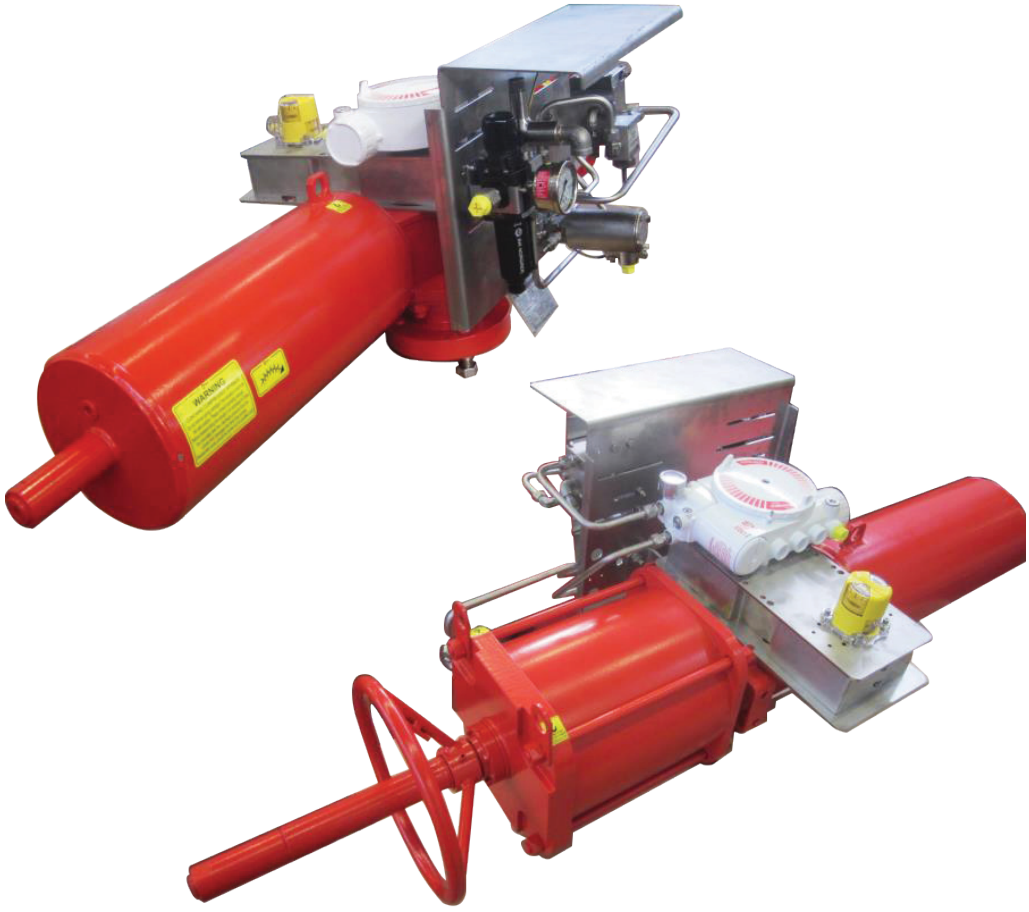
Installation, Operation and Maintenance Manual
MAN 604-1C Rev. 1
July 2021

Biffi ALGAS-MHW or MRHW

Spring-Return Pneumatic Actuator with Handwheel Manual Override



BIFFI

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Revision Details

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1	July 2021	General update (Migration to new template)			
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NOTICE

Biffi Italia has taken every care in collecting and verifying the documentation contained in this installation, operation and maintenance manual. Nevertheless, Biffi Italia does not provide any guarantees for this instruction manual. Biffi Italia will not be responsible for any mistakes contained in it or for any damage either accidental or due to the use of this manual. The information herein contained is reserved property of Biffi Italia and is subject to being modified without notice.

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 Italia s.r.l. 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 PED equipment
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

1.1.2 Terms and Conditions

Biffi Italia s.r.l. 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 the present manual. The warranty can last either one year from the date of installation by the initial user of the product, or eighteen 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 be 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 Italia s.r.l. liability shall lapse in the event that 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.

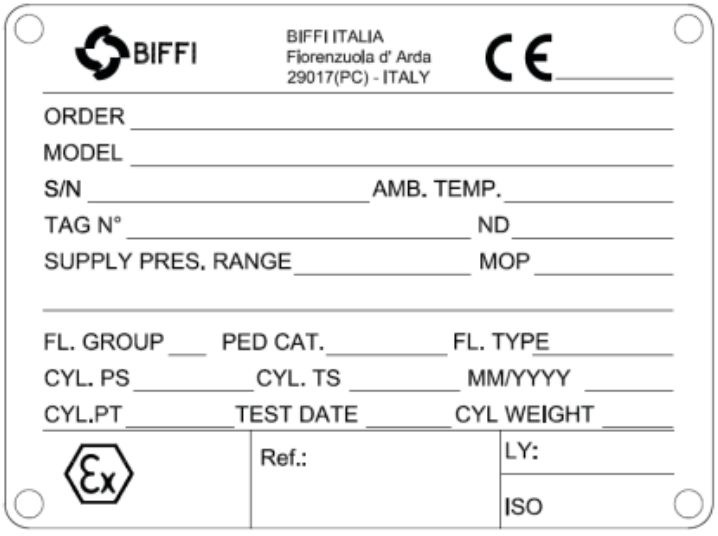
1.2 Identification Plate

⚠ WARNING

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

The plate fastened on the actuator contains the following information (Figure1).

Figure 1 Data plate



1.3 Description of the Actuator

ALGAS low pressure pneumatic spring-return, are suitable for the operation of quarter-turn valves (ball valves, butterfly valves, plug valves) in both ON-OFF and modulating heavy-duty service.

The actuator is made up of a weatherproof scotch yoke mechanism transforming the linear movement of the pneumatic cylinder (or mechanical manual override, if foreseen) and of the spring into the rotary movement, which is necessary for operation.

The spring-return pack incorporates up to four springs, fully encapsulated in a factory welded cartridge: this ensures safety to personnel and simplifies assembly. The spring action can be easily changed in the field from to close in to open or from to open in to close (modular design).

The angular stroke of the yoke is adjustable between 82° and 98° by means of the external mechanical stops screwed into the end flange of the pneumatic cylinder and into the end flange of the spring-return pack. The cover of the scotch yoke mechanism is arranged for the assembly of the required accessories (position-transmitter, signaling-limit switches, positioner , 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 or a stem extension. Their internal hole 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 Customer's requirements.

The expected lifetime of actuator is approximately 25 years .

Table 1. Single Acting Low Pressure Pneumatic Actuators (Coding System)

ALGAS	XXX	K	-	YYYY	-	ZZZZ	-	F	S	C

Actuator series

Scotch yoke mechanism size

Yoke Shape
C = Canted
S = Symmetric

Spring cartridge size

Cylinder size
Internal diameter in mm

Spring action
CL = Closing
OP = Opening

Service
Blank = Standard
QA = Quick-Acting

Manual Override
Blank = No Manual Override
MHP = Manual Handpump
MHW = Manual Handwheel
MRHW = Manual Reduced Handwheel

Section 2: Installation

2.1 Checks to be Carried Out on Receiving the Actuator

1. If the actuator arrives already assembled onto the valve, the settings of the mechanical stops and of the microswitches (if existing) has already been made by the person who assembled the actuator onto the valve. If the actuator arrives separately from the valve, the settings of the mechanical stops and of the micro switches (if existing) must be checked and, if necessary, carried out while assembling the actuator onto the valve.
2. Check that the actuator has not been damaged during transport. If necessary, repair all damages to the paint-coat, etc.
3. Check that the model, the serial number of the actuator and the performance data written on the data plate are in accordance with those described on the order acknowledgement, test certificate and delivery note.
4. Check that the fitted accessories comply with those listed in the order acknowledgement and the delivery note.

2.2 Storage

(For handling and lifting procedure, please refer to Figures 6, 7 and 8).

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 air 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.
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.
3. In case of long-term storage, 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 filtered, dehydrated and lubricated air; after such operations all the threaded connections of the actuator and the valves of the control panel (if existing) should be carefully plugged.

2.3 Assembling the Actuator onto the Valve

2.3.1 Types of Assembly

For coupling to the valve, the housing is provided with a flange with threaded holes according to Biffi standard tables (SCN6200; SCN6200-1; SCN6201; SCN6201-1). 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 "standard" configuration. For the biggest actuator models, the actuator flange can be machined in accordance with the valve flange dimensions.

The yoke has bored with keyways for coupling to the valve stem, the dimensions of which are according to Biffi standard tables SCN6200* and SCN6201*.

Figure 2 Coupling dimensions - Models 0.3 to 6

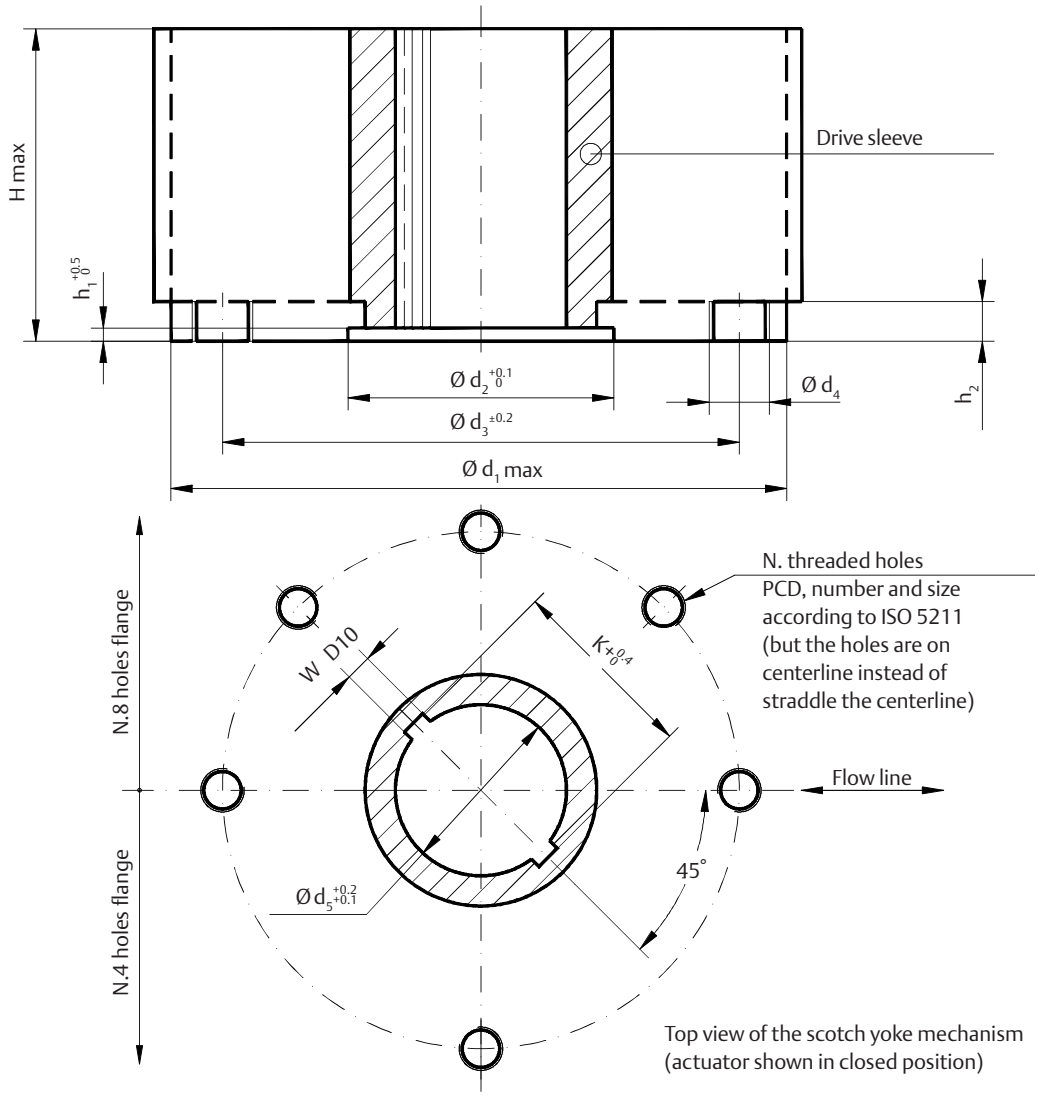


Table 2. SCN6200

Dimensions in millimeters

Actuator model	Ø d_1	Ø d_2	Ø d_3	Ø d_4	N	h_1	h_2	H max	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	93.6
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

Figure 3 Coupling dimensions - Models 14 to 42

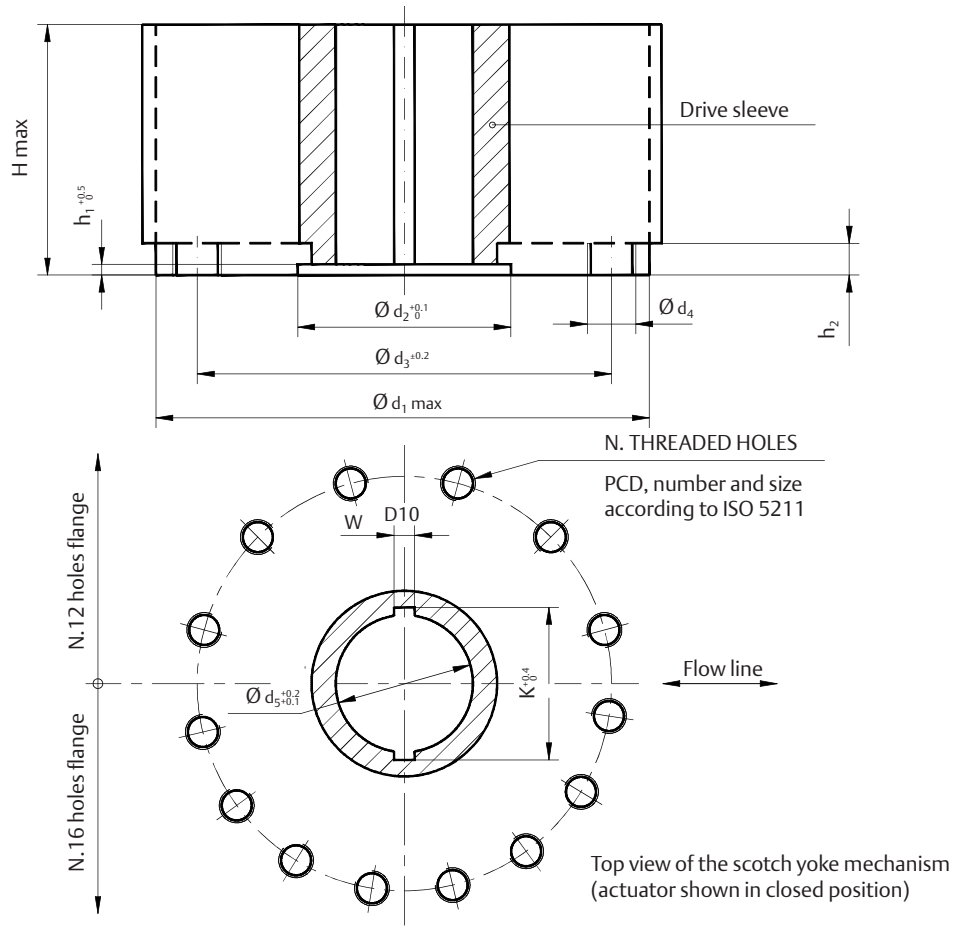


Table 3. SCN6201

Dimensions in millimeters

Actuator model	Ø d_1	Ø d_2	Ø d_3	Ø d_4	N	h_1	h_2	H max	Ø d_5	W	K
14	580	250	483	M36	12	10	29	340	175	45	195.8
18	680	290	603	M36	16	12	32	350	200	45	220.8
32	780	290	603	M36	16	12	32	400	220	50	242.8
35	780	315	603	M36	16	11	32	400	240	50	242.8
42	840	310	603	M36	16	12	32	400	220	50	242.8

Figure 4 Coupling dimensions - Models 50 and 60

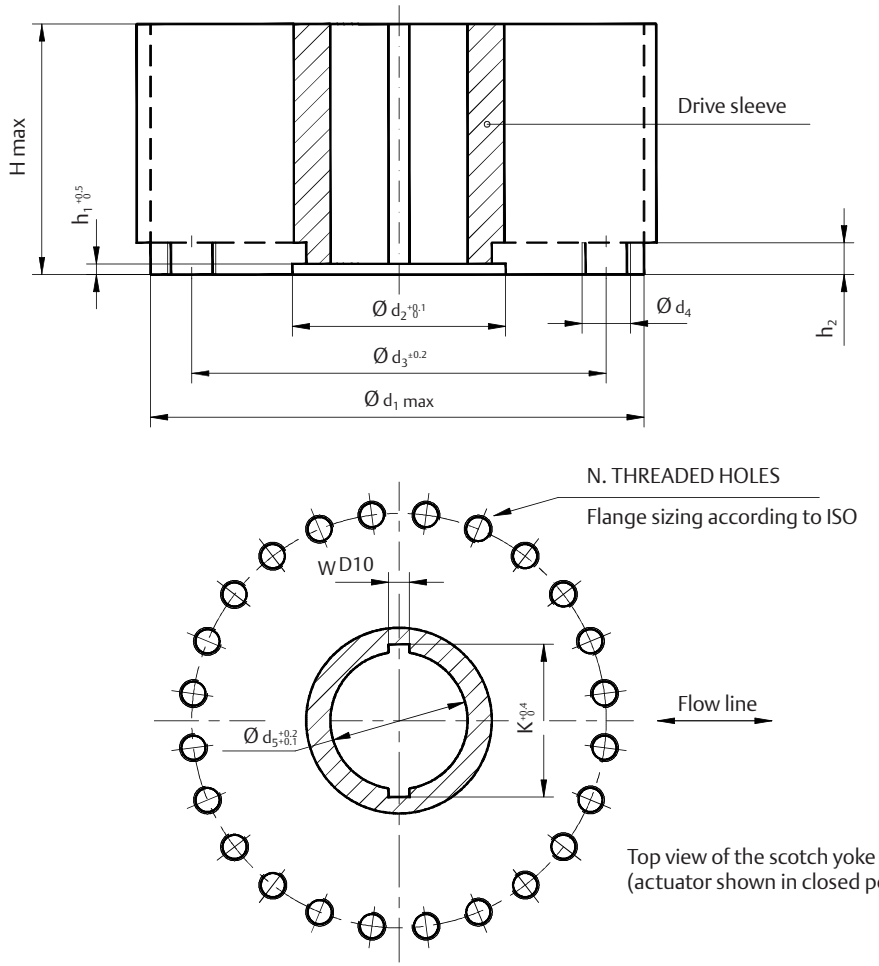


Table 4. SCN6201-1

Dimensions in millimeters

Actuator model	Ø d_1	Ø d_2	Ø d_3	Ø d_4	N	h_1	h_2	H max	Ø d_5	W	K
50	800	315	698	M36	24	10	32	430	240	56	264.8
60	840	315	698	M36	24	10	32	430	240	56	264.8

If required, for the standard models size 0.3 to 6, Biffi can supply an insert bush with unmachined bore in accordance with Biffi standard 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, enclosed. The particular execution of the flange and bushing allow the actuator to be rotated by 90° in 4 different positions according to Figure 5.

Figure 5 Insert bush + intermediate coupling flange

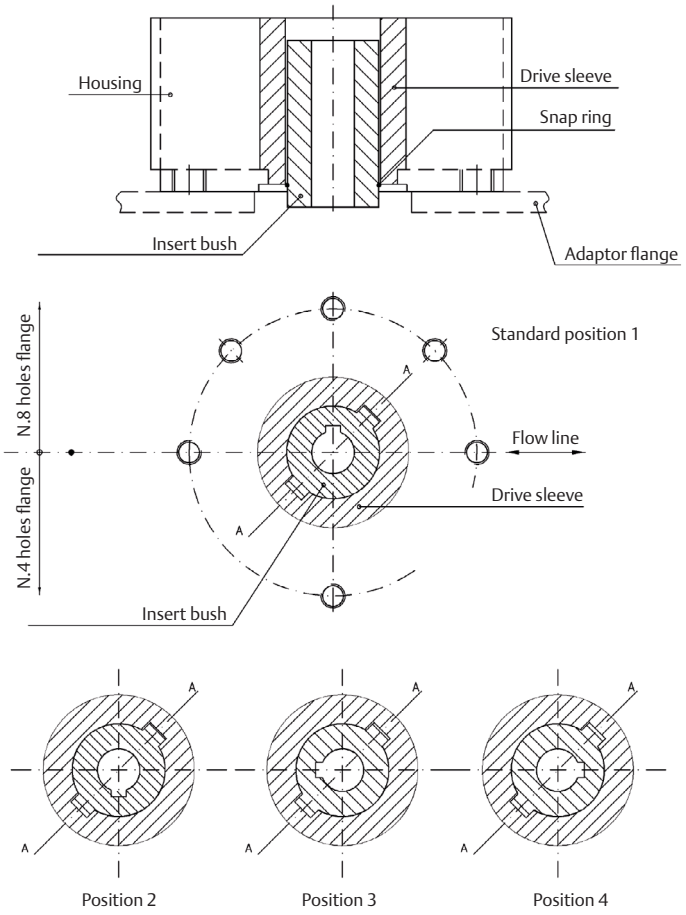


Table 5.

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, actuator can be mounted in 4 positions at 90° on top of the valve. For biggest actuator models, the bore of the yoke can be machined according to the dimensions of valve stem.

2.3.2 Valve Stem with Vertical Axis

NOTICE

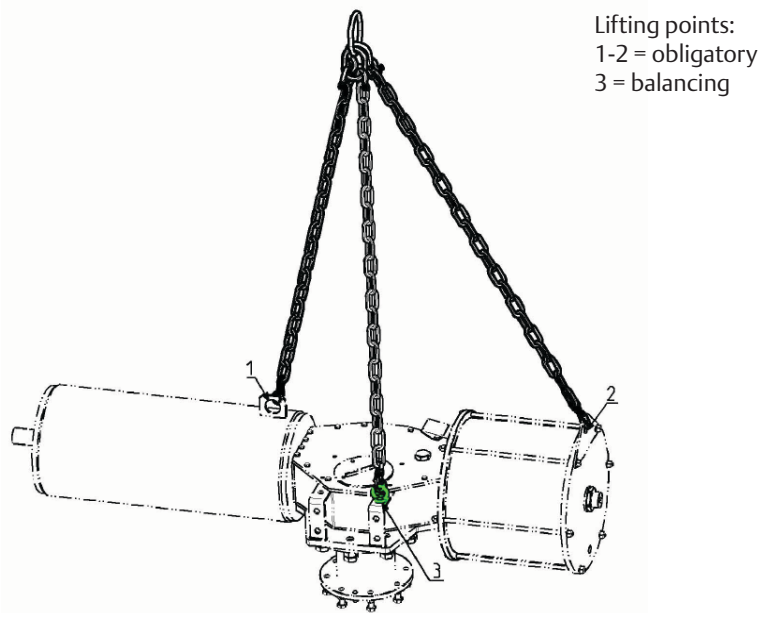
The lifting and handling of the actuator must be done by qualified personnel and in accordance with the laws and regulations in force. Avoid the lifted actuator to be hung above the personnel.

⚠ 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 6.

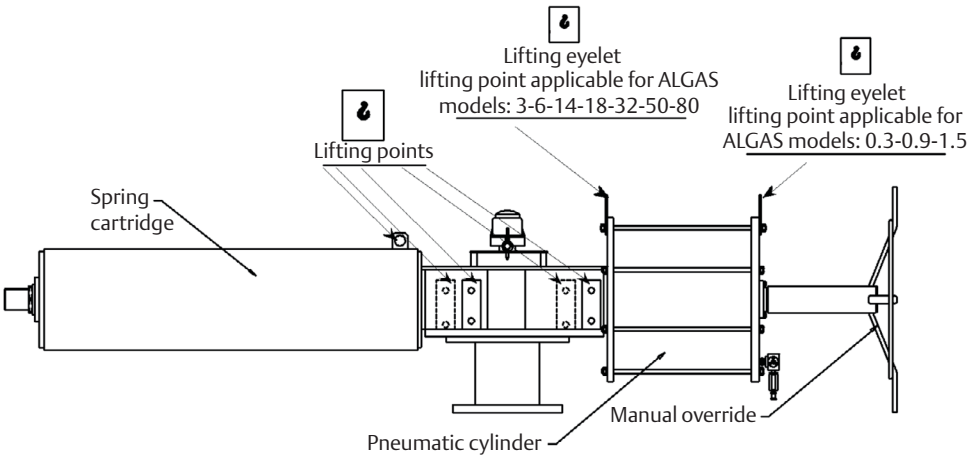
Figure 6 Example of hook with safety latch

Figure 7 Lifting points



Lift ALGAS actuators (pneumatic spring-return) by means of the proper lifting points represented and indicated on actuator by sticking labels. Also, refer to Figure 8 for lifting points positions.

Figure 8



- **For lifting unbalanced loads, use ropes of different lengths or chains with adjustable length.**
- **Check each time the conditions 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.**
- **Use the utmost caution and remain at a safe distance from lifted actuator unless absolutely necessary; do not stand or pass under suspended loads.**
- **Pay attention in putting under tension the ropes to prevent the load shifting sideways in an uncontrolled manner.**
- **Use slings of such length that the angles of the leg from vertical are as narrow as possible (αMAX < 20°).**
- **During handling, do not transport the suspended actuator above staff members in charge of the operation.**

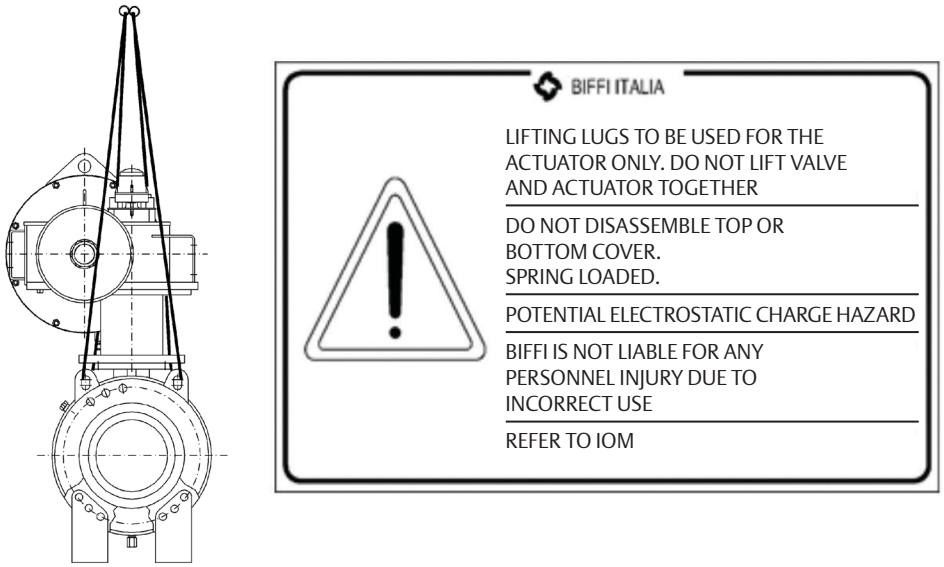
⚠ WARNING

Do not use the lifting eyelets on actuator to lift valve + actuator assembly.

⚠ WARNING

Any lifting method different from what described above is strictly forbidden.
Biffi reject any responsibility for damages to goods or injuries to persons coming from wrong lifting operations.

Figure 9



The actuator can be assembled onto the valve flange either by using the actuator-housing flange with threaded holes, or by the interposition of an adaptor flange or a spool piece. The actuator drive sleeve is generally connected to the valve stem by an insert bush or a stem extension. The assembly position of the actuator, with reference to the valve, must comply with the plant requirements (cylinder axis parallel or perpendicular to the pipeline axis).

To assemble the actuator onto the valve proceed as follows:

1. Check that the coupling dimensions of the valve flange and stem, or of the relevant extension, meet the actuator coupling dimensions.
2. Bring the valve to the position related to the actuator spring operation.
3. Lubricate the valve stem with oil or grease in order to make the assembly easier. Be careful not to pour any of it onto the flange.
4. Clean the valve flange and remove anything that might prevent a perfect adherence to the actuator flange and especially all traces of grease, since the torque is transmitted by friction.
5. If an insert bush or stem extension for the connection to the valve is supplied separately, assemble it onto the valve stem and fasten it by tightening the proper stop dowels.
6. Bring the actuator to the position caused by the spring operation.
7. Connect a sling to the support points of the actuator and lift it: make sure the sling is suitable for the actuator weight. When possible, it is easier to assemble the actuator to the valve if the valve stem is in the vertical position. In this case, the actuator must be lifted while keeping the flange in the horizontal position.

8. Clean the actuator flange and remove anything that might prevent a perfect adherence to the valve flange and especially all traces of grease.
9. Lower the actuator onto the valve in such a way that the insert bush, assembled on the valve stem, enters the actuator drive sleeve. This coupling must take place without forcing and only with the weight of the actuator. When the insert bush has entered the actuator drive sleeve, check the holes of the valve flange. If they do not meet with the holes of the actuator flange or the stud bolts screwed into them, the actuator drive sleeve must be rotated; feed the actuator cylinder with air at proper pressure, indicated on data sheet for actuator.
10. Tighten the nuts of the connecting stud bolts evenly with the torque prescribed in the table. The stud bolts must be made of ASTM A320 L7 steel; the nuts must be made of ASTM A194 grade 2 steel.
11. If possible, operate the actuator to check that it moves the valve smoothly.

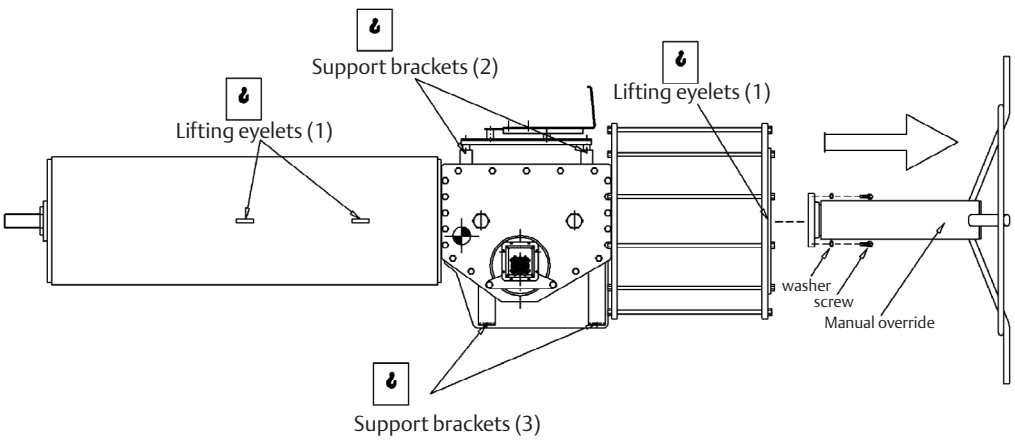
Table 6.

Thread size	Recommended 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

2.3.3 Valve Stem with Horizontal Axis

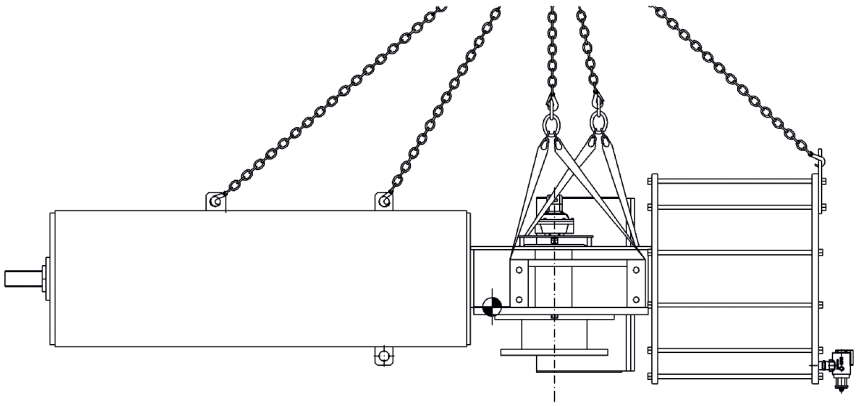
The actuator can also be lifted to assemble directly onto the valve with stem with horizontal axis. Remove the manual override (unscrewing the 4 fixing screws with its washers) to make easier the lifting operations:

Figure 10



1. Connect properly the actuator lifting points 1 with chains, and connect by suitable slings the support brackets 2 and 3.

Figure 11



2. Balance the weight and lift the actuator until to make possible rotation of actuator in its final mounting position, with cylinder on top, or spring container placed on top, as showed in the following images:

Figure 12

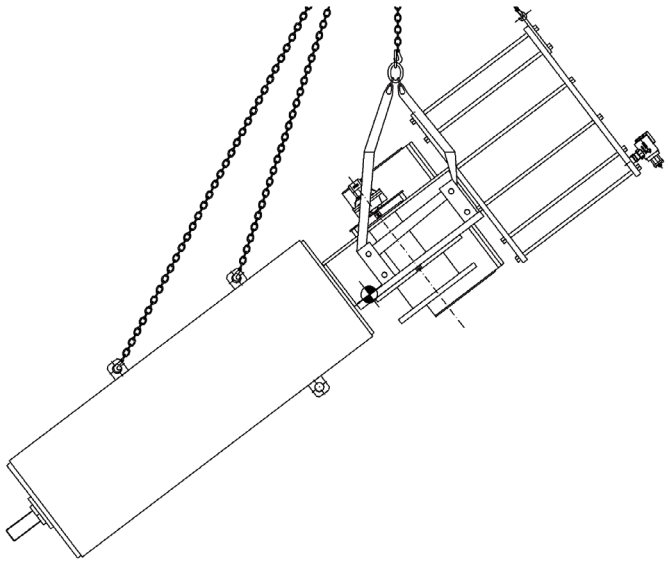
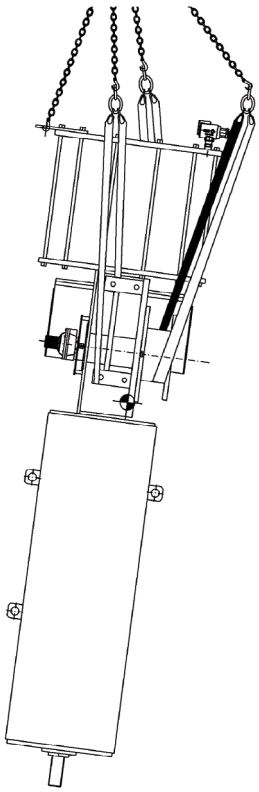


Figure 13



3. Clean the actuator flange and remove anything that might prevent a perfect adherence to the valve flange and especially all traces of grease.
4. Lift the actuator near to the valve in such a way that the insert bush, assembled on the valve stem, enters the actuator drive sleeve without forcing the coupling. When the insert bush has entered the actuator drive sleeve, check the holes of the valve flange. If they do not meet with the holes of the actuator flange or the stud bolts screwed into them, the actuator drive sleeve must be rotated; feed the actuator cylinder with air at proper pressure, indicated on data sheet for actuator.
5. Tighten the nuts of the connecting stud bolts evenly with the torque prescribed in the table. The stud bolts must be made of ASTM A320 L7 steel; the nuts must be made of ASTM A194 grade 2 steel.
6. Reassemble the manual override with 4 fixing screws and washers.
7. If possible, operate the actuator to check that it moves the valve smoothly.

Section 3: Operation and Use

3.1 Setting of the Angular Stroke

It is important that the mechanical stops of the actuator (and not those of the valve) stop the angular stroke at both extreme valve position (fully open and fully closed), except when this is required by the valve operation (e.g. metal seated butterfly valves).

The travel stop screws are screwed into the end flange of the manual override, depending on actuator different configuration (i.e. spring to open or spring to close), and spring cartridge. The setting of the open valve position is performed by adjusting the travel stop screw on the left side of the actuator. The setting of the closed valve position is performed by adjusting the travel stop screw on the right side of the actuator.

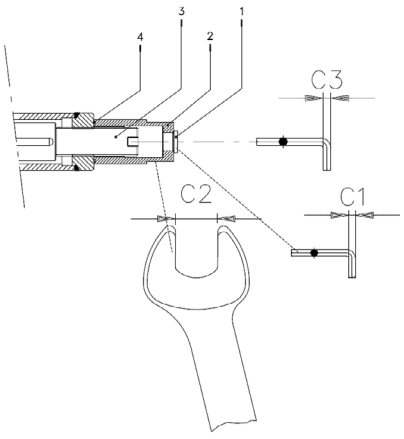
3.1.1 Travel Stop-screw Screwed on the End of Manual Override

For the adjustment of the travel stop screws proceed as follows (see Figure 14):

1. Unscrew the protection plugs (item 1) with allen wrench (C3).
2. If the actuator angular stroke is stopped before reaching the end position (fully open or closed), unscrew the stop screw cover (item 2) with wrench C2 and unscrew the stop setting screw (item 3) with an allen wrench C3 by turning it anticlockwise, and actuate the handwheel of manual override until the valve reaches the right position. When unscrewing the stop screw, keep the lock nut still with a wrench so that the sealing washer does not withdraw together with the screw.
3. Tighten the stop-setting screw cover, after having correctly placed the seal ring (item 4).
4. If the actuator angular stroke is stopped beyond the end position (fully open or closed valve), actuate the handwheel of manual override and screw the stop screw by turning it clockwise until the valve reaches the right position.
5. Tighten the stop setting screw cover, after having correctly placed the seal ring (item 4).

3.1.2 Travel Stop Screw Screwed on the End of Mechanical Manual Override

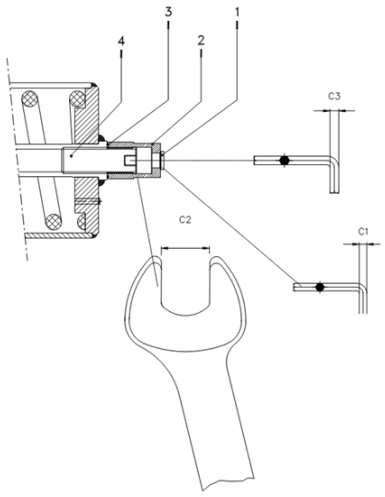
Figure 14



3.1.3 Travel Stop Screw Screwed on the End Flange of Spring Container

For the adjustment of the travel stop-screw, proceed as follows (see Figure 15):

Figure 15



1. Unscrew the protection plugs (1) with Allen wrench C1.
2. Unloose the stop setting screw covers (2) with wrench C2 .
3. Adjust the travel stop screws (4) with Allen wrench C3 .
4. If the stop screw is too hard to be operated, reduce or remove the cylinder pressure, in order to move the mechanism far from the screw. Operate the setting screw and then pressurize again the cylinder to reach end position.
5. If the actuator angular stroke is stopped beyond the end position, screw the stop screw by turning it clockwise until the valve reaches the correct position.
6. Tighten the two stop setting screw covers (2).
7. Tighten the protection plugs (1).

3.2 Calibration of Microswitches (Applicable for Biffi Limit Switch Box Only)

NOTICE

Operate only the microswitch corresponding to the direction of operation being carried out, as clearly reported on the microswitch.

⚠ WARNING

If different microswitches assembly or limit switch box is supplied, please refer to the specific documentation.

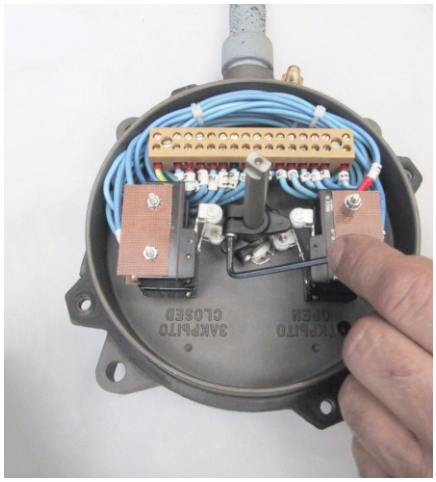
Microswitches are placed inside a special box (Figure 16).

For microswitches calibration please refer to the relative wiring diagram and follow these steps:

- Unscrew the fastening screws of the cover (Figure 16).
- Remove the cover paying attention not to deteriorate the gasket and the cylindrical and flat coupling surfaces.
- Operate the actuator (in opening or closing) with local pneumatic or hydraulic operation (Section 3.3).
- Unscrew the screw of the operating cam relative to the micro-switch to calibrate and adjust it according to the settings (Figure 17).
- Tighten the screw.
- Operate the actuator and adjust any other micro-switch with the procedure already described.
- Position the cover making sure the cam-carrier shaft grips with the index dragging shaft.
- Check that the cover and the index show the proper position of the valve (Figure 18).
- Tighten the screws.

Figure 16 Microswitches box

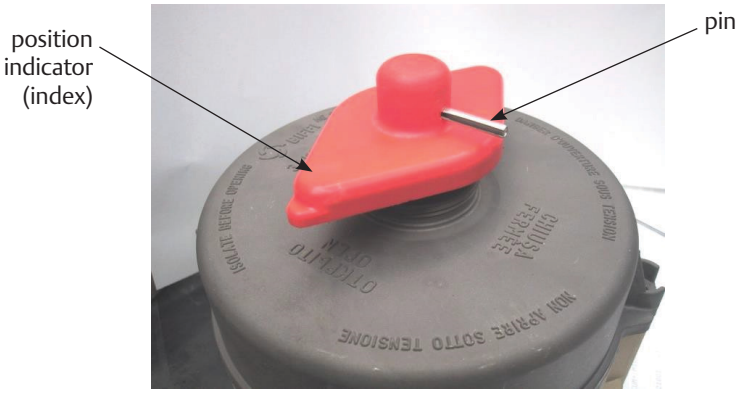
Figure 17 Cam adjustment



If the index (Figure 18), does not signal the proper position of the valve but is turned by 90°:

- Remove the roll pin placed on the position indicator (index).
- Turn the indicator until reaching its proper positioning.
- Put the roll pin back in its position.

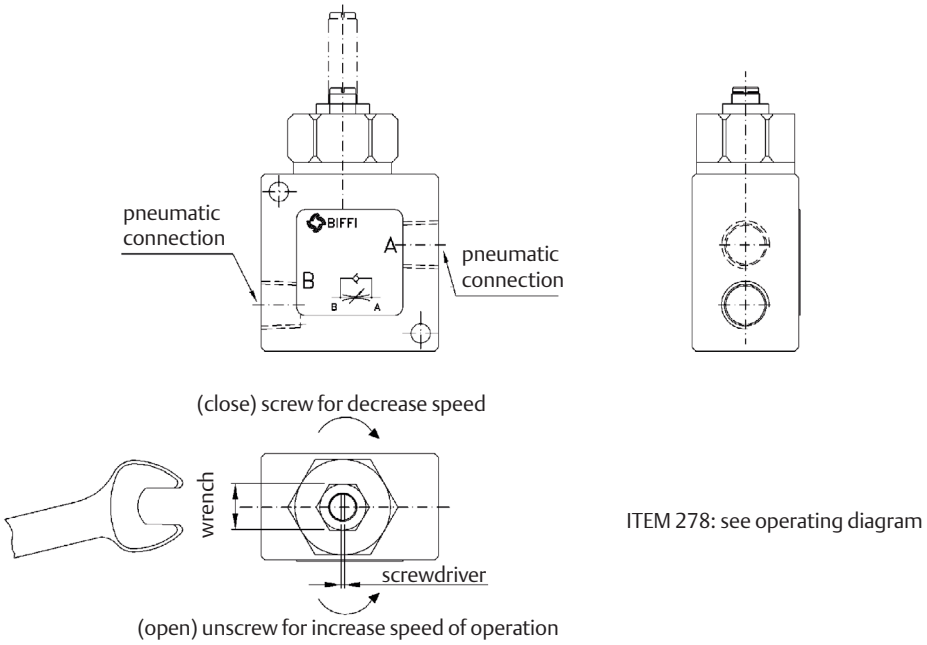
Figure 18 Position indicator and pin for microswitches box



3.3 Calibration of Operating Time in Supply Operation

The calibration of the operation time is made by Biffi Italia s.r.l. according to customer requirements and to technical data sheet included in technical documentation. If necessary, it is possible to modify or to reset the operating time through the flow regulation valve placed between the control system and the pneumatic cylinder (Figure 19).

Figure 19 Adjustment of operating time



To carry out the adjustment, use an adequate Allen wrench and follow these steps (Figure 19):

1. Loosen the locknut.
2. Screw with a screwdriver the setting screw to increase the operation time.
3. Unscrew with a screwdriver the setting screw to decrease the operation time.
4. After the adjustment is over, screw the locknut.

The procedure is absolutely general. It is applicable both fail-to-open and fail-to-close actuators.

3.4 Preparation for Start-up

3.4.1 Pneumatic Connections

Connect the actuator to the pneumatic feed line with fittings and pipes in accordance to the plant specifications. They must be sized correctly in order to guarantee the necessary airflow 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 pneumatic pipe-work 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 air 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 leaks in the pneumatic connections.

3.4.2 Electrical Connections

Connect the electrical feed, control and signal lines to the actuator, by linking them up with the terminal blocks of the electrical components. In order to do this, the housing covers must be removed without damaging the coupling surfaces, the O-rings or the gaskets. Remove the plugs from the cable entries.

For electrical connections, use components (cable glands, cables, hoses, conduits) which meet the requirements and codes applicable to the plant specifications (mechanical protection and/or explosion-proof protection).

Screw the cable glands tightly into the threaded inlets, so as to guarantee the weatherproof and explosion-proof protection (when applicable).

Insert the connection cables into the electrical enclosures through the cable glands, and connect the cable wires to the terminals according to the applicable wiring diagram.

If conduits are used, it is advisable to carry out the connection to the electrical enclosures by inserting hoses so as not to cause anomalous stress on the housing cable entries.

Replace the plastic plugs of the unused enclosure entries by metal ones, to guarantee perfect weatherproof tightness and to comply with the explosion-proof protection codes (where applicable).

Once the connections are completed, check that the controls and signals work properly.

3.5 Start-up

During the start-up of the actuator, proceed as follows:

1. Check that the pressure and quality of the air supply (filtering degree, dehydration) are as prescript. Check that the feed voltage values of the electric components (solenoid valve coils, microswitches, pressure switches, etc.) are as prescript.
2. Check that the actuator controls work properly (remote control, local control, emergency controls, etc.).
3. Check that the required remote signals (valve position, air pressure, etc.) are correct.
4. Check that the setting of the components of the actuator control unit (pressure regulator, pressure switches, flow control valves, etc.) meet the plant requirements.
5. Check that there are no leaks in the pneumatic connections. If necessary, tighten the nuts of the pipe fittings.
6. Remove all rust and, in accordance with the applicable painting specifications, repair paint-coat that has been damaged during transport, storage or assembly.

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

NOTE:

Before carrying out any maintenance operation, it is necessary to close the pneumatic 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. Please refer to warning on Section 1.

5.1 Routine Maintenance

ALGAS actuators have been designed to work for long periods in the severest conditions with no need for maintenance.

NOTICE

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

NOTICE

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

Anyway 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.

5.2 Special Maintenance

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

⚠ WARNING

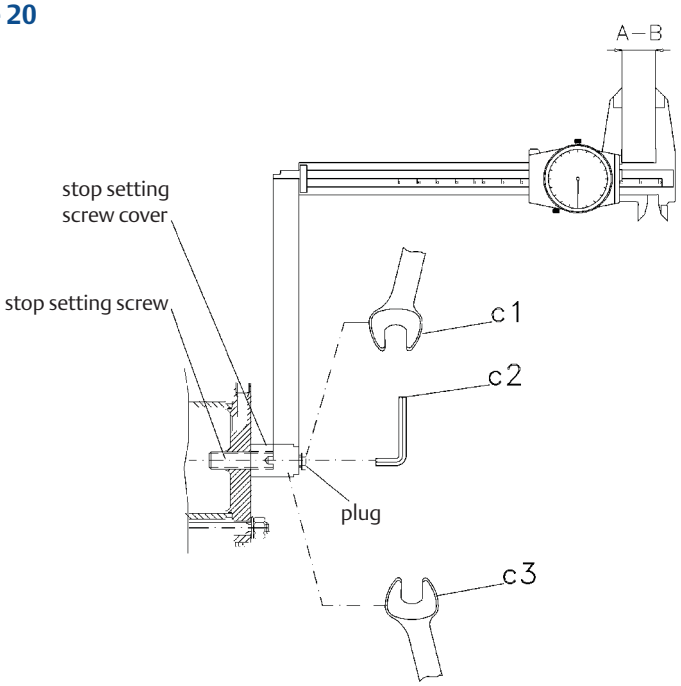
If the actuator can be operated, it is essential to take it to fail-safe position, with the spring totally extended, otherwise the actuator should be disassembled from the valve and follow these steps.

- Remove the plug (26) from the cover of the adjustment screw (20).
- Record the length between end flange and stop setting screw, as in Figure 20.
- Bring the adjustment screw back to the maximum (26) to let the spring loosen.

⚠ WARNING

Before disassembling the cylinder, make sure the above operation of spring release is done.

Figure 20



5.2.1 Replacement of Cylinder Seals

1. Measure the protrusion of the stop screw (52) with reference to the protection tube (51) surface, to be able to easily restore the setting of the actuator mechanical stop, once the maintenance procedures have been completed. Disassemble the manual override from the pneumatic cylinder end flange by unscrewing the fastening screws (61), as described in following pages.
2. Remove the washer (51) and the sealing washer (50).
3. Unscrew the nuts (16) from the tie rods (18) from the side of the end flange: they must be gradually unscrewed all at the same time.
4. Slide off the end flange (22) and the tube (19).

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 (AGIP-ENI HTX-SIL if seals are in NBR/Viton or Neoprene rubber, with Aeroshell Grease 7 if the seals are in Fluorosilicon 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 (47) of the head flange (17).
2. Replace the O-ring (49) and the guide sliding ring (48) of the piston (21).
3. Replace the O-ring (47) of the end flange (22).

5.2.1.2 Reassemble

1. Carefully clean the inside of the tube (19) and check that the entire surface, particularly that of the bevels, is not damaged. Lubricate the inside surface of the tube and the bevels at the ends. Slide the tube onto the piston taking care not to damage the piston O-ring (49) and the head flange O-ring (47).
2. Assemble the end flange by centering it on the inside diameter of the tube, taking care not to damage the O-ring (47).
3. Assemble the washer (24) and the nuts (16) onto the tie rods (18). Tighten the nuts to the recommended torque, alternating between opposite corners.
4. Screw the stop screw (26) into the threaded hole of the end flange until it reaches its original position (the same protrusion with reference to the flange surface). To make the operation easier feed the pneumatic cylinder with air (if possible) in order to compress the spring.
5. Check that the sealing washer (57) and the O-ring (59) are in contact with the end flange (22) surface.
6. Reassemble the manual override: tighten the screws (61) to fix protection tube.

NOTICE

After maintenance operations carry out a few actuator operations (5-10) to check that its movement is regular, that there is no air leakage through the seals and to eliminate any oil residues in the air circuit, deriving from the lubrication of the seals during the replacement phase.

Figure 21 ALGAS-MHW spring-return pneumatic actuator

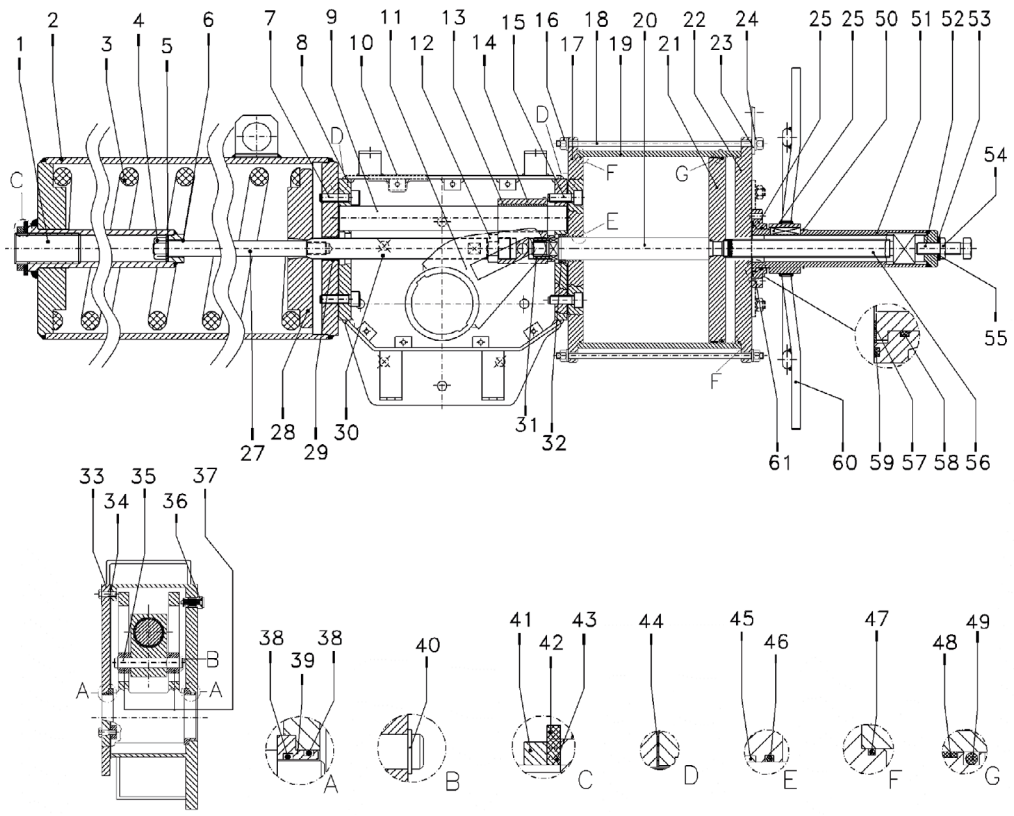


Table 7. Parts list

Item	Description	Item	Description	Item	Description
1	Stop setting screw	26	Key	51	Protection tube
2	Spring container	27	Guide rod	52	Stop setting screw
3	Spring	28	Spring thrust flange	53	Washer
4	Nut	29	Rod bushing	54	Nut
5	Shoulder washer	30	Container rod	55	Sealing washer
6	Rod bushing	31	Adaptor bush	56	Jackscrew
7	Screw	32	Washer	57	Thrust bearing washer
8	Housing	33	Cover	58	O-ring
9	Guide bar	34	Screw	59	O-ring
10	Cover gasket	35	Guide block pin	60	Handwheel
11	Yoke	36	Vent valve	61	Screw
12	Plug	37	Sliding block		
13	Bushing	38	O-ring		
14	Guide block	39	Yoke bushing		
15	Screw	40	Retainer ring		
16	Nut	41	Nut		
17	Head flange	42	Washer		
18	Tie rod	43	Sealing washer		
19	Cylinder tube	44	Gasket		
20	Piston rod	45	Piston rod bushing		
21	Piston	46	O-ring		
22	End flange	47	O-ring		
23	Lifting eyelet	48	Guide sliding ring for piston		
24	Spring washer	49	O-ring		
25	Flange	50	Retainer ring		

5.2.2 Replacement of the Seals of Manual Override “MHW”

NOTICE

Before any operation, you must keep the actuator in release position to allow the air and spring stroke.

1. Measure the protrusion of the stop screw (52) with reference to the surface of the protection tube (51) end flange, so as to be able to easily restore the setting of the actuator mechanical stop, once the maintenance procedures have been completed.
2. Loosen the lock nut (54) and unscrew the stop screw (54) until it is removed from the end flange of protection tube (51) together with the nut (54), the washer (53) and the sealing washer (55).
3. Rotate clockwise the handwheel (60) so to move backward the jackscrew (56) until it hits the end flange of protection tube.
4. Disassemble the manual override from the pneumatic cylinder end flange by unscrewing the fastening screws (61).
5. Disassemble the retainer ring (50) and remove the handwheel (60).
6. Disassemble the flange (25) from the protection tube (51).
7. Remove the O-rings (58-59) from their grooves in the flange. Carefully clean the grooves and lubricate them with protective grease film. Assemble the new O-rings into their grooves and lubricate them.
8. Assemble the flange (25), the handwheel (60) and the retainer ring (50) onto the protection tube (51).
9. Fasten the manual override to the pneumatic cylinder end flange by the proper screw.
10. Remove the sealing washer (55) from the stop screw (52). Carefully clean and lubricate the stop screw thread and the surface of the end flange area, on which the sealing washer works. Screw the new sealing onto the stop screw until it touches the nut (54).
11. Assemble the washer (53) onto the sealing washer (55). Screw the stop screw into the threaded hole of the end flange of protection tube until it hits the jackscrew (56) of manual override.
12. Actuate the manual override, by rotating anticlockwise the handwheel until it is possible to screw the stop screw (52) till it reaches its previous position related to fully open valve position (the same protrusion with reference to the surface of the protection tube end flange as before the disassembly).
13. Check that the sealing washer (55) and the washer (53) are in contact with the end flange surface.
14. Tighten the lock nut (54).

5.2.3 Replacement of the Seals of Reduced-Manual Override “MRHW”

NOTICE

Before any operation , you must keep the actuator in release position to allow the air and spring stroke.

1. Measure the protrusion of the stop screw (19) with reference to the surface of the protection tube (6) end flange, to be able to easily restore the setting of the actuator mechanical stop, once the maintenance procedures have been completed.
2. Loosen the lock nut (20) and unscrew the stop screw (19) until it is removed from the end flange of protection tube (6) together with the nut (20), the washer (34) and the sealing washer (35).
3. Rotate the handwheel (7) clockwise to move backward the jackscrew (18) until it hits the end flange of protection tube.
4. Disassemble the manual override from the pneumatic cylinder end flange by unscrewing the fastening screws (36).
5. Disassemble the screw (31), which fasten the reduction unit to the spacer bracket (5).
6. Move the reduction unit along the protection tube (6) till the key (13) is accessible. Remove the key from the protection tube. Move the spacer bracket (5) along the protection tube (6) till the O-ring (4) is accessible.
7. Remove the O-rings (1-4) from their grooves. Carefully clean the grooves and lubricate them with protective grease film. Assemble the new O-rings into their grooves and lubricate them.
8. Move the spacer bracket along the protection tube up to reach its working position. Assemble the key (13). Move the reduction unit to its working position and fasten it to the spacer bracket (5) by the screws (31).
9. Remove the sealing washer (35) from the stop screw (19). Carefully clean and lubricate the stop screw thread and the surface of the end flange area, on which the sealing washer works. Screw the new sealing onto the stop screw until it touches the nut (20).
10. Assemble the washer (34) onto the sealing washer (35). Screw the stop screw into the threaded hole of the end flange of protection tube until it hits the jackscrew (18) of manual override.
11. Actuate the manual override, by rotating anticlockwise the handwheel until it is possible to screw the stop screw (19) till it reaches its previous position related to fully open valve position (the same protrusion with reference to the surface of the protection tube end flange as before the disassembly).
12. Check that the sealing washer (35) and the washer (34) are in contact with the end flange surface.
13. Tighten the lock nut (20).

NOTICE

After maintenance operations carry out a few actuator operations (5-10) to check that its movement is regular, that there is no air leakage through the seals and to to eliminate any oil residues in the air circuit, deriving from the lubrication of the seals during the replacement phase.

Figure 22 Mechanical manual override "MRHW" worm gear reduction unit

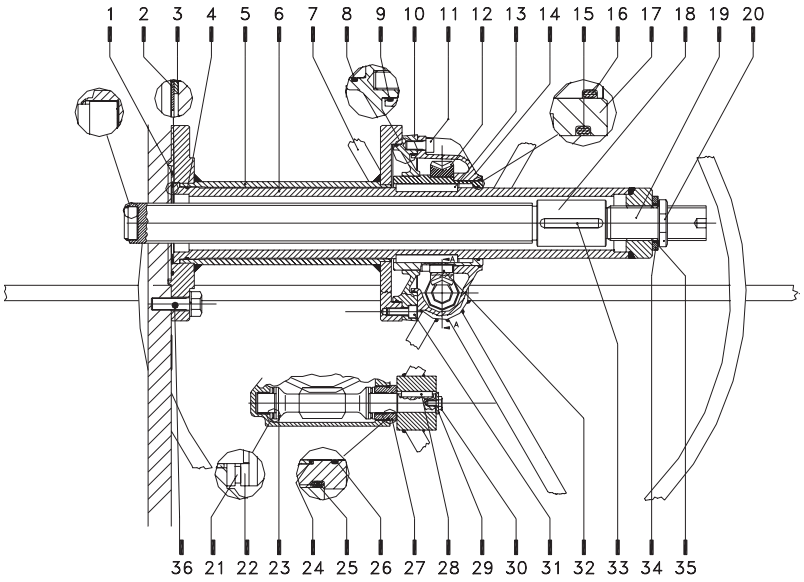


Table 8. Parts List

Item	Qty	Description	Material	Equivalence to USA standards
1	1	O-ring	* NBR	
2	1	Thrust bearing washer	Alloy steel	AISI SAE 9840
3	1	Sliding washer	Bronze	ASTM B427 Alloy 908
4	1	O-ring	* NBR	
5	1	Spacer bracket	Carbon steel	ASTM A106 gr B + ASTM A283 gr D
6	1	Protection tube	Carbon steel	API 5LX gr X52 (C<0.2%) + ASTM A283 gr D
7	1	Handwheel	Carbon steel	API 5L gr B
8	1	O-ring	* NBR	
9	1	O-ring	* NBR	
10	1	Worm gear box lower body	Aluminium	ASTM B85-73 Alloy S12B
11	3	Screw	Carbon steel	AISI SAE 1040
12	1	Worm wheel	Bronze	ASTM B427 Alloy 908
13	2	Key	Alloy steel	AISI SAE 9840
14	1	Worm gear box upper body	Aluminium	ASTM B85-73 Alloy S12B
15	1	O-ring	* NBR	
16	1	O-ring	* NBR	
17	1	Drive sleeve	Carbon steel	API 5LX gr X52
18	1	Jackscrew	Alloy steel + bronze	AISI SAE 9840 + ASTM B427 Alloy 908
19	1	Stop setting screw	Carbon steel	AISI SAE 1040
20	1	Nut	Carbon steel	ASTM A194 gr 2
21	2	Axial needle bearing	Alloy steel	AISI SAE 9840
22	4	Thrust bearing washer	Alloy steel	AISI SAE 9840
23	1	Worm screw	Alloy steel	AISI SAE 9840
24	2	Bushing	Steel + bronze + Teflon	
25	1	O-ring	* NBR	
26	1	O-ring	* NBR	
27	1	Ring nut	Carbon steel	AISI SAE 1040
28	1	Key	Carbon steel	AISI SAE 1040
29	1	Washer	Carbon steel	AISI SAE 1040
30	1	Screw	Stainless steel	AISI 304
31	4	Screw	Carbon steel	AISI SAE 1040
32	2	Key	Carbon steel	AISI SAE 1040
33	2	Key	Carbon steel	AISI SAE 1040
34	1	Washer	Carbon steel	AISI SAE 1040
35	1	Sealing washer	* PVC	
36	1	Screw	Carbon steel	AISI SAE 1040

NOTE:
* Recommended spare parts

Figure 23 Mechanical manual override "MRHW" bevel gear reduction unit

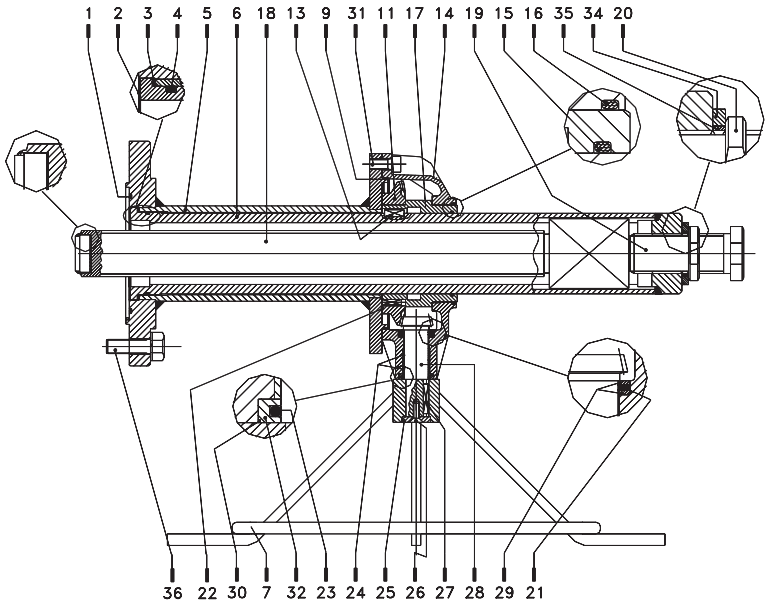


Table 9. Parts List

Item	Qty	Description	Material	Equivalence to USA standards
1	1	O-ring	* NBR	
2	1	Thrust bearing washer	Alloy steel	AISI SAE 9840
3	1	Sliding washer	Bronze	ASTM B427 Alloy 908
4	1	O-ring	* NBR	
5	1	Spacer bracket	Carbon steel	ASTM A106 gr B + ASTM A283 gr D
6	1	Protection tube	Carbon steel	API 5LX gr X52 (C<0.2%) + ASTM A283 gr D
7	1	Handwheel	Carbon steel	API 5L gr B
9	1	O-ring	* NBR	
11	1	Bevel driven gear	Alloy steel	AISI SAE 9840
13	4	Key	Carbon steel	AISI SAE 1040
14	1	Gear box	Aluminium	ASTM B85-73 Alloy S12B
15	1	O-ring	* NBR	
16	1	O-ring	* NBR	
17	1	Drive sleeve	* Carbon steel	API 5LX gr X52
18	1	Jackscrew	Alloy steel + bronze	AISI SAE 9840 + ASTM B427 Alloy 908
19	1	Stop setting screw	Carbon steel	AISI SAE 1040
20	1	Nut	Carbon steel	ASTM A194 gr 2
21	1	Axial needle bearing	Alloy steel	AISI SAE 9840
22	1	Thrust bearing washer	Alloy steel	AISI SAE 9840
23	1	O-ring	* NBR	
24	2	Bushing	Steel + bronze + Teflon	
25	1	Washer	Carbon steel	AISI SAE 1040
26	1	Screw	Carbon steel	AISI SAE 1040
27	1	Key	Alloy steel	AISI SAE 9840
28	1	Bevel pinion	Alloy steel	AISI SAE 9840
29	2	Axial bearing washer	Alloy steel	AISI SAE 9840
30	1	O-ring	* NBR	
31	4	Screw	Alloy steel	ASTM A320 L7
32	1	Bushing	Stainless steel	AISI 340
34	1	Washer	Carbon steel	AISI SAE 1040
35	1	Sealing washer	PVC	
36	1	Screw	Carbon steel	AISI SAE 9840

NOTE:
* Recommended spare parts

5.3 Lubrication of Mechanism

For normal duty, the scotch yoke mechanism and the spring-cartridge of the actuator is lubricated "for life". 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, and 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's also 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 re-lubrication:

Table 10.

AGIP MU/EP/2	
To be used in standard temperature conditions:	(-30 °C/+85 °C)
NLGI consistency:	2
Worked penetration:	280 dmm
ASTM Dropping Point:	185 °C
Base oil viscosity at 40 °C:	160 mm^2/s
ISO Classification:	L-X-BCHB 2
DIN 51 825:	KP2K - 20
Equivalent to:	ESSO BEACON EP2 BP GREASE LTX2 SHELL ALVANIA GREASE R2 ARAL ARALUB HL2 CHEVRON DURALITH GREASE EP2 CHEVRON SPHEEROL AP2 TEXACO MULTIFAK EP2 MOBILPLEX 47 PETROMIN GREASE EP2

AEROSHELL GREASE 7 or equivalent	
To be used in low temperature conditions:	(-60 °C/+65 °C)
Color:	Buff
Physical state:	Semi-solid at ambient temperature
Odor:	Slight
Density:	966 kg/m^3 at 15 °C
Flash Point:	>215 °C (COC) (Based on synthetic oil)
Dropping point:	260 °C (ASTM D-566)
Product code:	001A0065
Infosafe No.:	ACISO GB/eng/C

5.4 Dismantling and Demolition

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 oil 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 actuator and consequently the valve, in its fail-safe position.

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

Lift the actuator using the proper lifting points, see Section 2.3.2.

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

⚠ WARNING

The demolition of the actuator both concerning any electrical and mechanical parts should be made by specialized staff.

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

Section 6: Troubleshooting

6.1 Failure or Breakdown Research

Table 11.

Event	Possible cause	Remedy
Actuator does not work	Lack of power supply	Restore it
	Lack of pneumatic 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 spring	Call Biffi Italia s.r.l. customer service
	Failure of the control group	Call Biffi Italia s.r.l. customer service
	Unexpected intervention of torque limit-device	Call Biffi Italia s.r.l. customer service
	Low supply pressure	Restore (Section 1.4)
Actuator too slow	Low supply pressure	Restore (Section 1.4)
	Wrong calibration of flow regulator valves	Restore (Section 3.6)
	Bad functioning of quick exhaust valve	Call Biffi Italia s.r.l. customer service
	Wear of the valve	Replace
Actuator too fast	High supply pressure	Restore (Section 1.4)
	Bad functioning of booster/quick exhaust valve	Call Biffi Italia s.r.l. customer service
	Wrong calibration of flow regulator valves	Restore (Section 3.6)
Leakages on hydraulic or pneumatic circuits	Deterioration and/or damage to gaskets	Call Biffi Italia s.r.l. 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	Position the handle on the indication of the operation to make
	Leakages on the check valve of the hydraulic control group	Call Biffi Italia s.r.l. customer service

Section 7: Parts List

7.1 Spare Parts Order

For spare parts, order 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 part for a specific actuator model.

Please send every spare parts request to:

Biffi Customer Service - Italy

Tel.: +39 0523-944523

Fax: +39 0523-941885

e-mail: Biffispares@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 24 Scotch yoke mechanism - standard version

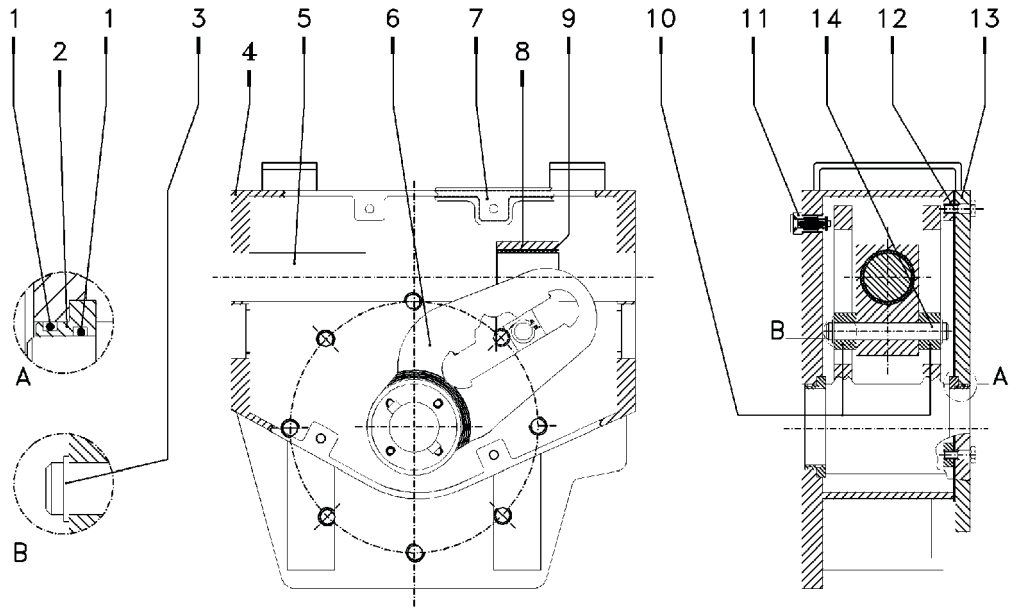


Table 12. Parts List

Item	Qty	Description	Material
1	4	O-ring	* NBR rubber
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	* SBR + cellulose + fillers
8	1	Guide block	Carbon steel
9	1	Bushing	Steel + Bz + Teflon
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

1. Cycles performed by actuator in 25 years expected lifetime - the minimum performed cycles are guaranteed by Biffi based on service conditions listed:
   - All the valve required torques have to be lower than the actuator Max Operating Torque (MOT)
   - The ratio between valve required running torque and actuator Max Operating Torque (MOT) has to be > 1.5
   - The actuator mechanism has to be lubricated in accordance with indication given on this IOM

Figure 25 Scotch yoke mechanism - heavy duty version

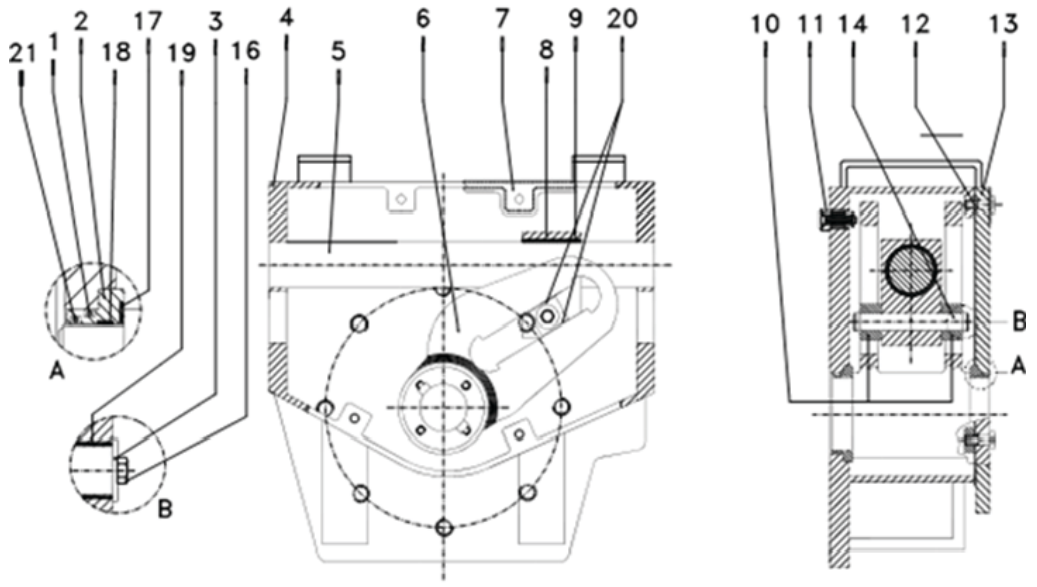


Table 13. Parts List

Item	Qty	Description	Material
1	2	O-ring	* NBR rubber
2	2	Yoke bushing	Carbon steel
3	2	Washer	Stainless steel
4	1	Housing	Carbon steel
5	1	Guide bar	Alloy steel
6	1	Yoke	Carbon steel
7	1	Cover gasket	* SBR + cellulose + fillers
8	1	Guide block	Carbon steel
9	1	Bushing	Stainless steel + fiberglide
10	2	Sliding block	Carbon steel
11	1	Vent valve	* Stainless steel + fluorosiliconic rubber
12	12	Screw	Carbon steel
13	1	Cover	Carbon steel
14	1	Guide block pin	Alloy steel
16	2	Screw	Stainless steel
17	2	Yoke supporter washer	Ertacetal
18	2	Yoke bushing seat	Steel + fiberglide
19	2	Guide block pin bushing	Steel + fiberglide
20	4	Sliding block seat	Steel + fiberglide
21	2	O-ring	* NBR rubber

NOTE:
* Recommended spare parts

1. Cycles performed by actuator in 25 years expected lifetime - the minimum performed cycles are guaranteed by Biffi based on service conditions listed:
   - All the valve required torques have to be lower than the actuator Max Operating Torque (MOT)
   - The ratio between valve required running torque and actuator Max Operating Torque (MOT) has to be > 1.5
   - The actuator mechanism has to be inspected, lubricated, seals and gaskets have to be replaced after each 200.000 cycles

Figure 26 Pneumatic cylinder with setting screw protection

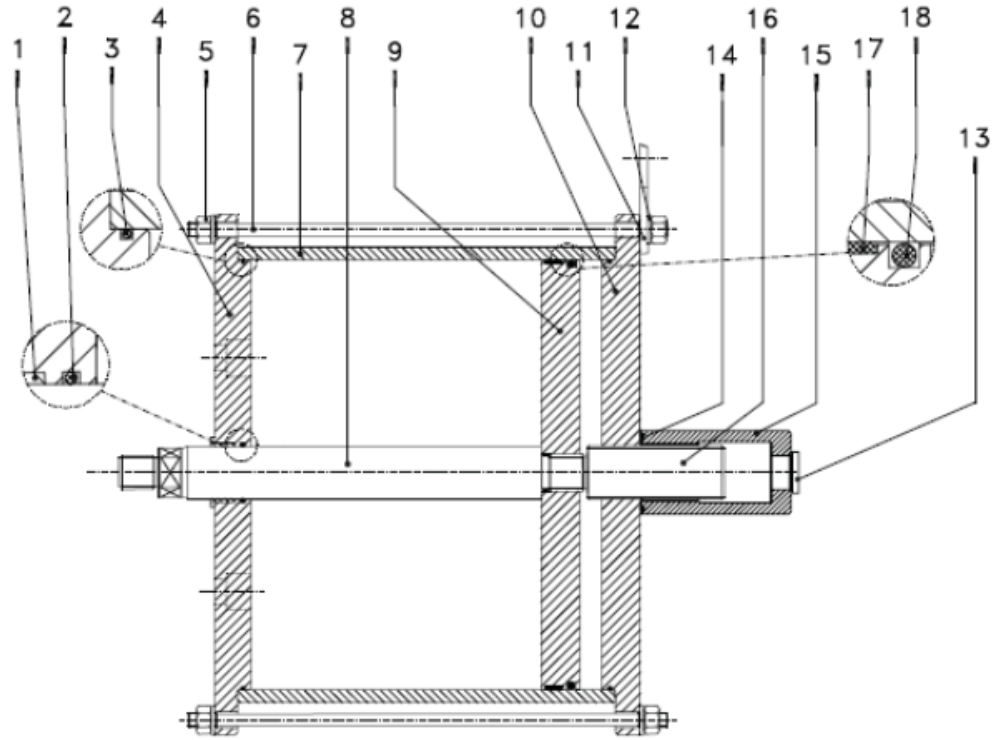


Table 14. Parts List

Item	Qty	Description	Material
1	1	Piston rod bushing	Steel + Bz + Teflon
2	1	O-ring	* Viton
3	2	O-ring	* Viton
4	1	Head flange	Carbon steel
5	8	Nut	Carbon steel
6	4	Tie rod	Alloy steel
7	1	Cylinder tube	Carbon steel
8	1	Piston Rod	Alloy steel
9	1	Piston	Carbon steel
10	1	End flange	Carbon steel
11	1	Lifting eyelet	Carbon steel
12	8	Spring washer	Carbon steel
13	1	Plug with Viton gasket	Stainless steel + Viton
14	1	O-ring	* NBR rubber
15	1	Stop setting screw cover	Carbon steel
16	1	Stop setting screw	Carbon steel
17	1	Guide sliding ring for piston	* Teflon + Graphite
18	1	O-ring	* Viton

NOTE:
* Recommended spare parts

Figure 27 Spring cartridge with setting screw protection

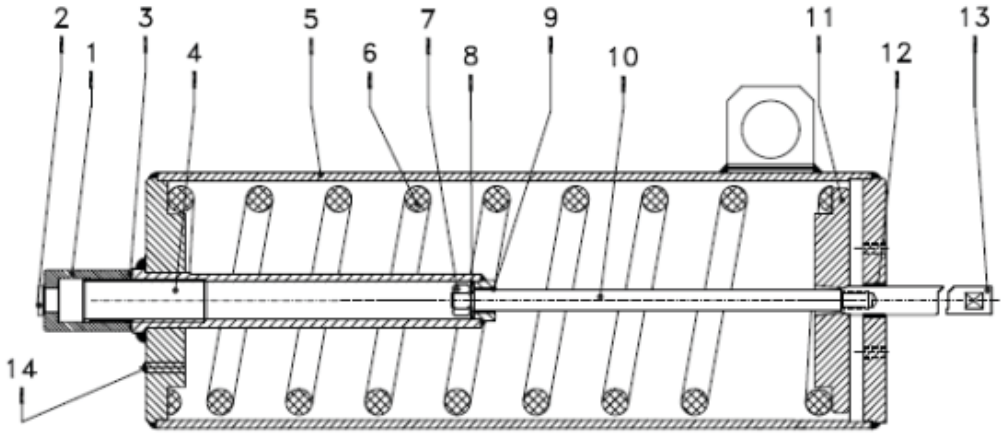


Table 15. Parts List

Item	Qty	Description	Material
1	1	Stop setting screw cover	Carbon steel
2	1	Plug with gasket	Stainless steel + Viton
3	1	O-ring	* NBR rubber
4	1	Stop setting screw	Carbon steel
5	1	Spring container (welded assembly)	Carbon steel
6	1	Spring	Carbon steel
7	1	Nut	Carbon steel
8	1	Shoulder washer	Alloy steel
9	1	Rod bushing	Steel + Bz + Teflon
10	1	Guide rod	Alloy steel (Chromium plated)
11	1	Spring thrust flange	Carbon steel
12	1	Rod bushing	Steel + Bz + Teflon
13	1	Container rod	Alloy steel (Chromium plated)
14	1	Plug	Stainless steel + FKM rubber

NOTE:
* Recommended spare parts

Figure 28 Assembly kit

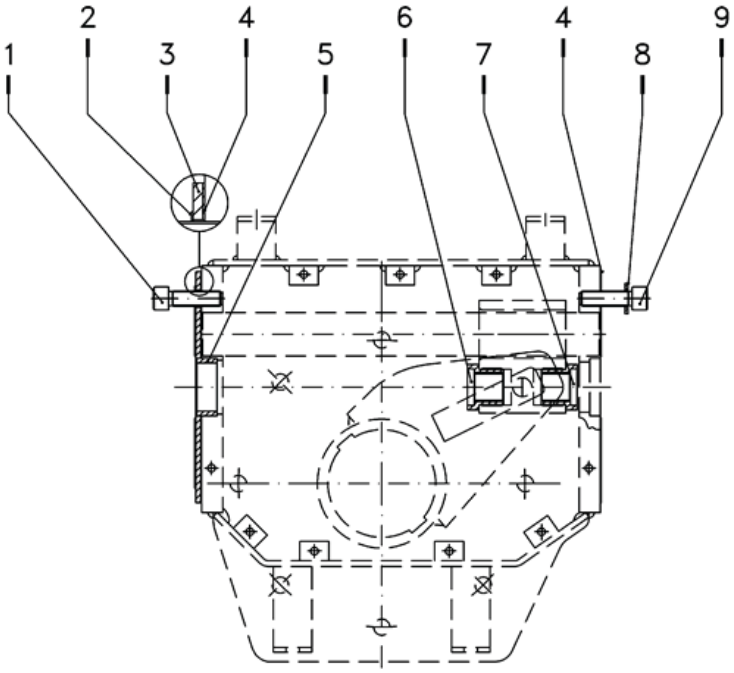


Table 16. Parts List

Item	Qty	Description	Material
1	4	Screw	Alloy steel
2	1	Gasket	* Fiber
3	1	Side plate	Carbon steel
4	2	Gasket	* Fiber
5	1	Washer	Carbon steel
6	1	Adoptor bush	Alloy steel
7	1	Adoptor bush	Alloy steel
8	6	Washer	Carbon steel + rubber
9	6	Screw	Alloy steel

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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