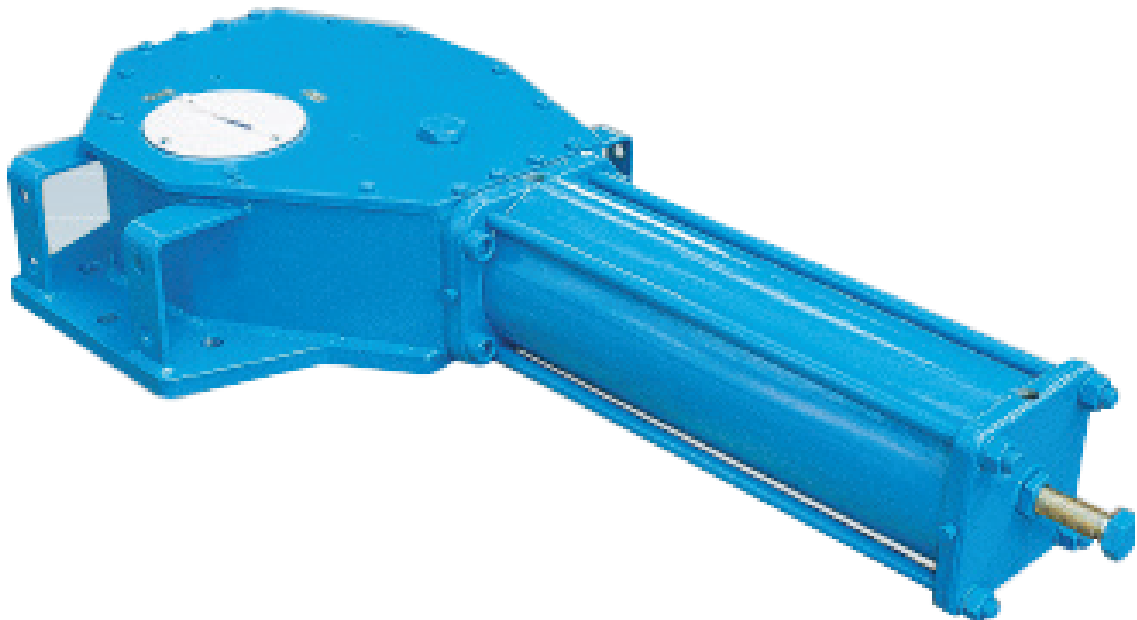


Biffi OLGA

Double-Acting Hydraulic Actuator



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Date Report for Maintenance Operations 54

NOTICE

Biffi™ pays the highest attention to collecting and verifying the documentation contained in this user manual. However, Biffi is not liable for any mistakes contained in this manual, for damage or accidents due to the use of the latter. The information contained is of exclusive reserved ownership of Biffi and may be modified without prior notice. All rights reserved.

Section 1: General Warnings

NOTICE

The manual is an integral part of the machine, it should be carefully read before carrying out any operation and it should be kept for future references.

1.1 Generalities

Biffi actuators are conceived, manufactured and controlled according to the Quality Control System in compliance with EN ISO 9001 international regulation.

1.1.1 Applicable Regulation

EN ISO 12100:2010:	Safety of machinery – General principles for design – Risk assessment and risk reduction
2006/42/EC:	Machine directive
2014/68/EU:	Directive for pressure equipment (PED)
2014/35/EU:	Directive for low voltage equipment
2014/30/EU:	Directive for the electromagnetic compatibility
2014/34/EU:	Directive and safety instructions for use in hazardous area

For EAC:

TR TS 004/2011:	Customs Union Technical Regulation (For safety of low voltage equipment)
TR TS 010/2011:	Customs Union Technical Regulation (For safety of low voltage equipment)
TR TS 012/2011:	Customs Union Technical Regulation (For safety of equipment operated in explosive atmosphere)
TR TS 020/2011:	Customs Union Technical Regulation (Electromagnetic Compatibility of Technical Products)
TR TS 032/2013:	Customs Union Technical Regulation (For safety of Excess Pressure Equipment)

1.1.2 Terms and Conditions

Biffi guarantees that all the items produced are free of defects in workmanship and manufacturing materials and meet relevant current specifications, provided they are installed, used and serviced according to the instructions contained in this manual. The warranty can last either one year from the date of installation by the initial user of the product, or eighteen (18) months from the date of shipment to the initial user, depending on which event occurs first. All detailed warranty conditions are specified in the documentation forwarded together with the product. This warranty does not cover special products or components not warranted by subcontractors, or materials that were used or installed improperly or were modified or repaired by unauthorized staff. In the event that a fault condition is caused by improper installation, maintenance or use, or by irregular working conditions, the repairs will be charged according to applicable fees.

The warranty and Biffi's liability shall lapse if any modification or tampering whatsoever be performed on the actuator.

1.1.3 Electrostatic Charge

An electrostatic charge risk is present on the actuator surface; in case of cleaning, use only antistatic cloth; in case of maintenance, avoid all rubbing/frictions that could electrostatically charge the equipment.

1.1.4 Noise Emission

The verification of the noise of the actuated valve is at valve maker care. The actuator's noise can be considered negligible since it is an equipment for regular on/off or intermittent use. If the integral quick exhaust valve is present, we recommend using ear Personal Protective Equipment (PPE) to avoid any possible acoustic discomfort.

Figure 1. Ear PPE



1.2 Identification Plate (Nameplate)

⚠ WARNING

It is forbidden to modify the information and the marks without previous written authorization by Biffi.

The plate fastened on the actuator contains the following information (Figures 2 and 3).

Figure 2. Nameplate Base (Sample)

		CE	
Order _____			
ACTUATOR Model _____			
ACTUATOR S/N _____		MM/YYYY _____	
ACTAG N° _____		ND _____	
Supply Press.Range _____		MOP _____	
Amb.Temp. _____			
CYLINDER FI.Type _____		FI.Group _____	PED Cat. _____
CYLINDERS _____		Test Date _____	
PS _____		PT _____	Cyl.Weight _____
Ex		Ref.: _____	WARNING: Potential Electrostatic Charging Hazard See Instructions

Figure 3. Nameplate for EAC Version (Sample)

		EAC Certificate of Conformity	
Order _____			
ACTUATOR Model _____			
ACTUATOR S/N _____		MM/YYYY _____	
ACTAG N° _____		ND _____	
Supply Press.Range _____		MOP _____	
Amb.Temp. _____		CE	
CYLINDER FI.Type _____		FI.Group _____	PED Cat. _____
CYLINDERS _____		Test Date _____	
PS _____		PT _____	Cyl.Weight _____
Ex		Ref.: _____	WARNING: Potential Electrostatic Charging Hazard See Instructions

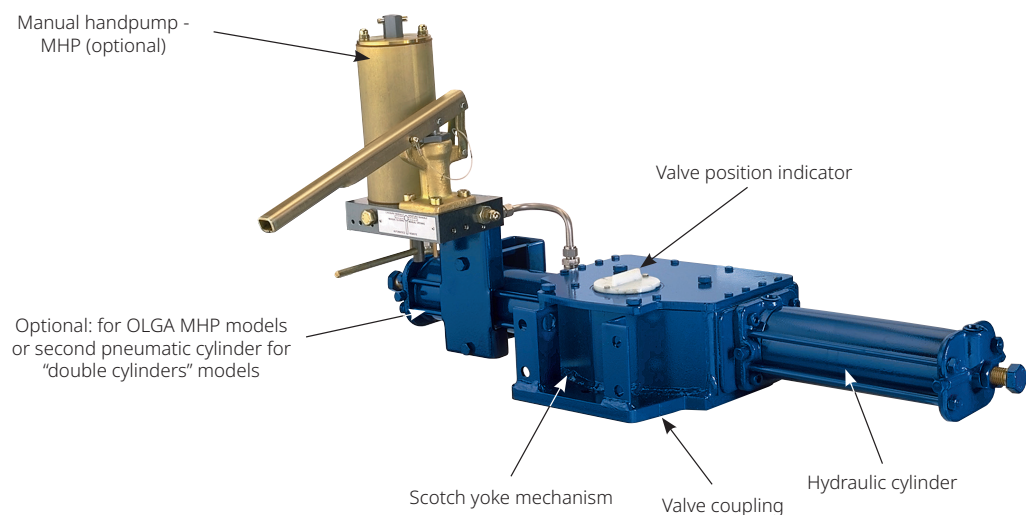
1.3 Description of the Actuator

The hydraulic actuator series OLGA was engineered and is manufactured to provide maximum torque output with minimum supply pressure. The OLGA actuators are suitable for any quarter turn application such as ball, plug or butterfly valves or dampers, in both on/off and modulating heavy duty service.

The actuator (see Figure 4) is made up of a weatherproof scotch yoke mechanism transforming the linear movement of the pneumatic cylinder (on closing or opening) into the rotary movement, which is necessary for operation. The angular stroke of the yoke is adjustable between 82° and 98° by means of the external mechanical stops screwed into the left wall of the mechanism housing and into the end flange of the pneumatic cylinder. The cover of the scotch yoke mechanism is arranged for the assembly of the required accessories (positioner, signalling limit switches, position transducer, etc.) by means of proper matching units. The above mentioned accessories are operated by the actuator drive sleeve. The housing of the scotch yoke mechanism has a flange with threaded holes to fix the actuator to the valve either directly or, if required, with the interposition of an adaptor flange or a mounting bracket. The actuator yoke has a hole with keyways suitable for the assembly of an insert bush the internal hole of which is machined (by Biffi or at customer's care), according to the shape and dimensions of the valve stem. Biffi can supply different types of control system following the customer's requirements.

The expected lifetime of actuator is approximately 25 years.

Figure 4. Identification of Actuator Parts



1.4 Data Sheet

Supply fluid	Hydraulic oil, special version for fire-resistant fluids
Operating temperature	Standard: from -30 to +100 °C Optional: from -60 to +140 °C
Supply pressure	Please refer to technical document: "actuator data sheet"

Section 2: Installation

2.1 Checks To Be Carried Out Upon Receiving the Actuator

- Check that the model, the serial number of the actuator and the technical data reported on the identification plate correspond with those of order confirmation (Section 1.2).
- Check that the actuator is equipped with the fittings as provided for by order confirmation.
- Check that the actuator was not damaged during transportation: if necessary renovate the painting according to the specification reported on the order confirmation.
- If the actuator is received already assembled with the valve, its settings have already been made at the factory.
- If the actuator is delivered separately from the valve, it is necessary to check, and, if required, to adjust, the settings of the mechanical stops (Section 3.4) and of microswitches (if any) (Section 3.5).

2.2 Actuator Handling

NOTICE

The lifting and handling of the actuator must be done by qualified personnel and in accordance with the laws and regulations in force. Avoid the lifted actuator to be hung above the personnel.

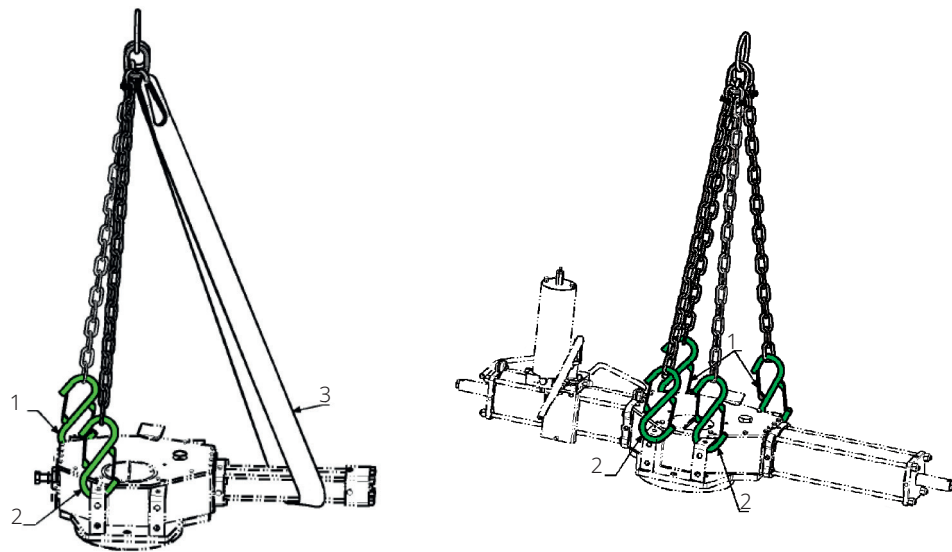
⚠ WARNING

The actuator must be lifted by means of a suitable lifting apparatus. The weight of the actuators is indicated in the technical documentation attached to the equipment itself. For lifting and moving the actuator, use only hooks fitted with safety latch, like the one, for example, shown in Figure 5.

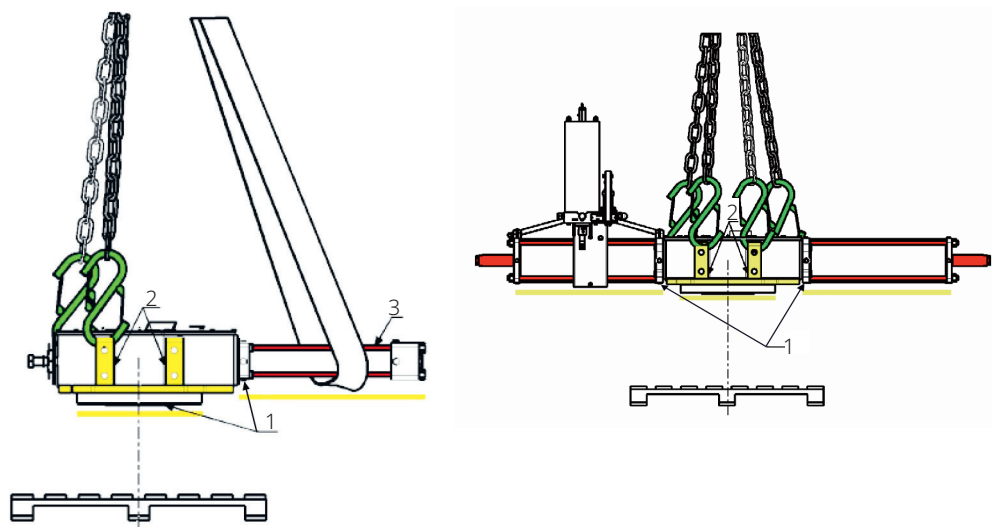
Figure 5. Example of Hook with Safety Latch



Figure 6. Lifting Points for OLGA / OLGA-MHP / OLGA-MSJ



1, 2 = LIFTING POINTS (OBLIGATORY)
3 = BALANCING POINT



1 = POINT OF SUPPORT
2 = SUPPORTS FOR LATERAL POSITIONING
3 = ADD BALANCING POINT

⚠ WARNING

Point 3 is a balancing point. Do not lay the actuator on tie rods of cylinder/s and do not lay the actuator on accessories (manual hand pump, manual jackscrew, pneumatic control group etc.).

- **For lifting unbalanced loads, use ropes of different lengths or chains with adjustable length.**
- **Always check the condition of all lifting equipment used and discard it if not in perfect working order.**
- **Do not knot or twist the ropes so as not to reduce the lifting capacity or produce torsional effects on the load being lifted.**
- **Exercise utmost caution and remain at a safe distance from the lifted actuator unless absolutely necessary; do not stand or pass under suspended loads.**
- **Pay attention when putting the ropes under tension to prevent the load from shifting sideways in an uncontrolled manner.**
- **Use slings of such length that the angles of the leg from vertical are as narrow as possible ($\alpha_{MAX} < 20^\circ$).**
- **During handling, do not transport the suspended actuator above staff members in charge of the operation.**

For the transport of OLGA actuators with hydraulic manual hand pump, when it was necessary put in horizontal position the tank of MHP, to avoid leakage on oil level stick, substitute these with a blind-plug during the transport (a specific warning label for transport in horizontal position is attached on the MHP body); remove the blind plug and restore the dipstick before operate the actuator with MHP. Biffi hydraulic manual hand pump must be maintained with tank in upper position to operate the actuator with MHP correctly.

Figure 7. MHP Manual Hand Pump Detail

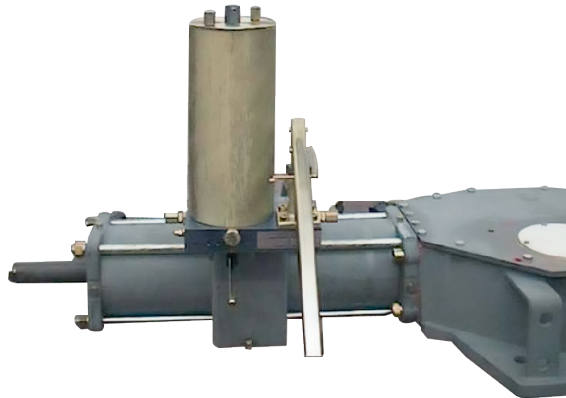


Figure 8. OLGA with MHP

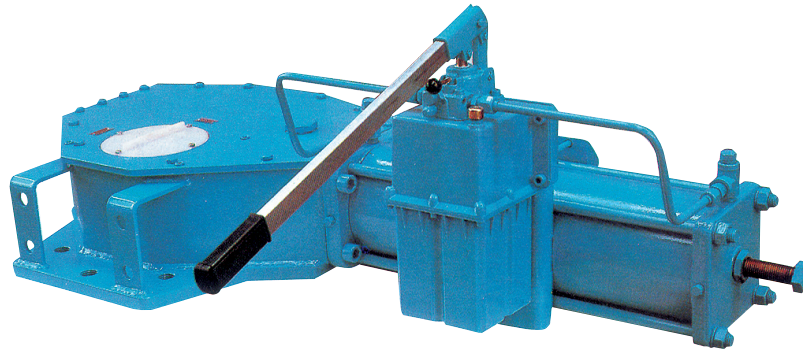
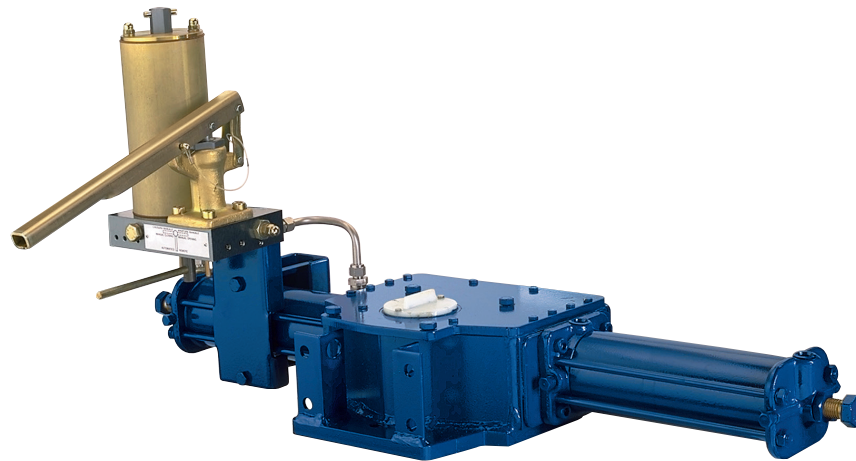
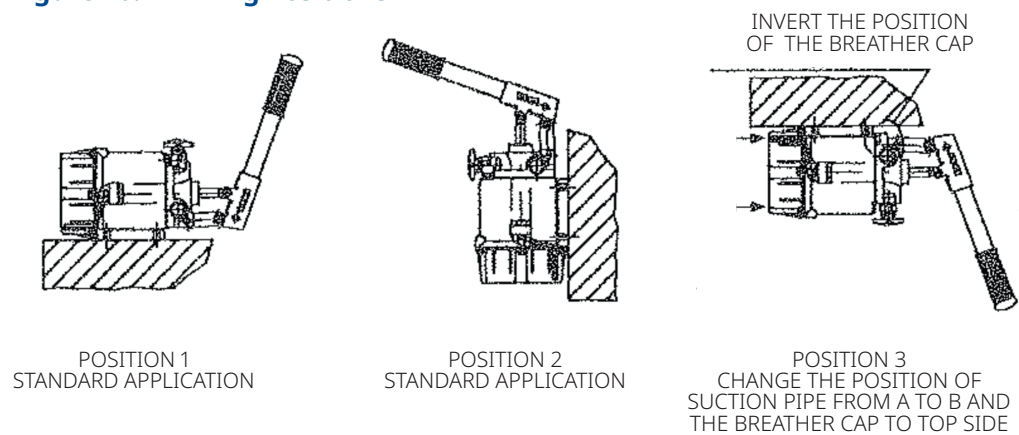


Figure 9. OLGA with MHP (Alternative Configuration)



OMFB manual hand pump should be transported and used with MHP tank in horizontal position, but in position 3 of follow picture (extracted from OMFB technical documentation) it is necessary change the position of suction pipe and breather cap.

Figure 10. Fixing Positions



2.3 Storage

⚠ WARNING

The actuators should remain in their cases until required for installation.

⚠ CAUTION

Pay attention to use the proper tool to open the case and the tool inside.

For handling and lifting procedure, please refer to Figures 12, 13 and 14.

⚠ WARNING

The actuator mounting bracket is to support the actuator only. Under no circumstances should the valve be suspended from the actuator.

⚠ CAUTION

Before testing or cycling be sure to remove all the appropriate port plugs. Storage time is counted as part of the service interval.

The actuators leave the factory in excellent working conditions and with an excellent finish (these conditions are guaranteed by an individual inspection certificate); in order to maintain these characteristics until the actuator is installed on the plant, it is necessary to observe a few rules and take appropriate measures during the storage period.

1. Make sure that plugs are fitted in the oil connections and in the cable entries. The plastic plugs, which close the inlets, do not have a weatherproof function, but are only a means of protection against the entry of foreign matter during transport. If long-term storage is necessary and especially if the storage is outdoors, metal plugs must replace the plastic protection plugs, which guarantee a complete weatherproof protection. Make sure that all seals are not exposed to very high or very low temperatures and gas for a prolonged period of time.
2. If the actuators are supplied separately from the valves, they must be placed onto a wooden pallet so as not to damage the coupling flange to the valve. In case of long-term storage, the coupling parts (flange, drive sleeve, insert bush) must be coated with protective oil or grease. If possible, blank off the flange by a protection disk. In cases where actuators are not be cycled during extended dormant conditions, slight seal leakage may occur during start-up. If this occurs, multiple cycling will flex the seals and significantly improve the seal function. If leakage persists, installation of new seals may be required.
3. In case of long-term storage (>1 year), it is advisable to keep the actuators in a dry place or to provide at least some means of weather protection. If possible, it is also advisable to periodically operate the actuator with the proper oils listed in the IOM or selected/approved at time of order or nitrogen with 99% purity; after such operations all the threaded connections of the actuator and the valves of the control panel (if existing) should be carefully plugged.

2.4 Assembling the Actuator on the Valve

2.4.1 Types of Assembly

For coupling to the valve, the housing is provided with a flange with threaded holes according to Biffi base tables (SCN6200; SCN62001; SCN6201; SCN6201-1; SCN6201-3; SCN6201-5). The number, dimensions and diameter of the holes are made in accordance with ISO 5211, but for actuator models 0.3 to 6, the holes are drilled on the centerline in order to allow an easier assembly of an intermediate flange, when required. This intermediate flange (or spool piece) can be supplied when the valve flange cannot directly match the actuator flange in its "base" configuration. For the biggest actuator models, the actuator flange can be machined in accordance with the valve flange dimensions.

The yoke is bored with keyways for coupling to the valve stem, the dimensions of which are according to Biffi base tables SCN2600 and SCN2601 (Tables 1 to 5).

Figure 11. Coupling Dimensions - Actuator Models 0.3 to 6 (SCN6200E - Rev. 15/10/19)

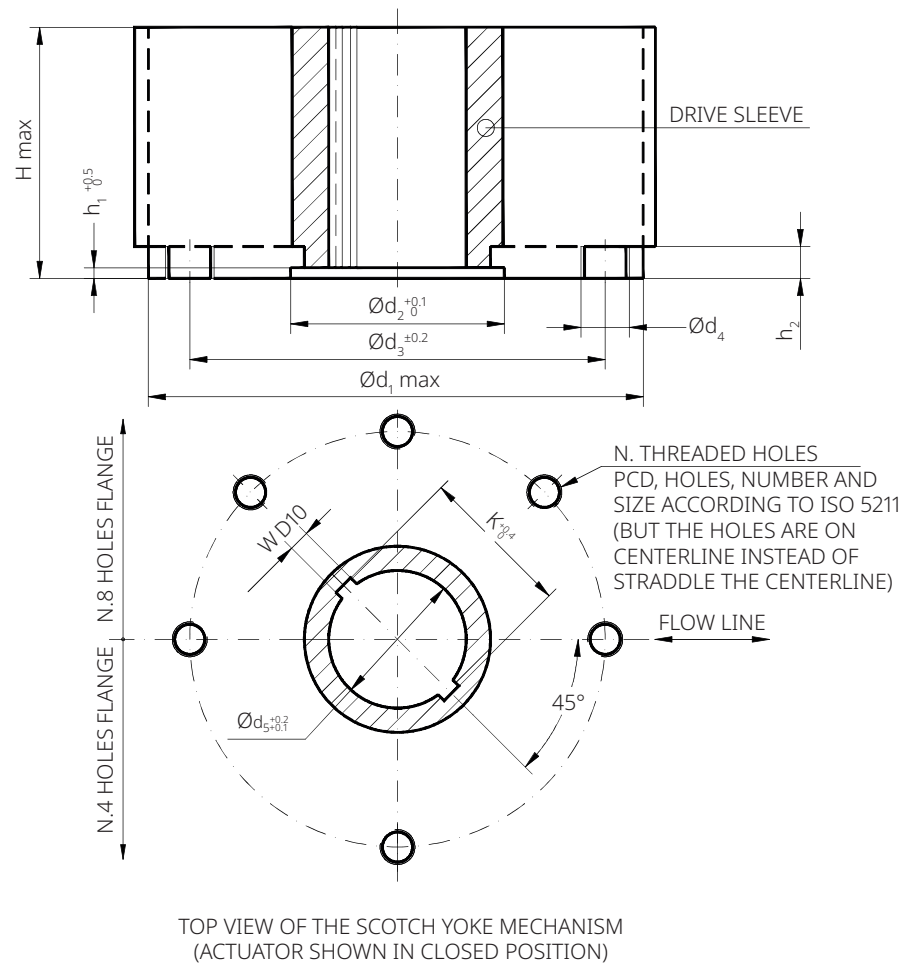


Table 1. SCN6200E - Rev. 15/10/19

Actuator Model	$\text{Ø}d_1$	$\text{Ø}d_2$	$\text{Ø}d_3$	$\text{Ø}d_4$	N	h_1	h_2	H max	$\text{Ø}d_5$	W	K
0.3	240	93	165	M20	4	5	17	127	70	12	75.6
0.9	310	112	254	M16	8	5	19	150	86	14	96.6
1.5	360	144	298	M20	8	6	19	190	112	18	119.0
3	430	195	356	M30	8	9	23	200	157	25	167.8
6	520	250	406	M36	8	14	29	260	200	28	212.8

NOTE:
All dimensions are in millimeters.

Figure 12. Coupling Dimensions - Actuator Model 14 (SCN6201E - Rev. 16/06/20)

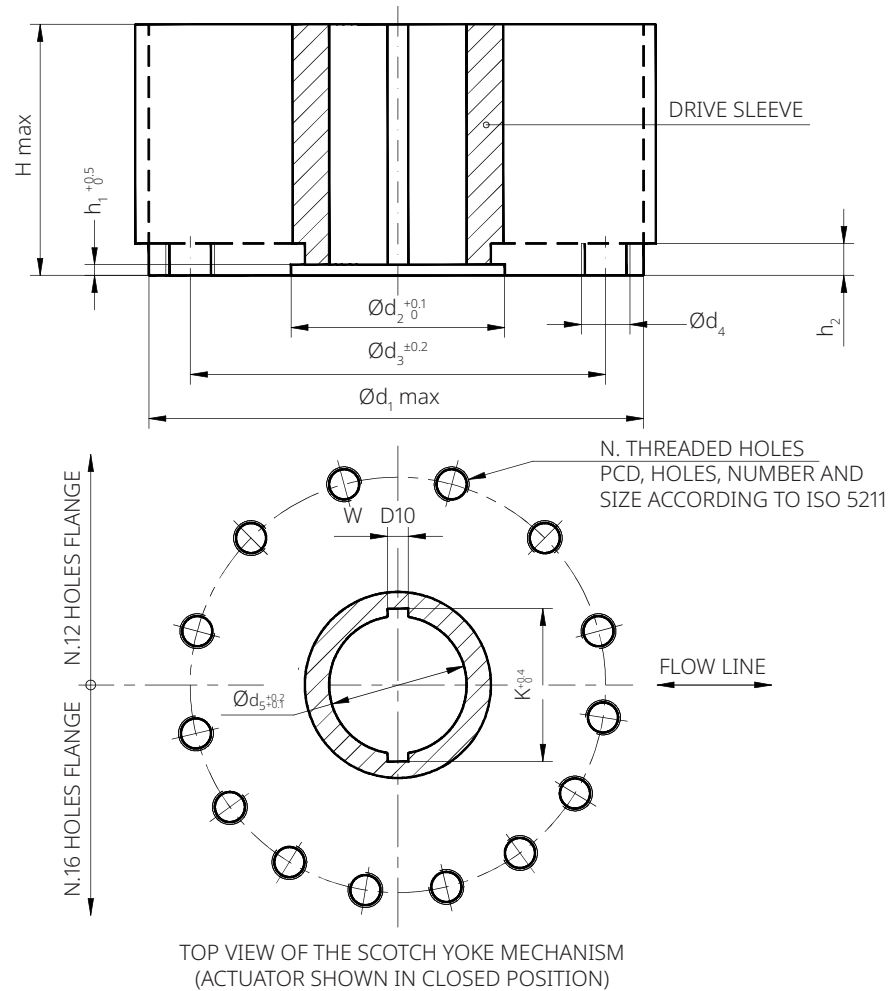


Table 2. SCN6201E - Rev. 16/06/20

Actuator Model	$\varnothing d_1$	$\varnothing d_2$	$\varnothing d_3$	$\varnothing d_4$	N	h_1	h_2	H max	$\varnothing d_5$	W	K
14	580	250	483	M36	12	10	29	340	170	45	195.8

NOTE:
All dimensions are in millimeters.

Figure 13. Coupling Dimensions - Actuator Models 18 and 32 (SCN6201E - Rev. 16/06/20)

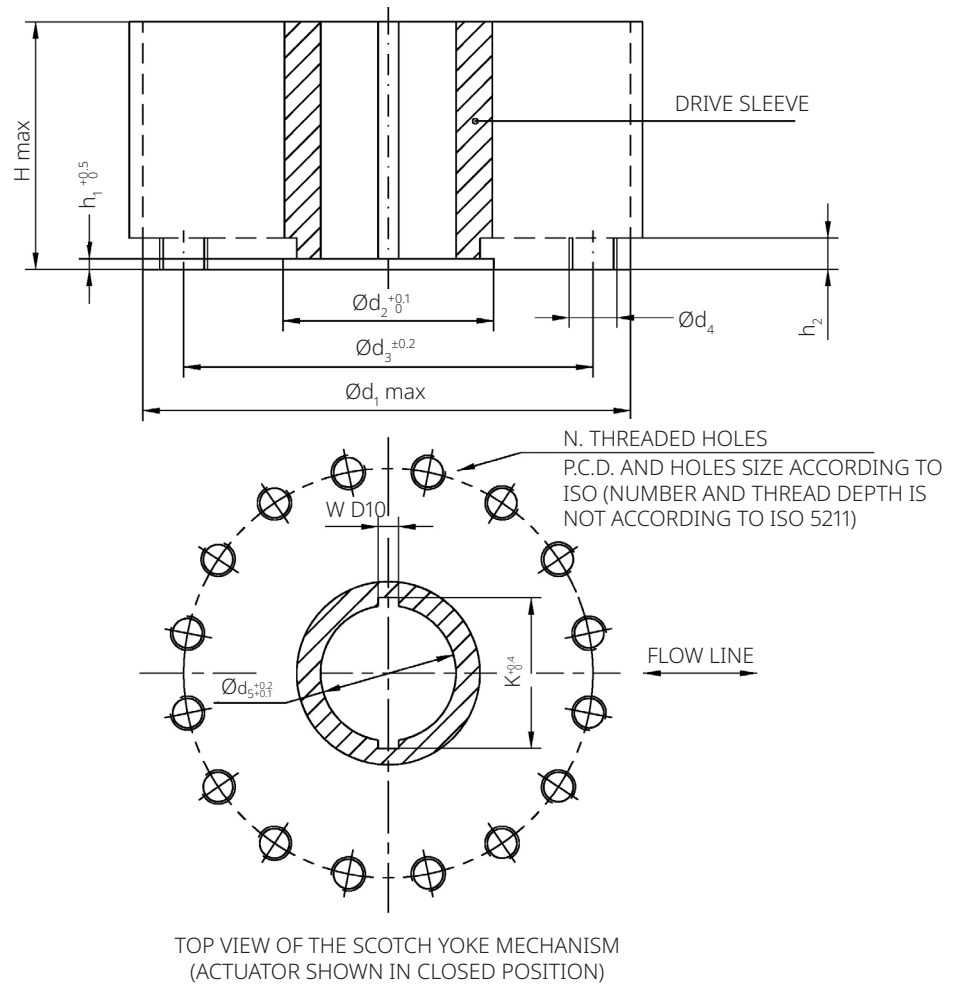


Table 3. SCN6201E - Rev. 16/06/20

Actuator Model	$\varnothing d_1$	$\varnothing d_2$	$\varnothing d_3$	$\varnothing d_4$	N	h_1	h_2	H max	$\varnothing d_5$	W	K
18	680	290	603	M36	16	12	32	350	200	45	220.8
32	780	310	603	M36	16	12	32	400	220	50	242.8

NOTE:
 All dimensions are in millimeters.

Figure 14. Coupling Dimensions - Actuator Model 50 (SCN62011 - Rev. 15/10/19)

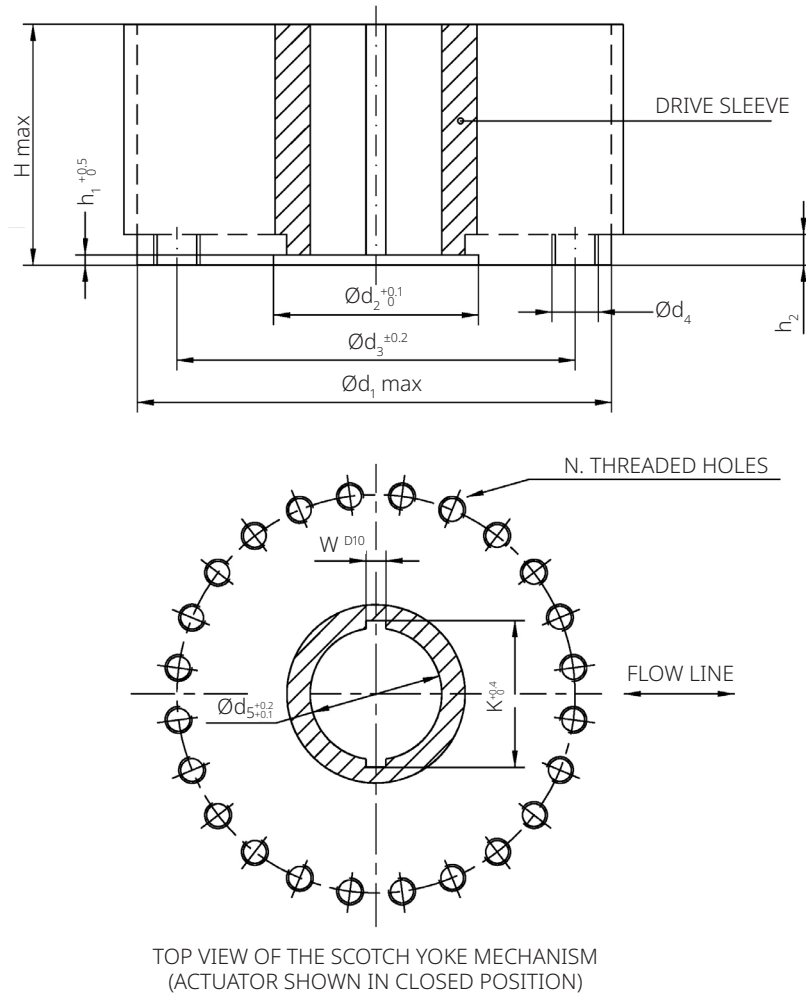


Table 4. SCN62011 - Rev. 15/10/19

Actuator Model	Ød ₁	Ød ₂	Ød ₃	Ød ₄	N	h ₁	h ₂	H max	Ød ₅	W	K
50	800	315	698	M36	24	10	32	430	240	56	264.8

NOTE:
All dimensions are in millimeters.

Figure 15. Coupling Dimensions - Actuator Models 65 and 80 (SCN62013 - Rev. 19/06/20)

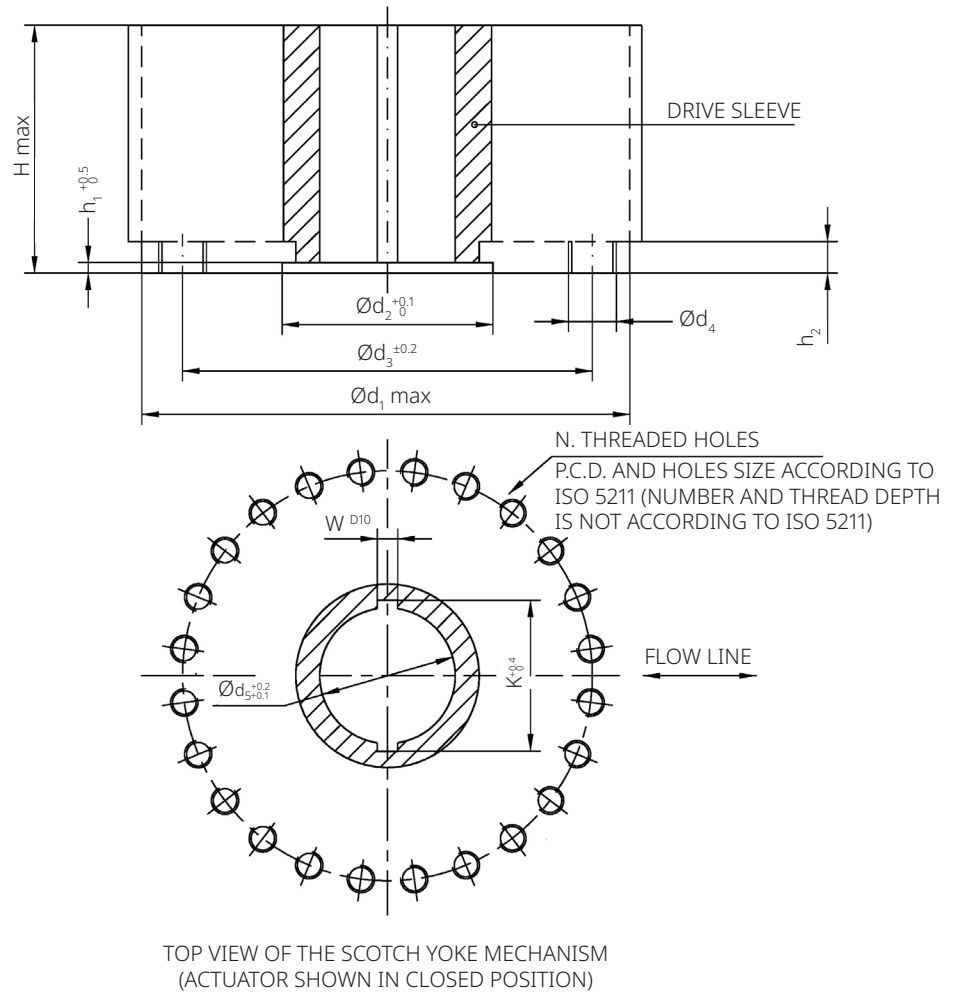


Table 5. SCN62013 - Rev. 19/06/20

Actuator Model	Ød ₁	Ød ₂	Ød ₃	Ød ₄	N	h ₁	h ₂	H max	Ød ₅	W	K
65	910	370	813	M42	24	12	37	540	280	46	327.4
80	900	970	813	M42	24	12	37	540	280	46	327.4

NOTE:
 All dimensions are in millimeters.

2.4.1.1 Coupling with Insert Bush

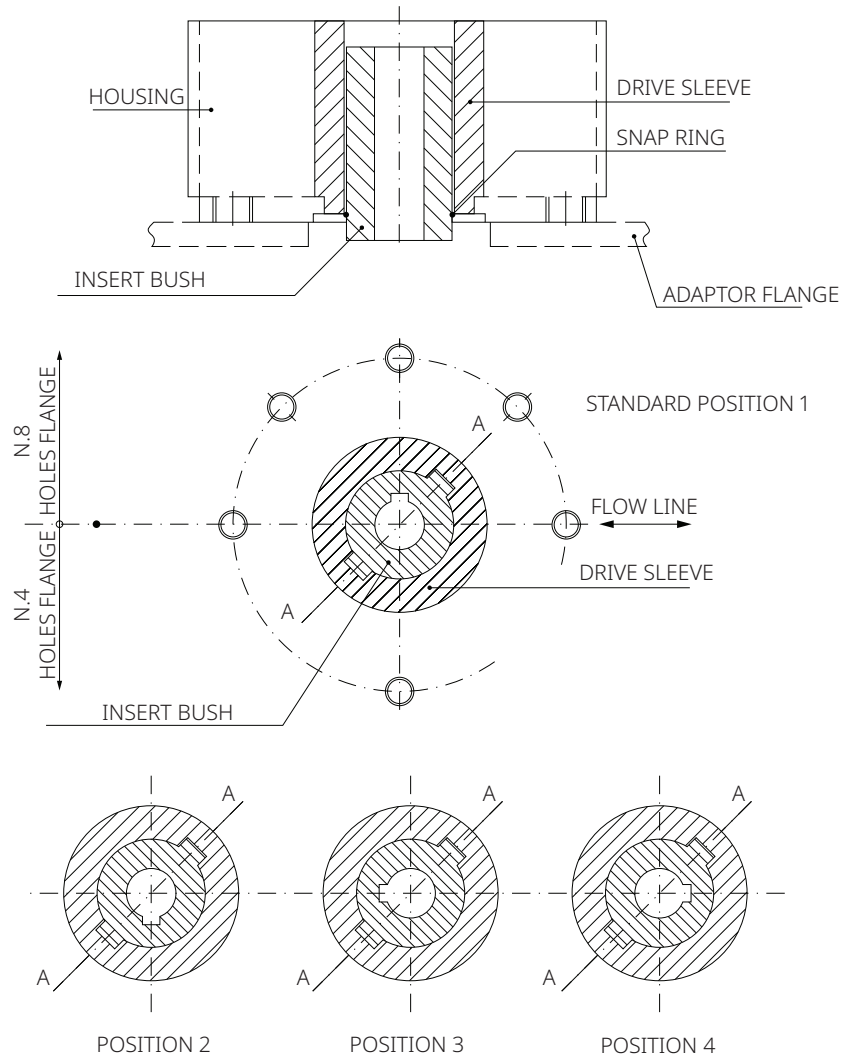
If required, for the base models size 0.3 to 6, Biffi can supply an insert bush with unmachined bore in accordance with Biffi base table SCN6202. On request, the insert bush bore can be machined by Biffi to couple the valve stem, provided its dimensions match the maximum stem acceptance of the bush according to Biffi table TN1005 (ask factory or refer to TDS), and refer to Figure 16. The particular execution of the flange and bushing allow the actuator to be rotated by 90° in 4 different positions according to Figure 16.

Table 6. Insert Bush Setting

Position 2	Position 3	Position 4
Rotate insert-bush 180° around vertical-standard position 1	Rotate insert-bush 180° around axis A-A, from position 2	Rotate insert-bush 180° around axis A-A, from position 1
Insert bush turned upside down		

The Biffi insert bush with 2 external keys at 45° allows to position the keyway for the valve every 90°. Consequently, the actuator can be mounted in 4 positions at 90° on top of the valve. For the biggest actuator models, the bore of the yoke can be machined according to the dimensions of valve stem.

Figure 16. Insert Bush + Intermediate Coupling Flange



2.4.2 Assembly Procedure

NOTICE

Failure to comply with the following procedures may void product warranty.

⚠ WARNING

Installation, commissioning and maintenance and repair works should be carried out by qualified staff. A non-conforming assembly could be the source of serious accidents.

For actuator assembly on the valve:

NOTICE

Check that the assembly position, as shown on the documentation, complies with system's geometry. Check the consistency of the parts of actuator-valve coupling.

- Operate the actuator so that it reaches the position matching valve position (Section 3.3).
- Lubricate valve stem with oil or grease.
- Properly clean and remove grease from coupling flange surfaces.
- Connect, if supplied separately, the adjustment insert to valve stem and fasten it with the special fastening pins.
- Lift the actuator using the special lifting points (Section 2.2).
- Install the actuator so that valve stem inserts in the coupling area. This coupling should be made without forcing.
- Fasten the two parts with the threaded connections (screws, tie rods, nuts). If holes of coupling flanges are not aligned, adequately operate the actuator if necessary move the mechanical stops backwards (Section 3.4).
- Fasten threaded connections. Please refer to Table 7.

Table 7. Nuts Tightening Torque

Threading	Tightening Torque (Nm)
M8	20
M10	40
M12	70
M14	110
M16	160
M20	320
M22	420
M24	550
M27	800
M30	1100
M33	1400
M36	1700

The screwing values in Table 7 were calculated considering the materials ASTM A320 L7 for screws or tie rods and ASTM A194 grade 2H for the nuts.

2.5 Hydraulic Connections

NOTICE

Check that the values of hydraulic supply available are compatible with those reported on the identification plate of the actuator.

WARNING

The connections should be made by qualified staff. Use pipes, fittings and connections appropriate as for type, material and dimensions.

Connect the actuator to the hydraulic feed line with fittings and pipes in accordance to the plant specifications. They must be sized correctly in order to guarantee the necessary oil flow for the operation of the actuator, with pressure drops not exceeding the maximum allowable value. The shape of the connecting piping must not cause excessive stress to the inlets of the actuator. The piping must be suitably fastened so as not to cause excessive stress or loosening of threaded connections, if the system undergoes strong vibrations. Every precaution must be taken to ensure that any solid or liquid contaminants, which may be present in the hydraulic pipework to the actuator, are removed to avoid possible damages to the unit or loss of performance. The inside of the pipes used for the connections must be well-cleaned before use: wash them with suitable substances and blow through them with oil or nitrogen. The ends of the tubes must be well debarred and cleaned. Once the connections are completed, operate the actuator and check that it functions correctly, that the operation times meet the plant requirements and that there are no leakages in the hydraulic connections.

NOTICE

If necessary to mount components not in Biffi scope of supply, please check the accessories mounting hole details in the documents TN 1028 (for metric dimension) or TN 1028U (for imperial dimension).

2.6 Electrical Connections (If Any)

⚠ WARNING

Use components appropriate as for type, material and dimensions. The connections should be made by qualified staff. Before carrying out any operation, cut line power off Safety provisions:

2006/95/EC:	Directive for low voltage equipment (until 19 April 2016) 2014/35/EU from 20 April 2016
2004/108/EC:	Directive for the electromagnetic compatibility (until 19 April 2016) 2014/30/EU from 20 April 2016
94/9/CE:	Directive and safety instructions for use in hazardous Area (until 19 April 2016) 2014/34/EU from 20 April 2016

Remove plastic plugs from cables entries

- Screw firmly the cable glands.
- Introduce connection cables.
- Make the connections in compliance with applicable wiring diagrams on the documentation supplied.
- Screw the cable gland.
- Replace the plastic plugs of unused entries with metal plugs.

Figure 17. Junction Box on Control Group (if Foreseen)



2.7 Commissioning

WARNING

Check that values of electrical supply to the control group (if foreseen) are compatible with those on the plate on the junction box (Figure 17). Installation, commissioning and maintenance and repair works should be made by qualified staff.

Upon actuator commissioning, please carry out the following checks:

- Check that paint is not be damaged during transport, if necessary repair the damages to paint coat.
- Check that the values of hydraulic supply available in the system are compatible with those reported on the identification plate of the actuator (Figures 2 and 3) and on the documentation supplied.
- Check that the feed voltage values of the electric components (solenoid valve coils, microswitches, pressure switches, etc.) are compatible with those reported on the identification plate of the actuator (Figures 2 and 3).
- Check that the setting of the components of the actuator control unit (pressure regulator, pressure switches, flow control valves, etc.) meet the plant requirements.
- Conduct all kinds of operations and check if they were properly executed (Section 3.3).
- Check the pneumatic connections for leakages. If necessary, tighten the nuts of the pipe-fittings.
- Verify that all the necessary or requested operational signals are available to allow the requested functions (valve position, gas supply pressure, etc.).
- Conduct a complete functional test in order to verify that all the operations are executed according to the operating schematic diagram supplied along the order documentation.

Section 3: Operation and Use

3.1 Operation Description

In the normal operating situation, the double-acting actuator is fed by pressurised oil which flows into the relevant cylinder chamber (for example opening). The cylinder piston stroke causes the actuator operation and the consequent valve movement to the operational position requested (in this case to the "open" position).

Upon a demand, the closing chamber the cylinder is fed by pressurised oil and at the same time the oil is discharged from the open chamber into the return line: the actuator performs the closing operation driven by the piston movement, and the valve moves from the open position to the close (safety-related) position.

For local or remote operations, please refer to Sections 3.3.1, 3.3.2, and 3.3.3 and prior to technical documentation furnished with actuators.

Typical schematics for various applications are follow attached for information only.

The power and control systems are supplied on specific customer demand.

WARNING

For all the relevant information please refer to the specific technical documentation supplied with actuators.

Figure 18. OLGA General Sectional Cutoff

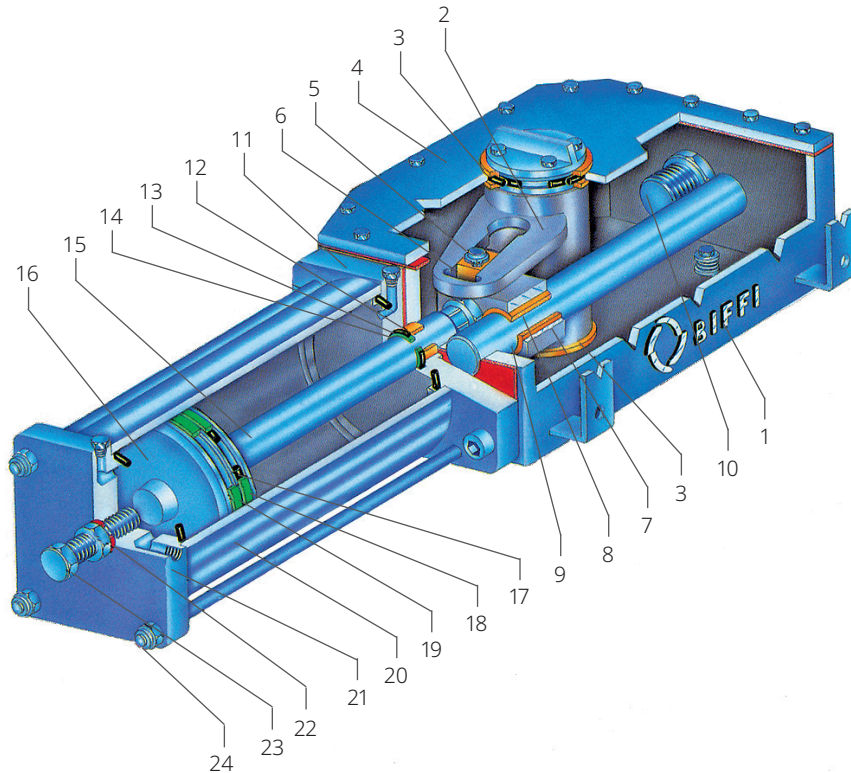


Table 8. Part List

Item	Name
1	Housing
2	Yoke
3	Yoke bushing
4	Cover
5	Guide block pin
6	Sliding block
7	Guide block
8	Guide bar
9	Guide block bushing
10	Travel stop screw
11	Cylinder head flange
12	Piston rod bushing
13	Piston rod O-ring
14	Piston rod seal ring
15	Piston rod
16	Piston
17	Piston O-ring
18	Piston guide sliding ring
19	Piston seal ring
20	Cylinder tube
21	End flange
22	Sealing washer
23	Travel stop screw
24	Tie rod

3.2 Residual Risks

⚠ WARNING

The actuator has parts under pressure.
Use the due caution.
Use individual protections provided for by the laws and provisions in force.

3.3 Operations

Please refer to the functional diagram and specific documentation supplied.

3.3.1 Local Manual Operation

The OLGA actuators can only have the hydraulic manual override for local operation. The compact hydraulic control unit mounted on the actuator consist of:

- Hand pump
- Directional control valve to select "to open" or "to close" actuator operation
- Relief valve to prevent the oil pressure delivered by the hand pump from exceeding the maximum allowable value
- Oil tank

Accessory are available on request, for instance:

- Dual pilot operated check valve
- Bladder-type or piston-type accumulator delivered

Figure 19. OLGA with MHP

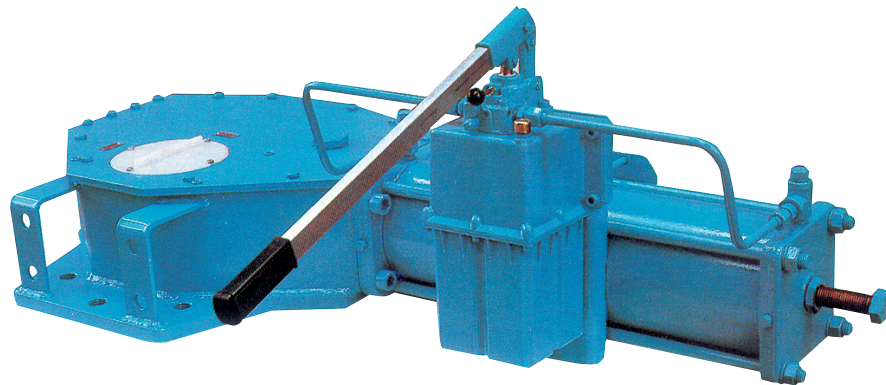


Figure 20. OLGA with MHP (Alternative Configuration)

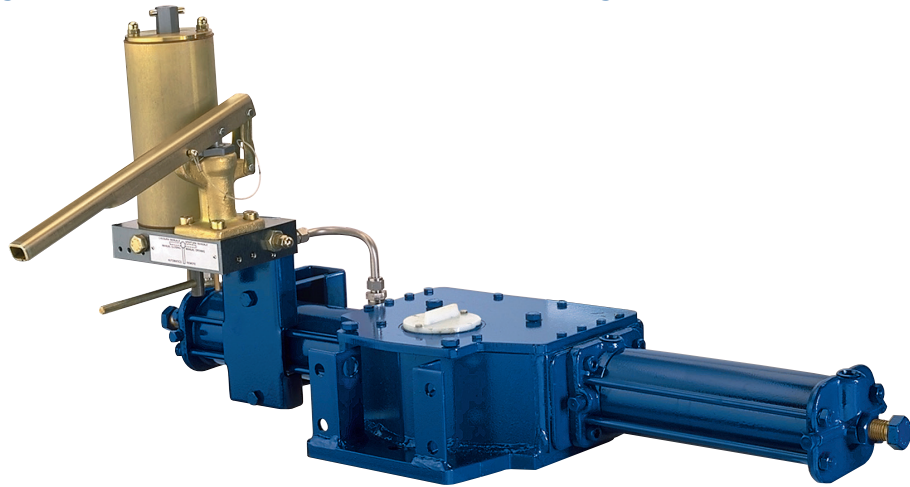


Figure 21. OLGA with Hydraulic Manual Hand Pump

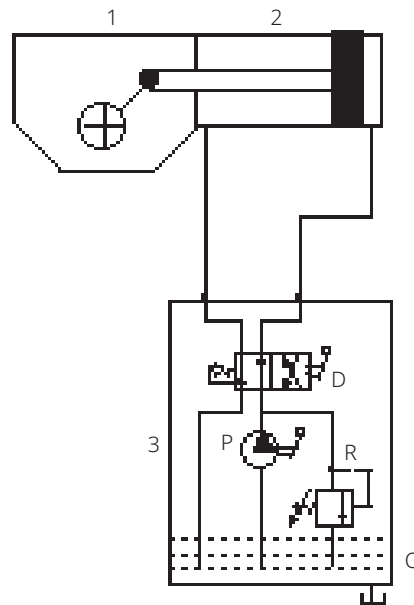


Table 9. Parts List Description

Item	Name
1	Scotch yoke mechanism
2	Hydraulic cylinder
3	Hydraulic manual override
D	Directional control valve
P	Hand pump
R	Relief valve
O	Oil tank

3.3.2 Emergency Manual Operation by MHP

The OLGA actuators can have an emergency manual override in addition to the local and/or remote control panel which controls the oil supplied by a power pack for the “normal” actuator operation. The emergency manual override, mounted on the actuator, consists of a hydraulic manual override and a hydraulic manual selector to choose actuator “Normal operation” with oil supply from a power pack, or the “Emergency manual operation”.

The compact hydraulic override consist of:

- Hand pump
- Directional control valve to select the “to open” or “to close” operation by hand pump
- Relief valve to prevent the oil pressure delivered by the hand pump from exceeding the maximum allowable value

On request the emergency manual override can be included in the power pack.

Figure 22. OLGA with Hydraulic MHP with Local Bypass

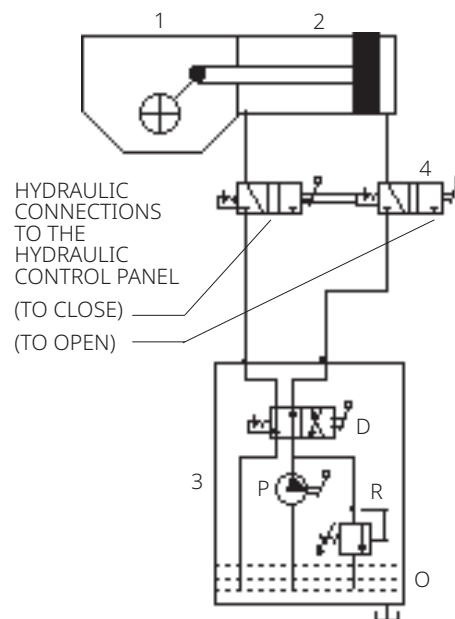


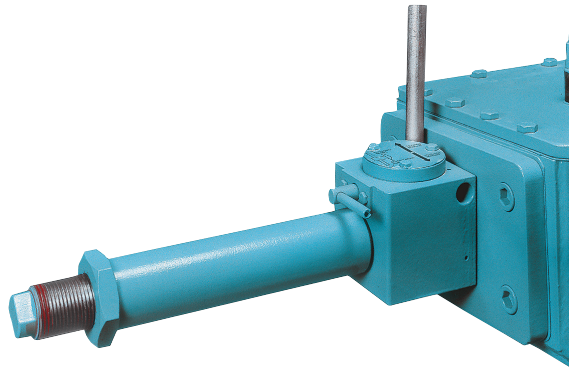
Table 10. Parts List Description

Item	Name
1	Scotch yoke mechanism
2	Hydraulic cylinder
3	Hydraulic manual override
4	Hydraulic manual selector
D	Directional control valve
P	Hand pump
R	Relief valve
O	Oil tank

3.3.3 Emergency Manual Operation by MSJ - MHW

The MSJ jackscrew manual override can be supplied for OLGA actuators from model 0.3 to model 3. The override is mounted on the left side of the actuator, the jackscrew end is screwed into the guide block. A bronze split screw nut is mounted inside the body. By rotating the engagement lever, the screw nut is engaged with the jackscrew. When the screw nut is engaged with the jackscrew manual operation follows by rotating the body of the screw container by a lever. The manual jackscrew, on request, could be furnished with fixed hand wheel welded on it.

Figure 23. MSJ Jackscrew Manual Override



3.4 Calibration of the Angular Stroke

The angular stroke of the yoke can be adjusted between 82° and 98° ($\pm 4^\circ$ with respect to the nominal positions of complete opening and closing) by means the mechanical stops screwed into the left side of the housing (open valve) and into the end flange of the hydraulic cylinder (closing) (Figure 24).

Figure 24. Mechanical Stops



In case of an actuator with two cylinders (Figure 25), both mechanical stops are screwed on the end flanges of the cylinders.

Figure 25. Actuator with Two Cylinders



For the adjustment of the mechanical stop on the end flange of cylinder, follow these steps (Figure 26):

- Remove with the specific wrench (c1) the plug (t).
- Insert a wrench for Allen keys (c2) in the through hole until reaching the adjustment pin (g).
- Keep the protection cover blocked with the special wrench (c3).
- Turn counterclockwise to increase the angular stroke, turn clockwise to decrease it.
- When the adjustment is over tighten the plug (t).

Figure 26. Mechanical Stop of the Cylinder

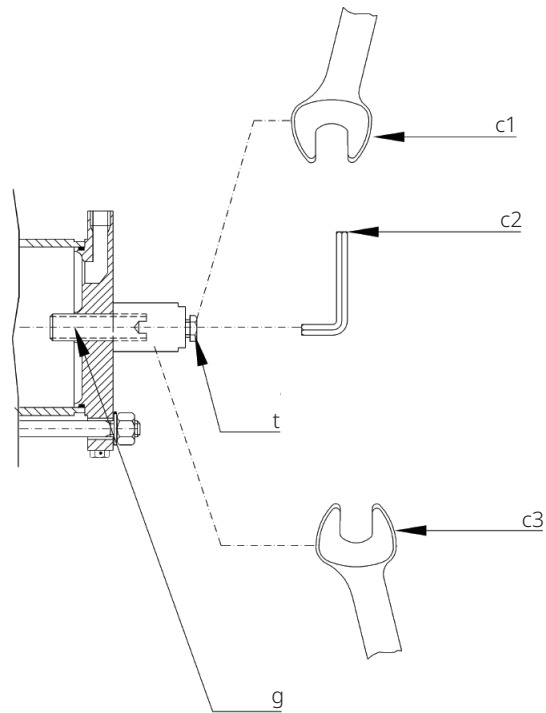


Table 11. Travel Stop Adjustment Tools Size

Hydraulic cylinder size	Wrench c1 (mm)	Wrench c2 (mm)	Wrench c3 (mm)
075	22	10	36
100	22	10	36
135	22	10	36
175	22	14	46
200	27	14	46
235	27	17	65
280	27	17	65
300	36	17	110

For the adjustment of the mechanical stop screwed into the left side of housing, follow these steps (Figure 27 and 28):

- Loosen the locknut (d) with the specific wrench (c2).
- Adjust the pin (g)/screw (v) with the adequate wrench (c1).
- Turn counterclockwise to increase the angular stroke, turn clockwise to decrease it.
- When the adjustment is over tighten the locknut (d).

Figure 27. Mechanical Stop on the Housing

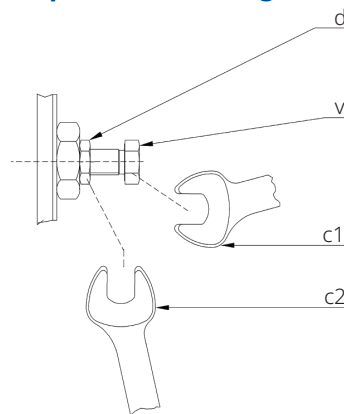


Table 12. Travel Stop Adjustment Tools Size

Hydraulic cylinder size	Wrench c1 (mm)	Wrench c2 (mm)
0,3	30	30
0,9	30	30
1,5	41	41
3	41	41
6	46	46

Figure 28. Mechanical Stop on the Housing

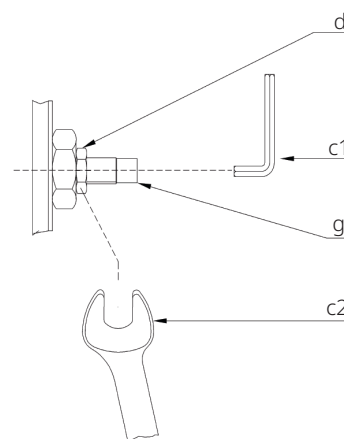


Table 13. Travel Stop Adjustment Tools Size

Hydraulic cylinder size	Wrench c1 (mm)	Wrench c2 (mm)
14	17	60
18	17	60
32	17	60
50	17	60

For the adjustment of the mechanical stop screwed on the end flange of manual override (see Section 7.2, Figure 43).

Figure 29. Mechanical Stop on the End Flange of Manual Override

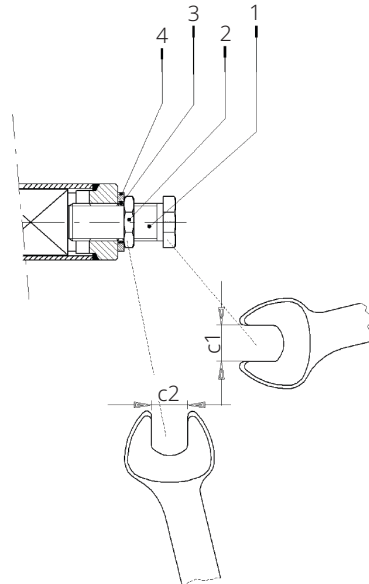


Table 14. Travel Stop Adjustment Tools Size

Hydraulic cylinder size	Wrench c1 (mm)	Wrench c2 (mm)
0,3	34	34
0,9	34	34

Figure 30. Mechanical Stop on the End Flange of Manual Override

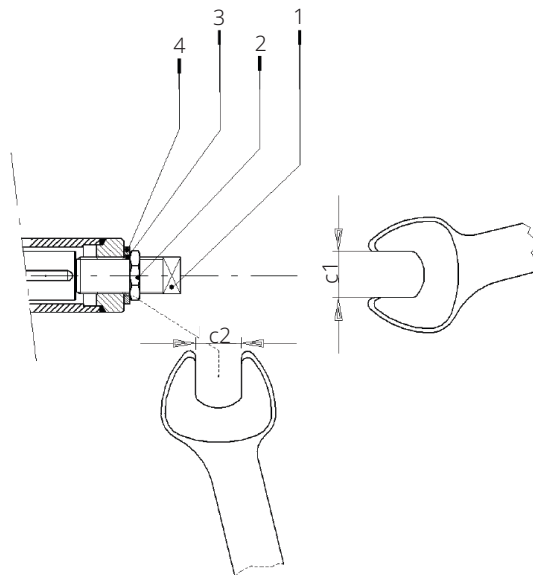


Table 15. Travel Stop Adjustment Tools Size

Hydraulic cylinder size	Wrench c1 (mm)	Wrench c2 (mm)
1,5	24	65
3	24	65

3.5 Calibration of Microswitches (If Foreseen)

Refer to the dedicated Safety Instructions Manual for limit switch box different from the sample proposed.

WARNING

Refer only to technical documentation related to installed switch box model. If different microswitches assembly or limit switch box is supplied, please refer to the specific documentation.

NOTICE

For mounting interface dimension of the Limit Switch box on the cover of the actuator, please refer to TN1163V (for metric dimension) or TN1163VU (for imperial dimension).

NOTICE

Operate only the microswitch corresponding to the direction of operation being carried out, as clearly reported on the microswitch. End of stroke microswitches should be operated before the stop of the stroke of the actuator due to mechanical stops. Adjust the relative cams properly.

3.6 Calibration of the Operation Time (Optional – If Foreseen)

The calibration of the operation time is made by Biffi according to customer requirements and to technical data-sheet included in technical documentation. If necessary it's possible to modify or reset the operating time through two flow regulation valves (optional) placed on inlets of hydraulic cylinder (see Figure 31 and the applicable operating diagram).

Figure 31. Example of Operating Time Adjustment (if foreseen)

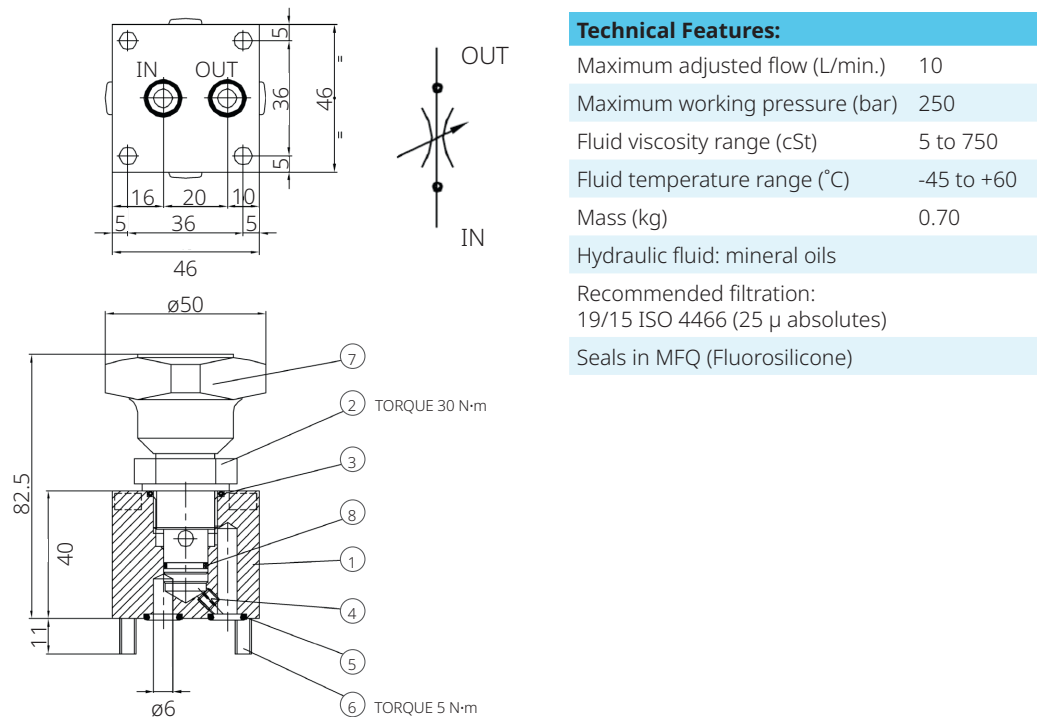


Table 16. Parts Lists

Item	Quantity	Name	Material	Type or drawing
1	1	Body	AISI 316	49.144.031
2	1	Cartridge	AISI 316	FT 2267/2-14-hFQSV
3 *	1	O-ring	MFQ-70Sh	OR 2-116
4	1	Screw	A4-70	M5x5 UNI 5923
5	2	O-ring	MFQ-70Sh	OR 5-612
6	4	Screw	A4-70	VCTEI M5x45 UNI 5931
7	1	Hand wheel	11S (2011)	29.102.378
8 *	1	OR+2BK	MFQ-6Sh+PTFE	OR2-013 + 2BK

NOTE:
Included in cartridge item 2

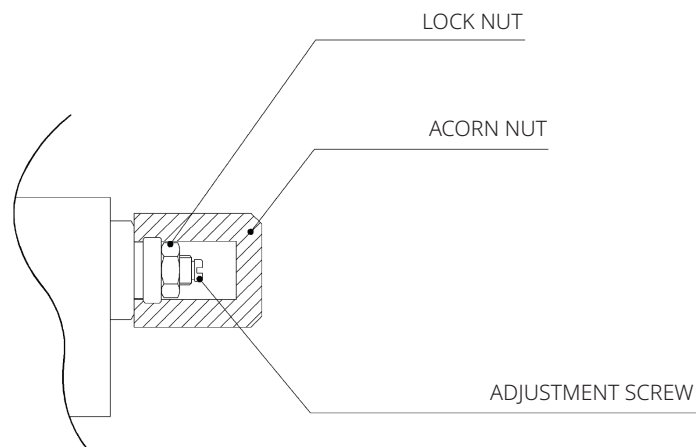
To carry out the adjustment, operate the hand wheel (turn clockwise the hand wheel to increase the operating time or turn the hand wheel counterclockwise to decrease the operation time).

For OLGA actuator with manual hand pump, the operating time is adjustable through two regulation valves placed on manual hand pump body (see Section 7.2, Figure 42).

To carry out the adjustment, use an adequate Allen wrench and follow these steps (Figure 32):

- Remove the cap nut.
- Loosen the locknut.
- Screw with a screwdriver the setting screw to increase the operation time.
- Unscrew with a screwdriver the setting screw to decrease the operation time.
- After the adjustment is over screw the locknut and put back in place the cap nut.

Figure 32. Flow Regulators Placed on Manual Hand Pump



Section 4: Operational Tests and Inspections

NOTICE

To ensure the guaranteed SIL grade, according to IEC 61508, the functionality of actuator must be checked with regular intervals of time, as described in the Safety Manual.

Section 5: Maintenance

NOTICE

Before carrying out any maintenance operation, it is necessary to close the hydraulic feed line and exhaust the pressure from the actuator cylinder and from the control unit, to ensure safety of maintenance staff.

⚠ WARNING

Installation, commissioning and maintenance and repair works should be carried out by qualified staff.

5.1 Periodic Maintenance

OLGA actuators are designed to operate long-term in heavy-duty operating conditions, without maintenance needs.

NOTICE

Periodicity and regularity of inspections is particularly influenced by specific environmental and working conditions.

⚠ WARNING

They can be initially determined experimentally and then be improved according to actual maintenance conditions and needs.

Every 2 years of operation, the following is recommended:

1. Check that the actuator operates the valve correctly and with the required operating times. If the actuator operation is very infrequent, carry out a few opening and closing operations with all the existing controls (remote control, local control, emergency controls, etc.), if this is allowed by the conditions of the plant.
2. Check that the signals to the remote control desk are correct.
3. Check that the air supply pressure value is within the required range.
4. If there is an air filter on the actuator, bleed the condense water accumulated in the cup by opening the drain cock. Disassemble the cup periodically and wash it with soap and water; disassemble the filter: if this is made up of a sintered cartridge, wash it with nitrate solvent and blow through with air. If the filter is made of cellulose, it must be replaced when clogged.
5. Check that the external components of the actuator are in good conditions.
6. Check all the paint-coat of the actuator. If some areas are damaged, repair the paint-coat according to the applicable specification.
7. Check that there are no leaks in the pneumatic connections. If necessary, tighten the nuts of the pipe fittings.

Figure 33. Level Measuring Stick

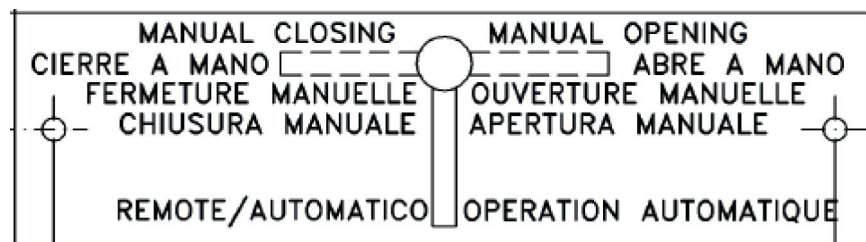


5.1.1

Check and Restore Oil Level in the Hydraulic Control Unit

Operate the distributor lever to “closing manual operation”.

Figure 34. Local and Remote Selection Label



Move the actuator into his “fail to close” position.

Unscrew the dipstick (1).

Check that the oil level into the tank (4) is in correspondence of the “MAX LEVEL” notch of the dipstick.

Screw and tighten the dipstick.

If necessary substitute or added the oil, proceeding as follow:

- Remove the dipstick (1) from the tank cover (22).
- Unscrew the plug (27) and the washer (9) to drain all the oil.
- If some dirt or/and sludge is found in the oil drained from the tank, before filling with new oil in the tank, disassemble the oil tank tube, by unscrewing the two cap nuts (2), and clean the internal surfaces of the tank. If necessary substitute the gaskets (21) of the tank.
- Replace the plug (27) and the washer (9) into the plate (11) and tighten.
- Pour the new oil into the tank through the dipstick hole (1) on the cover (22).
- Replace the dipstick (1).
- Add oil (refer to Table 17) if in the tank the oil level is BELOW THE MINIMUM (Figure 33) until to reach the optimal (MAXIMUM) oil level.
- Operate the distributor lever to “Remote” position.

NOTICE

For refill use oil of the same brand as previous, refer to related technical documentation.

Table 17. Hydraulic Oil List by Biffi for Refilling in Different Working Conditions

Standard Temperature Conditions (-30 to +85 °C)	
Producer	ENI®
Name	Arnica 22
Viscosity at 40 °C	20.9 sq. mm/s
Viscosity at 100 °C	4.73 sq. mm/s
Viscosity index ASTM	153
Flash point	192 °C
Pour point	-42 °C
Specific weight (at 15 °C)	0.857 kg/L
Equivalent oils:	Use an equivalent or better product in compliance with the oil proposed in the actual scope of supply by Biffi. Your oil supplier can verify and propose an alternative product at your responsibility.
Low Temperature Conditions (to -46 °C):	
Manufactured Name	Shell AeroShell® Fluid 41
Viscosity at -54 °C	2300 cST
Viscosity at -40 °C	491 cST
Viscosity at 40 °C	14.1 cST
Viscosity at 100 °C	5,30 cST
Viscosity index (ISO 2909)	>200
Flash point	105 °C
Pour point	<-60 °C
Specific weight	0.87 kg/cu. dm
(or equivalent)	
Low Temperature Conditions (to -60 °C)	
Manufactured Name	* SYNTESIS * SYNTRASS-CS 500
Viscosity at -60 °C	580 cST
Viscosity at -30 °C	39 cST
Viscosity at 20 °C	5.8 cST
Viscosity at 50 °C	2.1 cST
Flash point	152 °C
Pour point	-68 °C
Specific weight	0.897 kg/cu. dm
(or equivalent)	

NOTE:

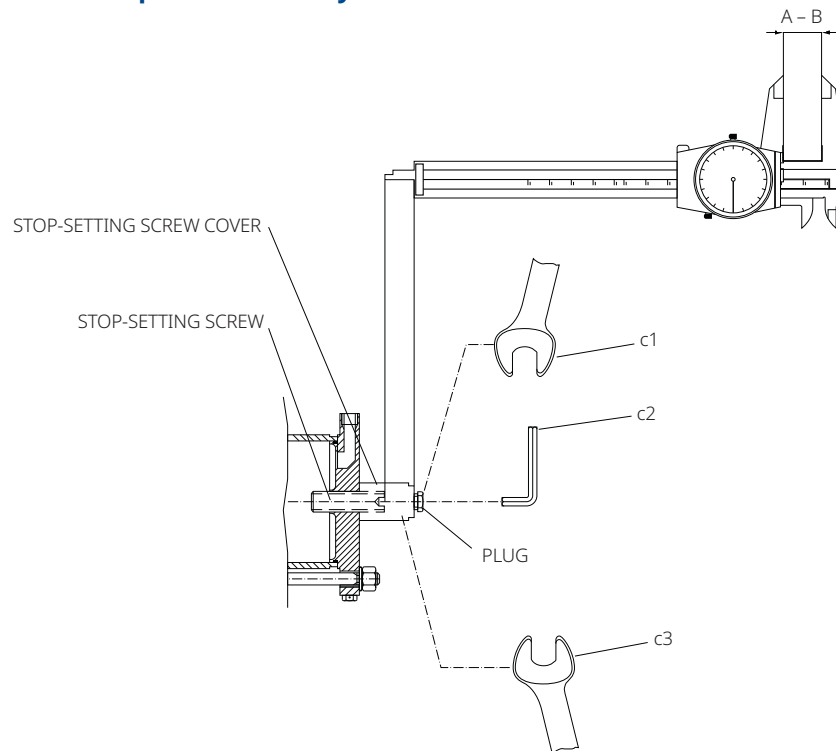
* Refer to Biffi to receive a quotation for this oil.

5.2 Extraordinary Maintenance

If there are leaks in the hydraulic cylinder, or a malfunction in the mechanical components, or in case of scheduled preventive maintenance, the actuator must be disassembled and seals must be replaced with reference to the follow general sectional drawing and adapting the following procedures.

5.2.1 Replacement of Cylinder Seals

Figure 35. Replacement of Cylinder Seals



WARNING

Before executing any maintenance operation, it is necessary to intercept the supply line and discharge pressure from the cylinder of the actuator.

1. Unscrew the stop-setting screw cover (23) from the cylinder end flange.
2. Measure the distance of the stop screw (20) with reference to the end flange (22) surface, so as to be able to easily restore the setting of the actuator mechanical stop, once the maintenance procedures have been completed.
3. Unscrew the stop screw (20) by turning it counterclockwise with an Allen wrench until the screw is completely with drawn inside the end flange threaded hole.
4. Unscrew the nuts (25) from the tie rods (18): they must be gradually unscrewed all at the same time.

5. Slide off the end flange (22) and the tube (21).
6. If the actuator control unit requires the cylinder chamber head flange side to be also filled with oil, and the piston rod seal ring (40) to be replaced, remove the screw (2) and the cover (1). Unscrew the piston rod (17) threaded end from the adaptor bush (30) of the guide block (14). Slide off the piston rod (17) from the head flange (42).
7. Disassemble the head flange (42) from the mechanism housing (8) by removing the screws (31) only if the gaskets (37) and (39) have to be replaced because damaged.

5.2.1.1 Seals Replacement

Prior to reassemble check that the actuator components are in good conditions and clean. Lubricate all the surfaces of the parts, which move in contact with other components, by recommended grease (Molykote® 2003 or Lubcon Turmoplex LTA 2 if seals are NBR (Nitrile Butadiene Rubber) or Viton® (FKM) or neoprene rubber, with Mobilgrease™ 33 if the seals are in fluorosilicone rubber). If the O-ring must be replaced, remove the existing one from its groove, clean the groove carefully and lubricate it with protective grease film. Assemble the new O-ring into its groove and lubricate it with a protective grease film.

1. Replace the O-ring (43) of the head flange (42).
2. Replace the O-ring (43) of the end flange (22).

To replace the piston rod seal rings (40) proceed as follows:

1. Remove the existing PTFE seal ring (40) with its O-ring from their groove.
2. Clean the groove carefully and lubricate it with a protective oil film.
3. Assemble the new O-ring into its groove and lubricate it with a protective oil film.
4. Assemble the new PTFE seal ring (40) into the flange groove, inside its rubber O-ring, by bending it: take care that the bending radius is as large as possible to avoid damaged the seal. Then enlarge the seal ring with your fingers so as to restore its round shape: pay attention not to utilise any tools, which can damage the seal ring.

To replace the piston seal ring (46) proceed as follows:

1. Remove the existing PTFE seal ring (46) with its O-ring from their groove.
2. Clean the groove carefully and lubricate it with a protective oil film.
3. Assemble the new O-ring into its groove and lubricate it with a protective oil film.
4. Assemble the new PTFE seal ring (46) on its rubber O-ring by introducing one side of it into the groove, then enlarge it with your fingers so as to fit it into the groove: take care to enlarge it uniformly without any tools which could possibly damage it. The elastic memory of the kind of PTFE the seal ring is made of allows the ring to shrink back to its previous dimension after a short time.

5.2.1.2 Reassemble

1. Assemble the new gasket (37-39) after cleaning the surfaces of housing (8), the flange (38) and head flange (42), which are in contact.
2. Assemble the head flange (42), replace the washers if damaged, tighten the screws (31) to the recommended torque.
3. Lubricate the piston rod (17) surface, with a protective oil film and introduce it into the head flange hole, taking care not to damage the O-ring (39). Carefully clean the threaded end of the piston rod (17) and the threaded hole of the adaptor bush (30) of guide block (14). Spread some sealant LOCTITE™ 452, or equivalent, on the rod threaded end and tighten.
4. Carefully clean the inside of the tube (21) and check that the entire surface, particularly that of the bevels, is not damaged. Lubricate with a protective oil film the tube internal surface and the bevels at the ends. Slide the tube onto the piston taking care not to damaged the PTFE seal ring (46): the tube bevel has to smoothly compress the seal ring; take care also not to damage the head flange O-ring (43).
5. Assemble the end flange by centring it on the inside diameter of the tube, taking care not to damage the O-ring (43).
6. Assemble the nuts (25) onto the tie rods (18). Tighten the nuts to the recommended torque, alternating between opposite corners.
7. Restore a generous coating of grease on the contact surfaces of the yoke (11) and the bushings (33), on the yoke grooves, on the sliding blocks (5), on guide bar (9).
8. Assemble the new gasket (10) after cleaning the surfaces of the housing (8) and cover (1).
9. Lubricate with protective oil or grease the O-ring (32).
10. Assemble the cover (1) and the screws (2). Tighten the screws to the recommended torque.
11. Screw the stop screw (20) by turning it clockwise with an Allen wrench until it reaches its original position (the same distance with reference to the end flange surface).
12. Screw the stop-setting screw cover (23) into the cylinder end flange.

NOTICE

After maintenance operations carry out a few actuator operations to check that its movement is regular and that there is no oil leakage through the seals.

Figure 36. OLGA Double-Acting Hydraulic Actuator

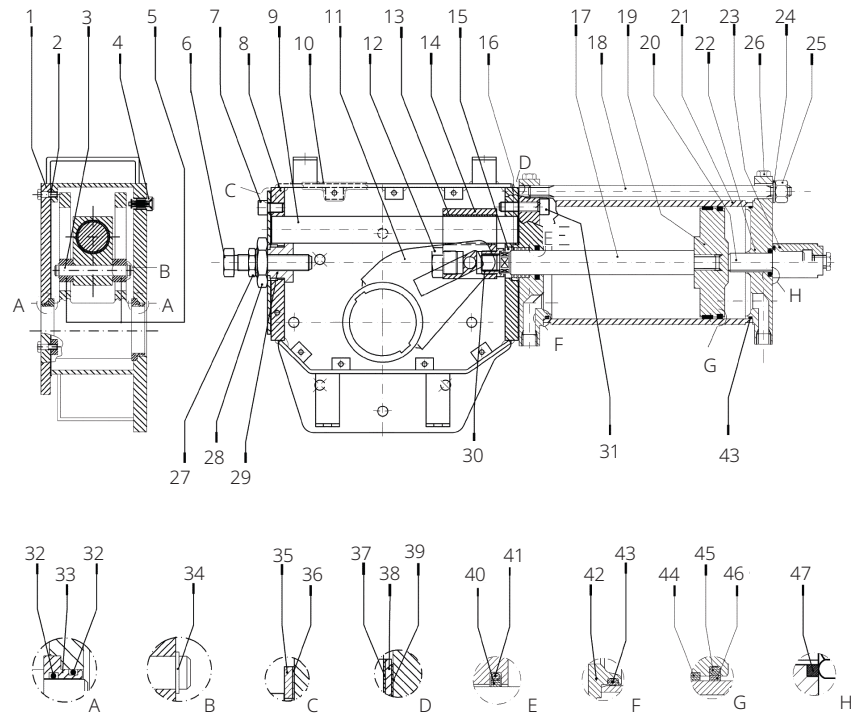


Table 18. Parts List

Item	Description	Item	Description
1	Cover	26	Plug
2	Screw	27	Nut
3	Guide block pin	28	Nut
4	Vent valve	29	Stopper bush
5	Sliding block	30	Adaptor bush
6	Screw	31	Screw
7	Screw	32	O-ring
8	Housing	33	Yoke bushing
9	Guide bar	34	Retainer ring
10	Cover gasket	35	Flange
11	Yoke	36	Gasket
12	Plug	37	Gasket
13	Bushing	38	Flange
14	Guide block	39	Gasket
15	Washer	40	Piston rod seal ring
16	Piston rod bushing	41	O-ring
17	Piston rod	42	Head flange
18	Tie rod	43	O-ring
19	Piston	44	Guide sliding ring for piston
20	Stop-setting screw	45	O-ring
21	Cylinder tube	46	Piston seal ring
22	End flange	47	Sealing washer
23	Stop-setting screw cover		
24	Spring washer		
25	Nut		

5.3 Lubrication of Mechanism

In case of high load and high frequency of operation, it may be necessary to periodically restore lubrication: it is advisable to apply a generous coating of grease on the contact surfaces of the yoke and bushings, on the yoke link grooves, on the sliding blocks, on the guide bar.

For this operation, it is necessary to disassemble the mechanism cover. In larger actuators, the lubrication can be performed through the inspection holes of the cover after removing the plugs.

It is necessary to restore the grease into spring cartridge (for this operation remove the plug on end flange of spring cartridge and restore a generous coating of grease).

The following grease is used by Biffi for standard working temperature and suggested for relubrication:

ENI MU/EP/2 * and **

To be used in standard temperature conditions: -30 to +85 °C

NLGI (National Lubricating Grease Institute) consistency:

2

Worked penetration:

280 dmm

ASTM Dropping Point:

185 °C

Base oil viscosity at 40 °C:

160 sq. mm/s

ISO Classification:

L-X-BCHB 2

DIN 51 825:

KP2K - 20

Equivalent to:

Use an equivalent or better product in compliance with the grease proposed in the actual scope of supply by Biffi. Your grease supplier can verify and propose an alternative product at your responsibility.

Mobilgrease 33 or Equivalent **

To be used in low temperature conditions: -60 to +100 °C

Notes:

- * If the service is not special (i.e., oxygen, hydrogen or other mentioned during the offer stage).
- ** Use an equivalent or better product in compliance with the grease proposed in the actual scope of supply by Biffi. Your grease supplier can verify and propose an alternative product at your responsibility.

5.4 Dismantling and Tear Down

Before starting the disassembly, a large area should be created around the actuator to allow any kind of movement without problems of further risks created by worksite.

WARNING

Before disassembling the actuator, it is necessary to close the pneumatic feed line and discharge pressure from the cylinder of the actuator from the control unit and from the accumulator tank, if present.

The opposition of pneumatic supply is discharged from the cylinder by the linear movement generated from the spring releasing. It moves the actuator and consequently the valve, in its fail-safe position.

If the actuator is still mounted onto the valve, loosen the threaded connections between valve and actuator (screws, tie rods and nuts)

Lift the actuator using the proper lifting points, see Sections 2.2 to 3.5.

If the actuator needs storage before demolition, see Section 2.2.

NOTICE

The tear down of the actuator both concerning any electrical and mechanical part should be made by specialized staff.

Separate the parts composing the actuator according to their nature (e.g., metallic and plastic materials, fluids, etc.) and send them to appropriate waste collection sites, as provided by the laws and provisions in force.

Section 6: Troubleshooting

6.1 Failure or Breakdown Research

Table 19. Troubleshooting

Event	Possible Cause	Remedy
Actuator does not work	Lack of power supply	Restore it
	Lack of hydraulic supply	Open line interception valve
	Blocked valve	Repair or replace
	Wrong position of the distributor of the manual hydraulic group	Restore correct position
	Failure of the control group	Call Biffi Customer Service
	Unexpected intervention of torque limit-device	Call Biffi Customer Service
Actuator too slow	Low supply pressure	Restore (Section 1.4)
	Wrong calibration of flow regulator valves	Restore (Section 3.6)
	Wear of the valve	Replace
Actuator too fast	High supply pressure	Restore (Section 1.4)
	Wrong calibration of flow regulator valves	Restore (Section 3.6)
Leakages on hydraulic or pneumatic circuits	Deterioration and/or damage to gaskets	Call Biffi Customer Service
Incorrect position of the valve	Wrong adjustment of mechanical stops	Restore (Section 3.4)
	Wrong warning of microswitches	Restore (Section 3.5)
Hydraulic manual pump does not work	Handle positioned on remote control	Reposition the operation indication handle to manual
	Leakages on the check valve of the hydraulic control group	Call Biffi Customer Service

Section 7: Spare Parts

7.1 Spare Parts Order

For spare parts orders to the relevant Biffi office, please make reference to Biffi order confirmation concerning all the supply and serial number of the actuator (Section 1.2) for any specific spare parts for a specific actuator model.

Please send every spare parts request to:

Biffi – Spare Parts and After Sales Department

Tel.: +39 0523-944523

Fax: +39 0523-941885

E-mail: Biffispare@Emerson.com

Please specify:

1. Actuator model
2. Biffi acknowledgement
3. Spare parts code
4. Quantity
5. Transport condition
6. Involved people

7.2 Parts List for Maintenance and Replacing Procedure

Figure 37. Scotch Yoke Mechanism

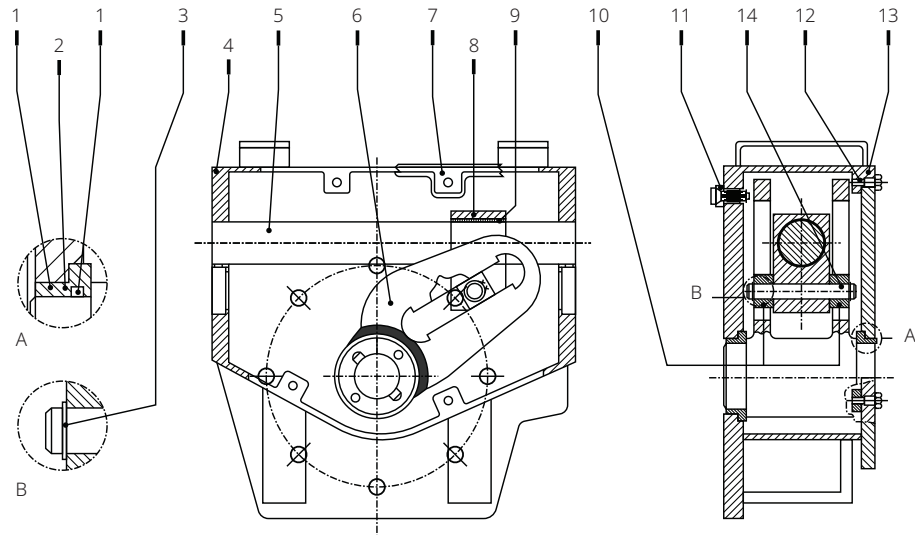


Table 20. Parts List

Item	Quantity	Description	Material
1	4	O-ring	* NBR
2	2	Yoke bushing	Bronze
3	2	Retainer ring	Stainless steel
4	1	Housing	Carbon steel
5	1	Guide bar	Alloy steel
6	1	Yoke	Carbon steel
7	1	Cover gasket	* Fiber
8	1	Guide block	Carbon steel
9	1	Bushing	Steel + Bronze + PTFE
10	2	Sliding block	Bronze
11	1	Vent valve	* Stainless steel
12	12	Screw	Carbon steel
13	1	Cover	Carbon steel
14	1	Guide block pin	Alloy steel

NOTE:

* Recommended spare parts

Figure 38. Hydraulic Cylinder

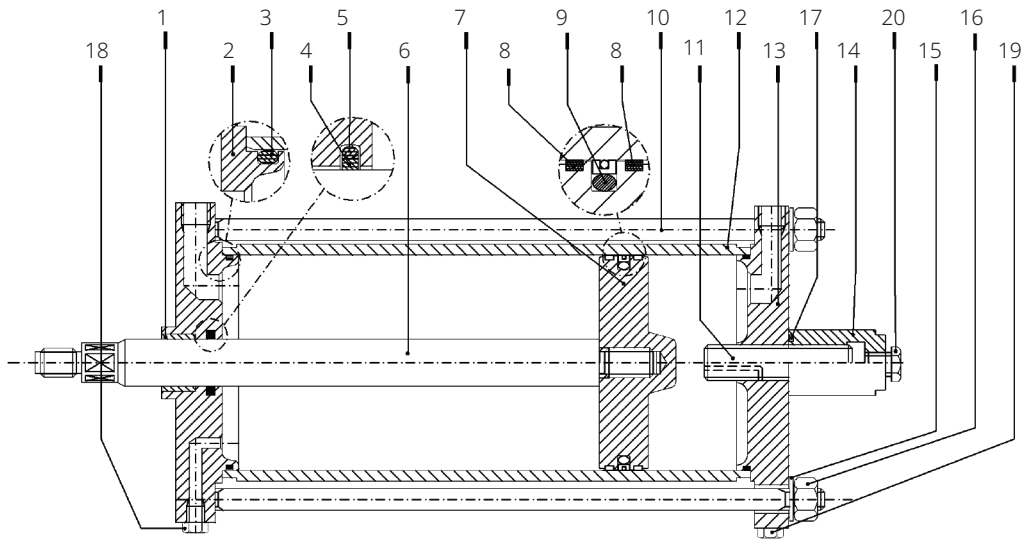


Table 21. Parts List

Item	Quantity	Description	Material
1	1	Piston rod bushing	Steel + Bronze + PTFE
2	1	Head flange	Carbon steel
3	2	O-ring	* NBR rubber
4	1	Piston rod seal ring	* PTFE + Graphite
5	1	O-ring	* NBR rubber
6	1	Piston rod	Alloy steel
7	1	Piston	Nickel plated carbon steel
8	2	Guide sliding ring for piston	* PTFE + Graphite
9	1	Piston seal ring	* PTFE + NBR
10	4	Tie rod	Alloy steel - ASTM A320 grade L7
11	1	Stop-setting screw	Alloy steel
12	1	Cylinder tube	Nickel plated carbon steel
13	1	End flange	Carbon steel
14	1	Stop-setting screw cover	Carbon steel
15	4	Spring washer	Carbon steel
16	4	Nut	Carbon steel - ASTM A194 grade 7
17	1	O-ring	* NBR rubber
18	6	Plug	Carbon steel
19	1	Plug	Carbon steel
20	1	Plug	Carbon steel

NOTE:

* Recommended spare parts

Figure 39. Hydraulic Cylinder for MHP (Optional)

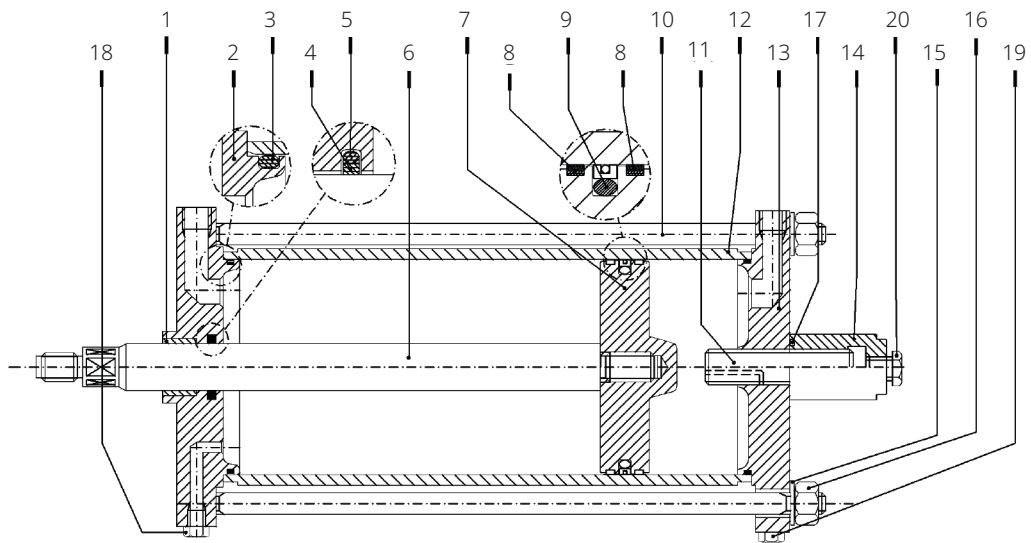


Table 22. Parts List

Item	Quantity	Description	Material
1	1	Piston rod bushing	Steel + Bronze + PTFE
2	1	Head flange	Carbon steel
3	2	O-ring	* NBR rubber
4	1	Piston rod seal ring	* PTFE + Graphite
5	1	O-ring	* NBR rubber
6	1	Piston rod	Alloy steel
7	1	Piston	Nickel plated carbon steel
8	2	Guide sliding ring for piston	* PTFE + Graphite
9	1	Piston seal ring	* PTFE + NBR
10	4	Tie rod	Alloy steel - ASTM A320 grade L7
11	1	Stop-setting screw	Alloy steel
12	1	Cylinder tube	Nickel plated carbon steel
13	1	End flange	Carbon steel
14	1	Stop-setting screw cover	Carbon steel
15	4	Spring washer	Carbon steel
16	4	Nut	Carbon steel - ASTM A194 grade 7
17	1	O-ring	* NBR rubber
18	6	Plug	Carbon steel
19	1	Plug	Carbon steel
20	1	Plug	Carbon steel

NOTE:

* Recommended spare parts

Figure 40. Assembly Kit

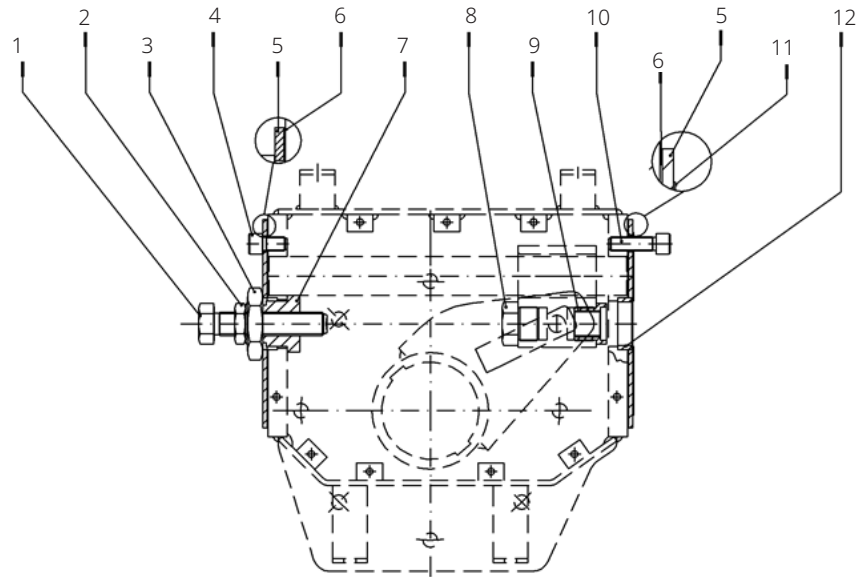


Table 23. Parts List

Item	Quantity	Description	Material
1	1	Screw	Alloy Steel
2	1	Nut	Carbon steel
3	1	Nut	Carbon steel
4	4	Screw	Alloy Steel
5	2	Flange	Carbon steel
6	2	Gasket	* Fiber
7	1	Stopper bush	Alloy Steel
8	1	Plug	Alloy Steel
9	1	Adaptor bush	Alloy Steel
10	4	Screw	Alloy Steel
11	1	Gasket	* Fiber
12	1	Washer	Alloy Steel

NOTE:

* Recommended spare parts

Figure 41. Hydraulic Control Unit MHP

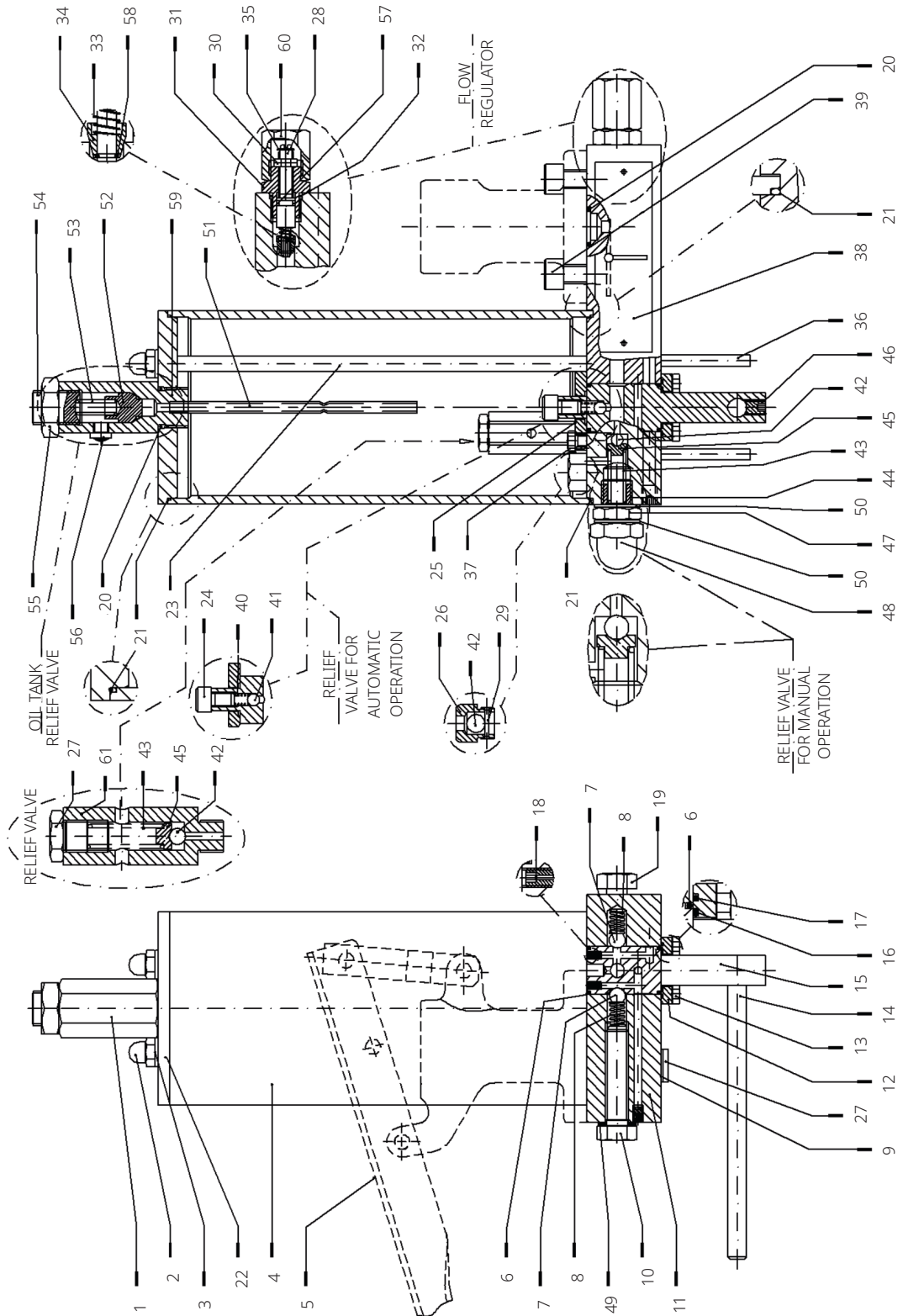


Table 24. Parts List

Item	Quantity	Description	Material
1	1	Dipstick	-
2	2	Cap nut	Carbon steel
3	2	Washer	Carbon steel + rubber
4	1	Hydraulic tank	Carbon steel
5	1	Hand pump	Refer to Table 25
6	2	O-ring	* Fluorosilicon rubber
7	2	Ball	Stainless steel
8	2	Spring	Spring steel
9	1	Washer	Carbon steel + rubber
10	1	Screw	Carbon steel
11	1	Plate	Carbon steel
12	1	Flange	Aluminum
13	4	Screw	Carbon steel
14	1	Lever	Carbon steel
15	1	Distributor	Stainless steel
16	1	O-ring	* Fluorosilicon rubber
17	1	O-ring	* Fluorosilicon rubber
18	1	Nozzle	Carbon steel
19	2	Screw	Carbon steel
20	3	O-ring	* Fluorosilicon rubber
21	2	O-ring	* Fluorosilicon rubber
22	1	Tank cover	Carbon steel
23	2	Tie rod	Carbon steel
24	1	Screw	Carbon steel
25	1	Flange	Aluminum
26	2	Check valve body	Aluminum
27	2	Plug	Carbon steel
28	2	Flow control valve setting screw	Stainless steel
29	2	Spring pin	Stainless steel
30	2	Nut	Carbon steel
31	2	Flange	Carbon steel
32*	2	O-ring	* Fluorosilicon rubber
33	2	Spring	Spring steel
34	2	Plug	Stainless steel
35	2	Retainer ring	Spring steel
36	2	Spring pin	Carbon steel
37	4	Screw	Carbon steel
38	1	Operation instruction plate	Stainless steel
39	4	Screw	Carbon steel
40	1	Spring	Stainless steel
41	1	Ball	Stainless steel
42	4	Ball	Stainless steel
43	2	Spring	Spring steel
44	1	Relief valve setting screw	Stainless steel
45	2	Spring pin	Carbon steel
46	1	Screw	Alloy steel
47	1	Spring	Stainless steel
48	1	Nut	Carbon steel
49	1	Washer	Carbon steel + rubber
50	2	Washer	Carbon steel + rubber
51	1	Dipstick	Stainless steel
52	1	Plug + O-ring	*
53	1	Spring	Stainless steel
54	1	Screw	Alloy steel
55	1	Nut	Carbon steel
56	1	Silencer	Brass
57	2	O-ring	* Fluorosilicon rubber
58	2	Retainer ring	Spring steel
59	1	Dipstick body	Aluminum
60	2	Nut	Carbon steel
61	1	Relief valve body	Aluminum

NOTE:

* Recommended spare parts

Figure 42. Hand Pump

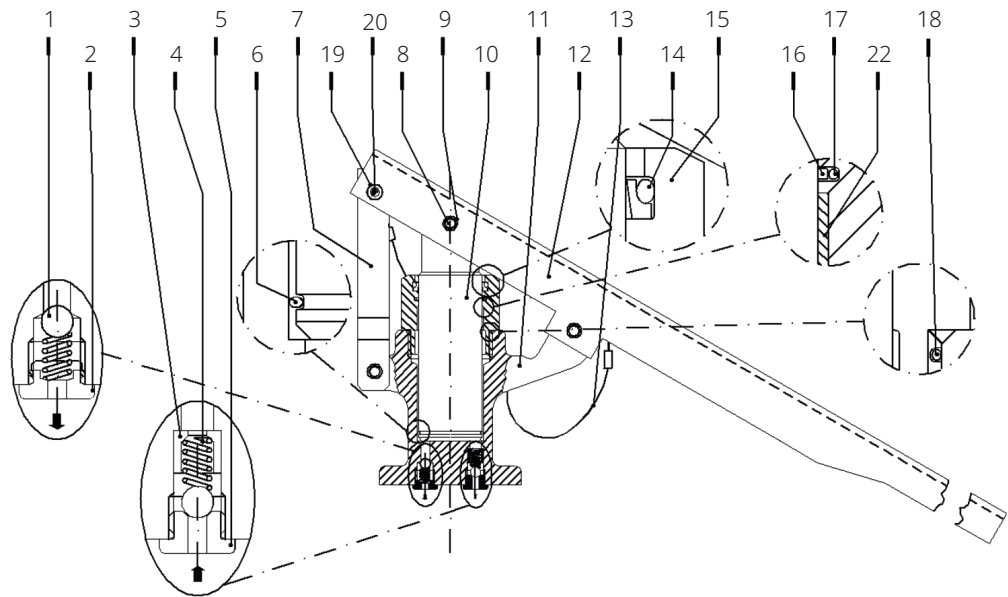


Table 25. Parts List

Item	Quantity	Description	Material
1	2	Ball	Stainless steel
2	1	Delivery valve bush	Carbon steel
3	1	Suction valve bush	Carbon steel
4	2	Spring	Stainless steel
5	1	Suction valve ring	Carbon steel
6	1	Spring retainer ring	Carbon steel
7	1	Fork	Carbon steel
8	2	Pin	Stainless steel
9	4	Retainer ring	Carbon steel
10	1	Rod	Alloy steel
11	1	Body	Carbon steel
12	1	Lever	Carbon steel
13	1	Split pin with rope	Nylon + carbon steel
14	1	Scraper ring	* PTFE + fluorosilicon rubber
15	1	Threaded bush	Aluminum
16	2	Rod seal ring	* PTFE + Graphite
17	2	O-ring	* Fluorosilicon rubber
18	1	O-ring	* Fluorosilicon rubber
19	1	Nut	Carbon steel
20	1	Screw	Carbon steel
21	1	Fork	Carbon steel
22	1	Piston rod bushing	Steel + Bronze + PTFE

NOTE:

* Recommended spare parts

Figure 43. Jackscrew Manual Override MSJ

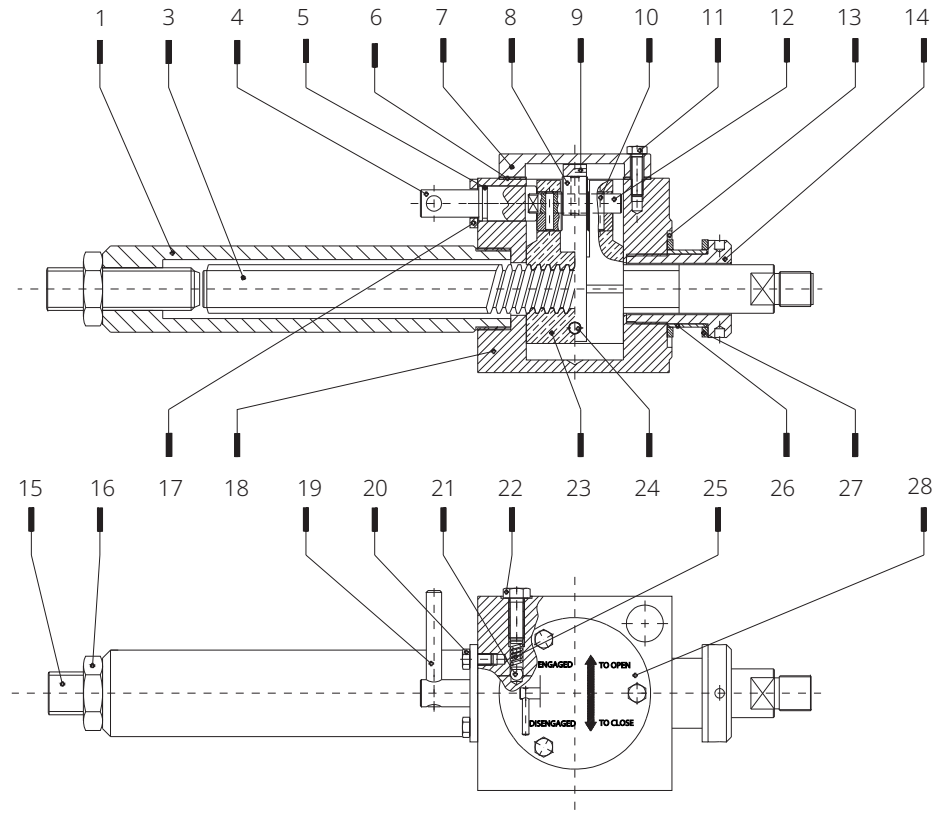


Table 26. Parts List

Item	Quantity	Description	Material
1	1	Protection pipe	Carbon steel
3	1	Jackscrew	Carbon steel
4	1	Engagement lever pin	Stainless steel
5	1	O-ring	* Fluorosilicon rubber
6	1	Cover gasket	* Fiber
7	1	Cover	Carbon steel
8	3	Cam	Alloy steel
9	1	Fork	Carbon steel
10	3	Spring pin	Stainless steel
11	3	Screw	Carbon steel
12	1	Screw nut operating cam	Alloy steel
13	1	O-ring	* Fluorosilicon rubber
14	1	Thrust nut operating cam	Alloy steel
15	1	Screw	Carbon steel
16	1	Nut	Carbon steel
17	1	Flange	Carbon steel
18	1	Body	Carbon steel
19	1	Spring pin	Spring steel
20	2	Screw	Carbon steel
21	1	Ball 1/4 in.	Stainless steel
22	1	Screw	Carbon steel
23	1	Screw nut	Bronze
24	1	Pin	Carbon steel
25	1	Spring	Spring steel
26	1	Bush	Bronze
27	2	Thrust shoulder washer	Bronze
28	1	Operating instruction plate	Aluminum

NOTE:
* Recommended spare parts

Section 8: Date Report for Maintenance Operations

Last maintenance operation date: (in factory, on delivery):
..... exec. by:
..... exec. by:
..... exec. by:

Next maintenance operation date: exec. by:
..... exec. by:
..... exec. by:

Start-up date: (in factory, on delivery)
..... (on plant)

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