chlorination installations working according to the vacuum method and must therefore not be used with excess pressure.

2. Functional description

A servomotor with a 90° bevel actuates the adjusting eccentric (1). It converts the rotary motion into the stroke movement of the valve rod (2). A spring (3) makes sure that there is a contact between the valve rod and the eccentric.

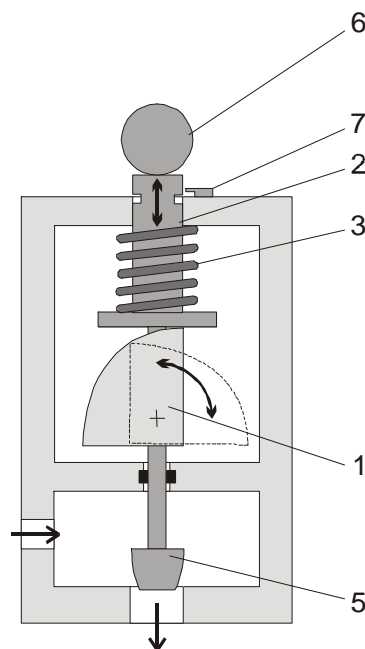
The actual control element is located at the lower end of the valve rod. Up to 2,500 g Cl₂/h, the control element is designed as an air jet in the form of a helically slotted cylindrical shaft (4), for higher quantities as a control cone (5).

Both control elements are shaped so that the cross-sectional area of flow changes in proportion to the position of the servomotor. The valve has a linear characteristic.

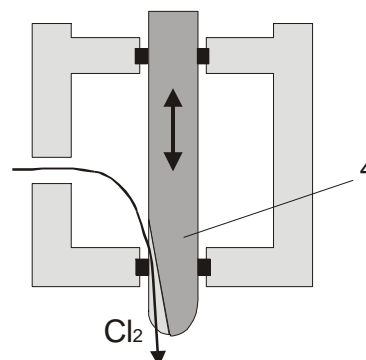
For manual chlorination, the valve rod can be lifted completely upwards by pulling the hand knob (6) and locked by means of the slide (7). The chlorine gas flow is then adjusted at the needle valve of the flow meter.

The housing of the control valve consists of two chambers, the valve chamber and the eccentric chamber. The chambers are separated from each other by a sealing so that the mechanical drive does not get in contact with the chlorine gas.

Functional diagram



Air jet



3. Scope of delivery

Be careful when unpacking the chlorine equipment and order-related accessories in order not to miss small parts. In many cases these are mounting screws for wall mounting. Compare the scope of delivery immediately to the delivery note to find out the reason if there are any discrepancies.

4. Safety instructions

- ⇒ JESCO chlorinators have to be maintained and tested by specialist staff at least once a year (cf. also local rules or specifications, e.g. GUV 8.15).
- ⇒ Chlorine gas is dangerous for health and life. Therefore be very careful whenever handling chlorination installations. All works on the installation require special knowledge and safety measures and may only be carried out by technical personnel.
- ⇒ Observe the local safety rules when working on chlorination installations. In Germany, the *safety rule "chlorination of water"* (VBG 65) applies, the latest version of which is available at the municipal accident insurance association.
- ⇒ Before working on the chlorination installation, close the chlorine cylinder valves. Empty all chlorine-bearing lines using the ejector.
- ⇒ C 7700 control valves are suitable for vacuum chlorination installations. They must not be used for gas under excess pressure.
- ⇒ Chlorine gas is extremely hygroscopic. Thus humidity will enter the system in the case of open device connections and lines. As a result hydrochloric acid will be formed which causes damage to the equipment. Consequently, all connections (including those of vacuum devices and vacuum lines) must be closed during down times of the system.
- ⇒ If chlorinators are to be used for other gases than chlorine gas, check the chemical resistance of the devices with the manufacturer.
- ⇒ Before working on the control valve, disconnect the mains line and make sure that it cannot be switched on again.
- ⇒ After modifying the electrical connections of the valve or settings of the servomotor, the screwed cable connections must be tightened and the protective cover of the servomotor must be mounted. Otherwise the protection class cannot be guaranteed.

5. Installation

Use the enclosed mounting material for wall mounting. It corresponds to the individual application as far as dimensions and material are concerned. The mounting position of the valve is vertical, the servomotor being installed laterally. The screwed cable connections of the servomotor show downwards (see installation examples).

5.1 Hydraulic installation

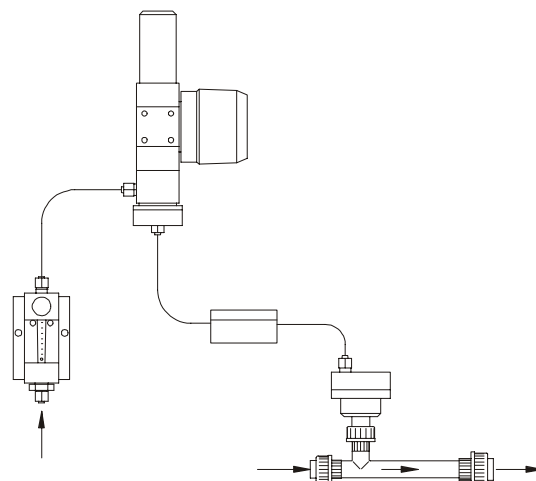
The C 7700 control valve is installed into the vacuum line at any point between the measuring glass and the ejector non-return valve. Tighten the PVC union nuts carefully. Even manually screwed down union nuts establish a tight connection. All connections of the control valve must be absolutely tight. Otherwise humidity enters the system during vacuum operation forming deposits together with the chlorine, which may affect the valve functions. This concerns especially the control slot of the smaller control valves.

Back-pressure regulator

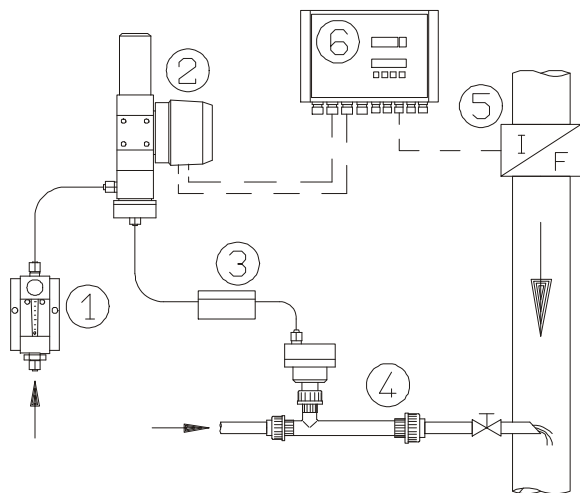
The flow rate at the control valve is determined by:

- a) the position of the control element and
- b) the intensity of the ejector vacuum.

The ejector vacuum must not vary in order to make sure that the metering capacity depends only on the position of the control element. Therefore German standard DIN19606 requires a so-called back-pressure regulator which provides for constant pressure conditions at the control valve and thus for an exact metering capacity and linear characteristic.



Proportional metering



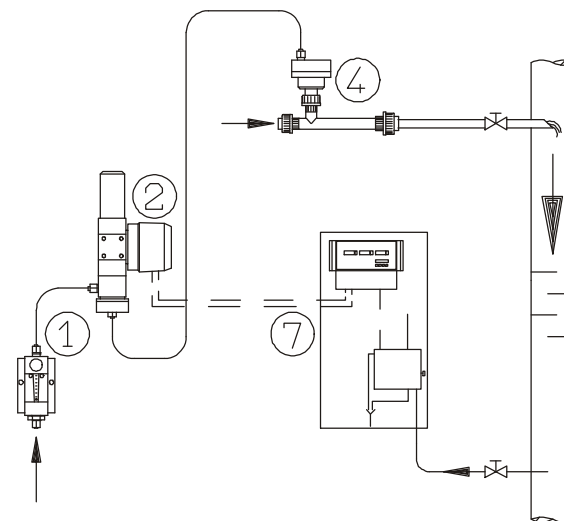
A ratio controller (6) controls the servomotor of the control valve proportionally to the signal of the flow meter (5). In some cases, a sensor is installed additionally to measure the concentration of free chlorine in the water. Then the controller controls the valve in dependence of the flow and the chlorine concentration.

A 3-point step signal is used mostly for financial reasons. A repeating potentiometer informs the controller about the actual position of the control valve.

If the controller is to be connected directly to the flow meter without including a controller, a servomotor with 4...20 mA control is required.

For this type of installation, the back-pressure regulator (3) ensures constant pressure conditions at the control valve. Thus metering is really proportional to the water flow.

Closed loop



In this case the control valve is controlled by the controller for free chlorine (7). The already chlorinated water is measured. Faulty metering due to varying suction capacity of the ejector is corrected by the controller. Therefore no back-pressure regulator is required for this type of installation.

5.2 Electrical connection

The local rules (DIN, VDE, ...) must be observed for the electrical installation. Please make sure that electrical work is always carried out by technical personnel.

Don't forget to connect the grounding terminal of the metal housing!

When carrying out the electrical connection, it must always be ensured that the protection class of the servomotor is maintained (use appropriate screwed cable connections and cables).

For wiring diagrams of the servomotors, see chapter 10.

6. Startup

6.1 Potentiometer adjustment

For the servomotor with 3-point-step control, the repeating potentiometer and the controller must be adjusted to each other after electrical connection. The procedure depends on the type of controller. In general, the following steps must be carried out:

- While the controller is in the adjusting mode, the servomotor is brought into a final position.
 - By means of a screwdriver, the potentiometer is turned on the slipping clutch into the same direction until stop (see chapter 10, servomotors).
 - The resistance value is confirmed at the controller.
 - The servomotor is brought into the other final position. A limit switch turns off the motor also in this case.
 - This value is also confirmed at the controller.
- The adjustment of potentiometer and controller is completed.

6.2 Definition of the control range

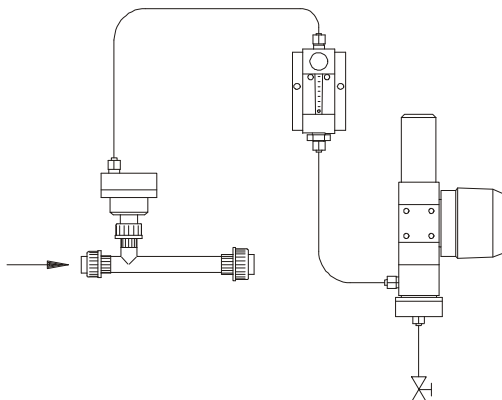
If the control range of the control valve is oversized for the particular application, it can be reduced by up to 50 %. Further reduction would affect the metering accuracy.

The bevel of the servomotor is limited so that the valve rod can only be lifted to a lower max. position. The procedure depends on the servomotor used (see chapter 10, servomotors).

In the case of 3-point step control, the potentiometer must be adjusted afterwards.

6.3 Leakage test

For the leakage test of the hydraulic connections, an additional measuring glass is required. It is installed between the control valve and the ejector non-return valve for the duration of the test.



Close chlorine supply. After moving slightly in the beginning, the ball must not go up anymore when the ejector is running.

7. Operation

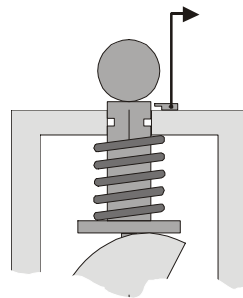
Automatic metering

Normally the control valve does not require any service during operation. A routine visual check is, however, recommended.

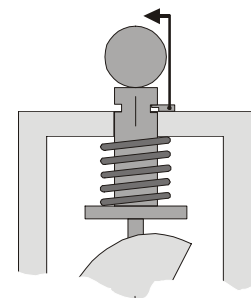
Manual metering

It is often necessary to stop metering temporarily by hand (e.g. for shock chlorination). For this purpose, the valve rod can be pulled up completely and locked. Metering is then independent of the position of the eccentric. It is adjusted at the manual valve of the flow meter instead.

Automatic operation



Manual operation



To return to automatic operation, the knob of the valve rod is pulled up and the stop pawl is removed. The **manual valve at the flow meter must then fully be opened.**

8. Disconnection of the system

For short interruptions, no special measures must be taken. It is sensible to empty the vacuum line using the ejector, if the chlorine cylinders are closed. In the case of longer shutdowns, the chlorination installation should be rinsed with dry air or nitrogen for some minutes. Afterwards all connections of the vacuum system must be closed carefully so that humidity cannot enter.

Maintenance of the devices should be carried out during down times so that deposits resulting from operation do not harden.

9. Maintenance

Regular maintenance avoids trouble!

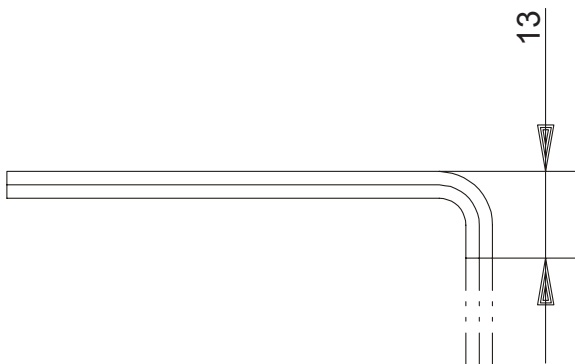
We recommend a maintenance contract.

If there are no rules/specifications (e.g. GUV 8.15) or special annotations prescribing shorter maintenance intervals, all JESCO chlorinators have to be maintained and tested by an authorized specialist firm at least once a year. Preferably this should happen at the beginning of a high-rate period, prior to a downtime or a restart.

Before working on the chlorination installation, the chlorine tanks/cylinders must always be closed. Empty the system using the ejector, until the measuring glass shows zero.

For maintenance, the control valve is disassembled, all parts are visually checked, and the wear parts are replaced.

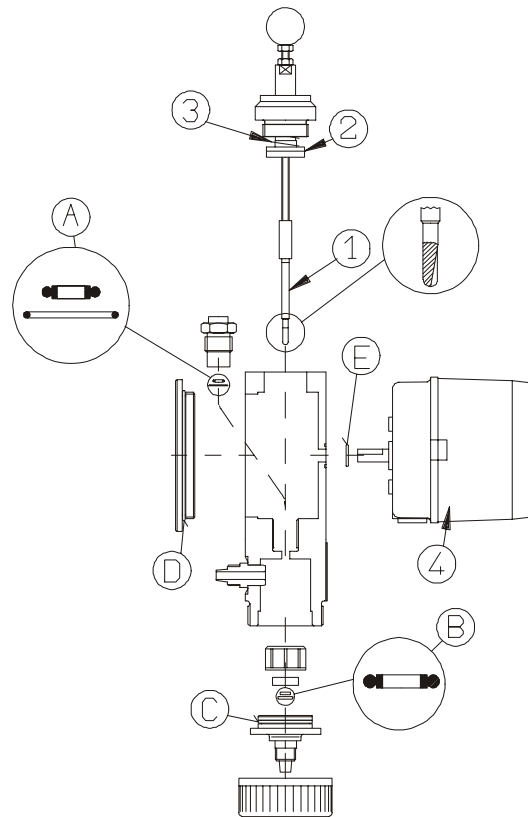
Warm water or isopropyl alcohol is suitable for cleaning the components. Before remounting, they must be absolutely dry. PVC threads are lubricated with little silicon grease. Thus they are easy to handle and can be detached without any problem. For disassembly of the eccentric, a SW4mm wrench with shortened leg is required.



9.1 Replacement of seals

Those seals which should be replaced during yearly maintenance are available as maintenance kits. These include seals for the valve rod and the air jet. They are subject to constant wear due to the up and down movement.

The eccentric chamber becomes accessible if the cover located opposite to the servomotor is unscrewed. Replace the seals in accordance with the following drawing.



A: The rod is passed through a PTFE ring which is prestressed by an external O-ring. The seal is used with little silicon grease. Stronger tightening does not increase tightness. Static sealing is ensured by the additional O-ring. For mounting, the O-ring is "sticked" to the clamping screw using silicon grease.
 B: (only up to 2,500 g/h) For the air jet, the same type of sealing is used as for A. This seal is mounted in dry condition in order to avoid blocking of the jet.
 C, D, E: These O-rings are lubricated with silicon grease so that they slide easily on the PVC surface when mounted.

9.2 Lubrication

Normally it is sufficient to renew lubrication of the control valve once a year as part of the routine maintenance.

For lubrication always use silicon grease but never vaseline. The chlorine gas extracts water from the vaseline so that it hardens. Increased wear and failures would be the result.

The numbers refer to the above drawing:

1: The shaft of the adjusting rod is slightly lubricated in the piston packing between eccentric chamber and valve chamber.

2: The needle bearing between eccentric and thrust washer is greased.

3: The pressure spring is slightly lubricated to ensure protection against corrosion.

4: The servomotor is greased sufficiently with transmission lubricant. It is, however, sensible to check the drive once a year for sufficient lubrication and to relubricate the gear wheels, if necessary. In the case of drives which are subject to increased temperatures, the intervals between the checks must be reduced.

- Mount new rod in opposite order.
- Zero-point adjustment.

Replacement of control cone (≥ 4 kg/h)

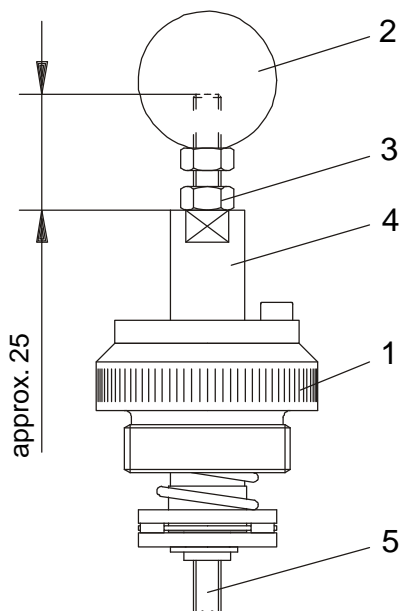
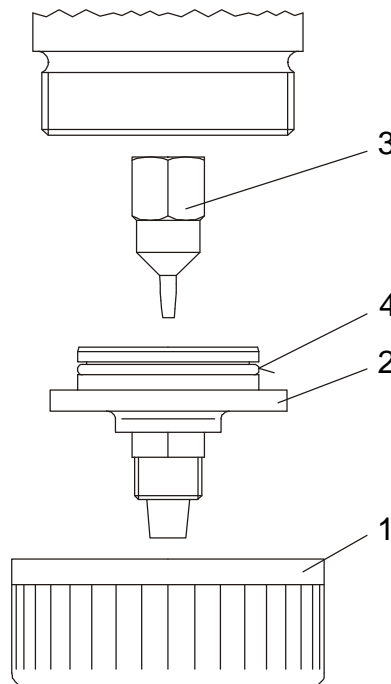
Depending on the size of the control cone to be replaced, the valve seat must be exchanged as well in most cases. For assignment, see Spare Parts sheet.

9.3 Replacement of valve rod

If the capacity of the control valve is too low or too high for the particular application, the actual control element can be replaced by the right size. The procedure depends on the type of control element.

Replacement of the air jet (up to 2,500 g/h)

As the different air jets are difficult to distinguish, they are marked with a number on the threaded shaft, which is visible after removing the cover of the eccentric chamber. For the assignment of the number, refer to the Spare Parts sheet.

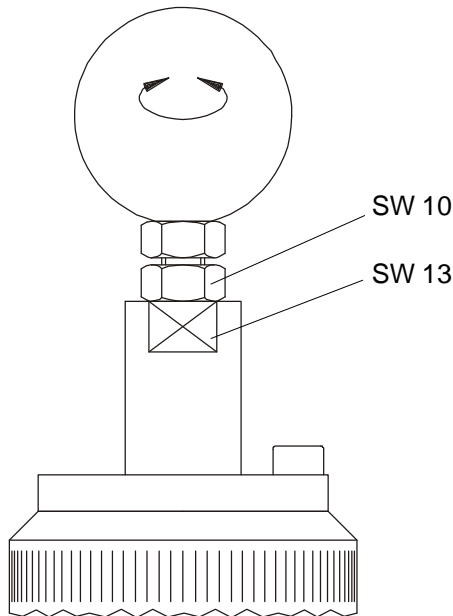


- Unscrew lock nut (1) at lower section of control valve.
- Remove valve seat (2).
- Unscrew control cone (3) from valve rod.
- Assembly in opposite order. The O-ring (4) of the valve seat must be exchanged after dismantling.
- Zero-point adjustment.

- Remove protective cover over hand knob.
- Unscrew guide nut (1) from valve and pull out rod.
- Remove hand knob (2) and lock nut from rod.
- Remove lock nut (3) and unscrew rod (5) from guide bolt (4).

9.4 Zero-point adjustment

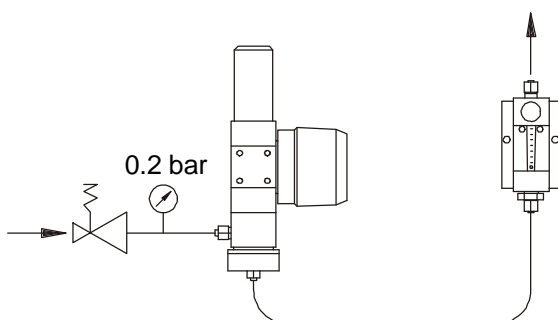
Upon delivery the position of the rod is optimally set. A zero-point adjustment is only required after maintenance or replacement of the rod.



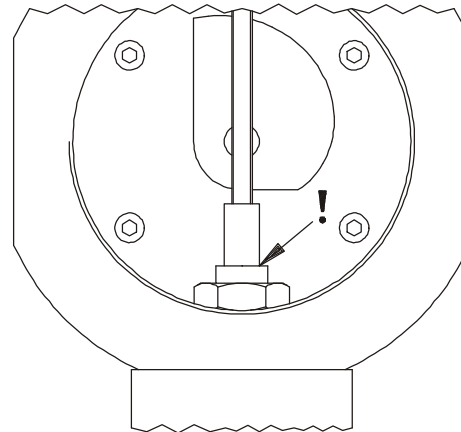
- Bring servomotor into "closed" position.
- Switch on ejector.
- Open metering valve at flow meter.
- Untighten nut (SW10) and counterhold guide bolt (SW13).
- Turn rod at hand knob until the flow meter indicates zero. Then carry on turning it by another ¼ revolution.
- Tighten nut (SW10) and counterhold guide bolt (SW13).

9.5 Check

In the case of maintenance work in the workshop, the control valve can be tested with air. To check the metering capacity of the valve, compressed air with 0.2 bar excess pressure is used. Thus the display at the vacuum flow meter for chlorine gas is the same as in real operation.



It also has to be checked if the piston packing between eccentric chamber and valve chamber is tight. This test is carried out at 0.2 bar excess pressure as well. Leak detector spray makes possible leaks visible. Wipe it off after the test.

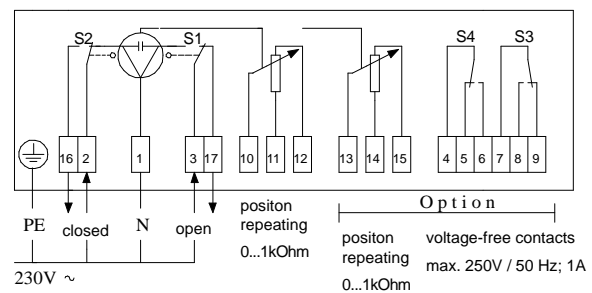


10. Servomotors

Servomotors are used with 3-point step control or with 4..20 mA signal.

a) 3-point step (standard version) AR30W..

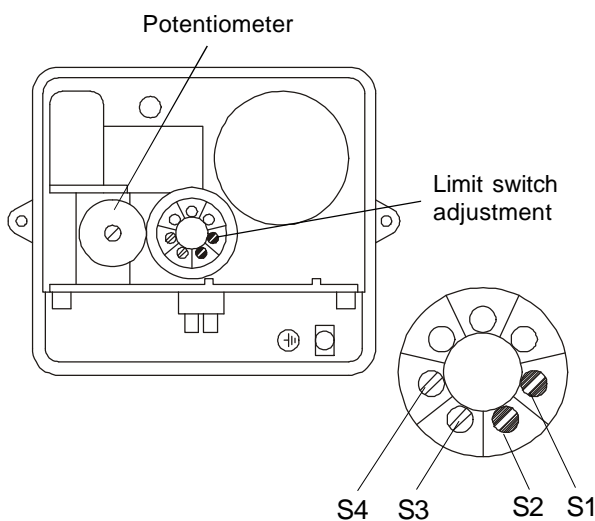
The servomotor is controlled by connecting the phase of the supply network for clockwise or counterclockwise rotation to the corresponding winding of the motor. The neutral conductor is commonly used.



AR 30 W 23

The potentiometer serves as a position repeating device so that the controller can bring the control valve exactly into the right position. Observe the operating instructions of the controller precisely when connecting the slider. Otherwise the controller might be damaged.

As an option the servomotor can be equipped with additional limit switches (S3 and S4). This additional signal is required, for example, if the motive water supply of the ejector is to be disconnected because the control valve is closed for a longer period. Thus carbonate precipitation is avoided at the controller which otherwise would cause a long-term failure of the ejector.



The limit switches can be adjusted by means of the screws located on the shaft of the servomotor. Each of the screws is assigned to a limit switch (S1..S4). Turning the screws clockwise means:

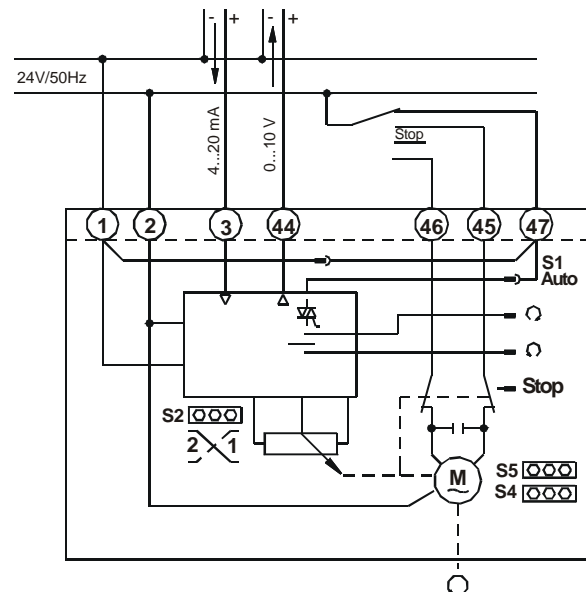
- S1 (valve fully opened) – reduce metering capacity
- S2 (valve closed) – lower rod
- S3, S4 (allocation freely selectable) – switch point for small metering capacities

b) (0)4..20 mA (option) AR30W..S

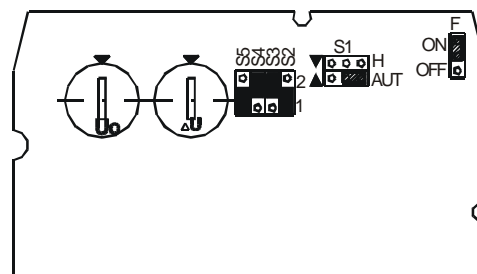
This servomotor is provided continuously with 24VAC voltage and changes its position depending on the input signal.

Position repeating via potentiometer is not necessary for this version because the position controller integrated in the servomotor ensures the correct position of the motor. For other applications, as for example in process control systems, a position repeating device is available.

Wiring diagram



Terminals 45, 46, 47 are only used if the operating mode of the motor is to be changed externally. Jumper F must be connected to OFF in this case. The servomotor offers a variety of possible operating modes which can be defined via jumpers.



The different jumpers have the following functions (factory setting in bold letters):

- "S1" operating mode
 - AUT** : automatic operation according to input signal
 - H : manual operation, servomotor is switched off
 - ▼ : control valve opens
 - ▲ : control valve closes
- "F" preselection of operating mode
 - ON** : without external operating mode switch
 - OFF : with external operating mode switch
- "S2" sense of action of position controller
 - 1 : opening proportional to signal
 - 2 : opening inversely proportional to signal

"S3" angle of rotation of servomotor

- 1 : 30° bevel
- 2 : 90° bevel

"S4" output signal

- 1 : 0..620 mV
- 2 : 0..10 V

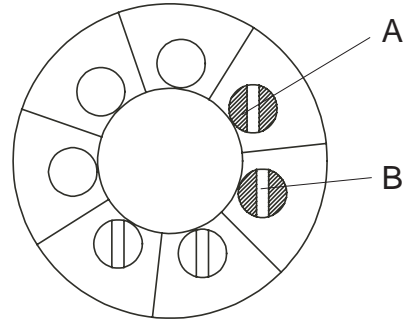
"S5" input signal

- 1 : 0(4)..20 mA
- 2 : 0(2)..10 V

Zero point and spreading of the input signal are adjusted at potentiometers.

U_0 zero point of signal (e.g. position 2 \approx 4 mA)

ΔU spreading of signal (e.g. position 8 \approx 16 mA)



The rotary motion of the servomotor is limited additionally by snap switches. The can be adjusted at the screws on the shaft of the servomotor. Each of the screws is assigned to a limit switch (A, E). Turning the screw clockwise means:

A (valve fully opened) – reduce metering capacity
 B (valve closed) –lower rod

With this servomotor, no additional limit switches can be installed.

Technical data

Type	AR 30W..	AR 30W..S
Design	reversible A.C. motor with self-locking reduction gear.	
Use	for controllers with switching output (3-point step)	for controllers with continuous output (2...10V or 4...20mA)
Auxiliary voltage	230V ~ \pm 15% 50...60 Hz	24V ~ \pm 20% 50...60 Hz
Control		2...10V or 4...20mA
Power consumption	2 W	7 W
Control time/bevel	120s / 90° = 0...100%	
Position repeating for remote display	potentiometer 0.5 W 0...1000 Ω = 0...100%	0...10V = 0...100%
Limit switch	internal limit switch for limiting angle of rotation. Signaling of final position via terminals 16 and 17	internal limit switch for limiting angle of rotation.
Protection class	IP 55 (EN 60529)	
Ambient temperature	-20 ... 60°C	
Option		
2nd potentiometer	0...1000 w 0.5 W	
Limit switches (2 off)	max. 250V 2A	
Part No.	78743	