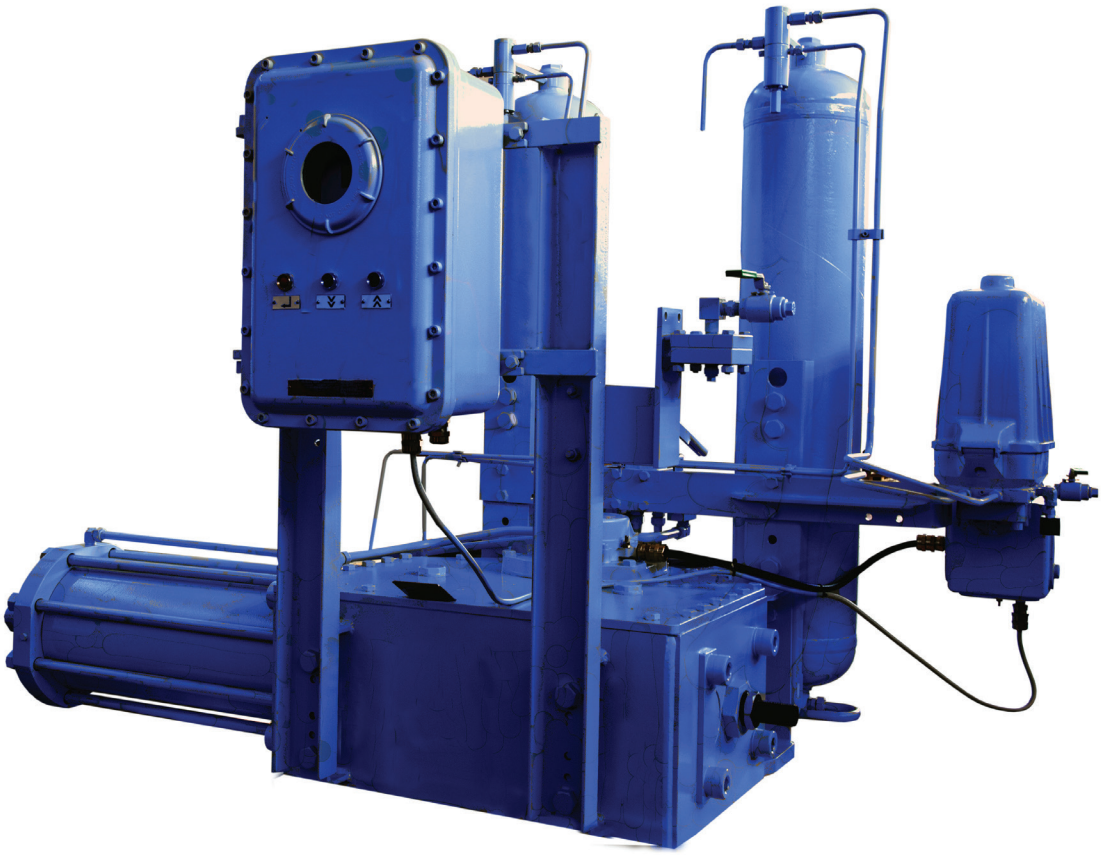
Installation, Operation and Maintenance Manual
MAN 571 Rev. 9
February 2025

Biffi GPO

Gas-Hydraulic Actuator



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NOTICE

Biffi Italia s.r.l. pays the highest attention to collecting and verifying the documentation contained in this Installation, Operation and Maintenance (IOM) Manual. However, Biffi Italia s.r.l. 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 Italia s.r.l. and may be modified without prior 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 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

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 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.

1.1.4 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 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

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

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

Figure 2. Nameplate Base (Sample)

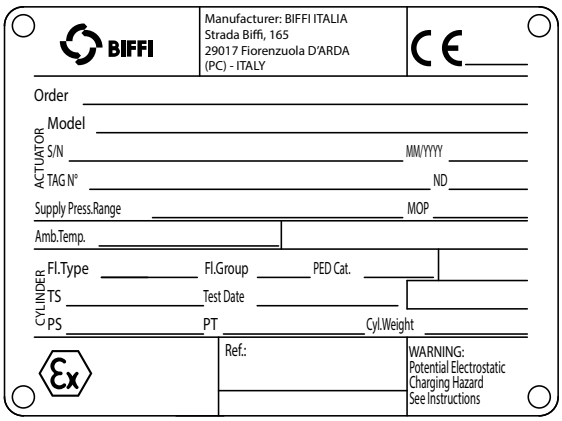
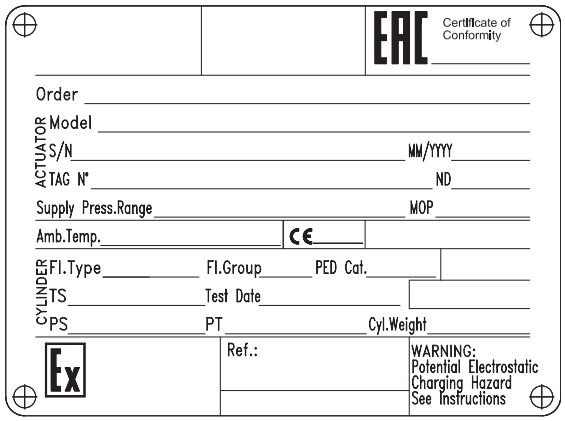


Figure 3. Nameplate for EAC Version (Sample)



1.3 Introducing the Actuator

The gas hydraulic GPO actuator is designed and used for the operation of quarter-turn valves (ball valves and plug valves) installed on gas transportation lines, in compressor stations and everywhere a high-pressure gas supply is available.

The GPO actuator (Figure 4) is composed of one or two pressurized double-action hydraulic cylinders that determines the linear motion of the piston contained in it.

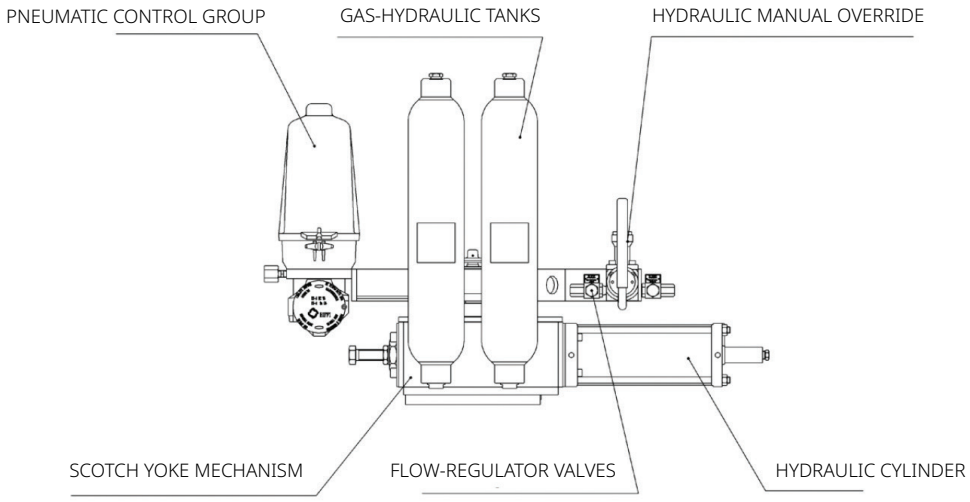
The linear motion of the piston is transformed into rotation by a scotch yoke mechanism.

The gas is directly received from the pipeline and then it pressurize the oil contained in one of the two gas-hydraulic tanks under pressure and then that of the cylinder, determining the control of the actuator.

A special characteristic of the GPO actuator is its great flexibility of use obtained through a simple, solid construction solution with no moving parts.

The expected lifetime of an actuator is approximately 25 years.

Figure 4. Identification of Actuator Parts



1.4 Data Sheet

Supply fluid	Natural gas / nitrogen /air
Operating temperature	Standard: from -20 to +80 °C Optional: from -60 to +80 °C
Supply pressure	Standard: ranging from 7 to 100 bar. Optional: minimum pressure starting from 3.5 bar, maximum pressure up to 160 bar. For higher gas supply pressures, a pressure regulator is available.

Section 2: Installation

2.1 Checks Upon Actuator Receipt

- Check that the model, the serial number of the actuator and the technical data reported on the identification plate correspond with those of the 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 repaint it 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 lifting the actuator above 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 shown in Figure 5.

Figure 5. Example of Hook with Safety Latch

Figure 6. Lifting Points

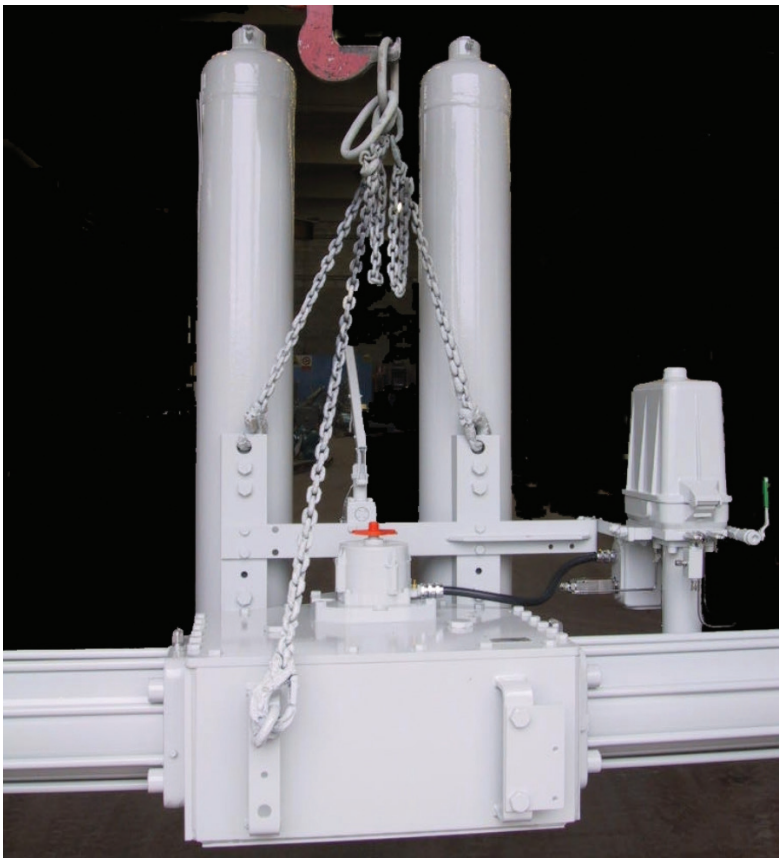


Figure 7. Lifting Points

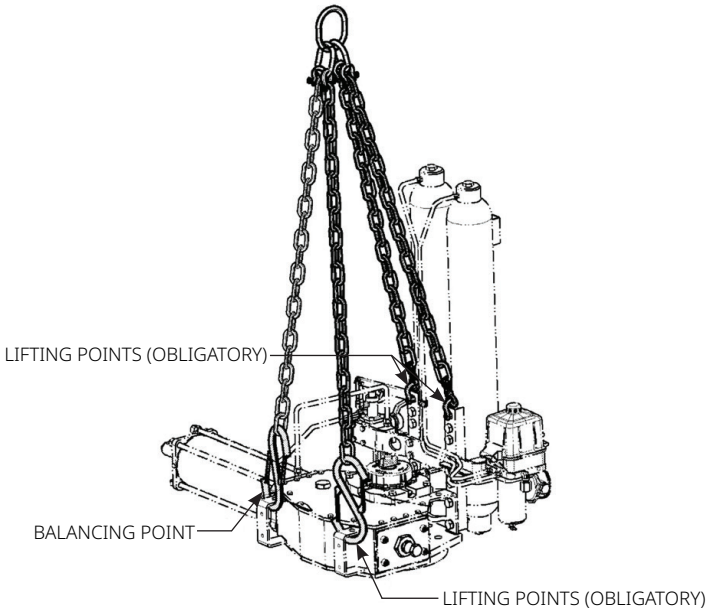
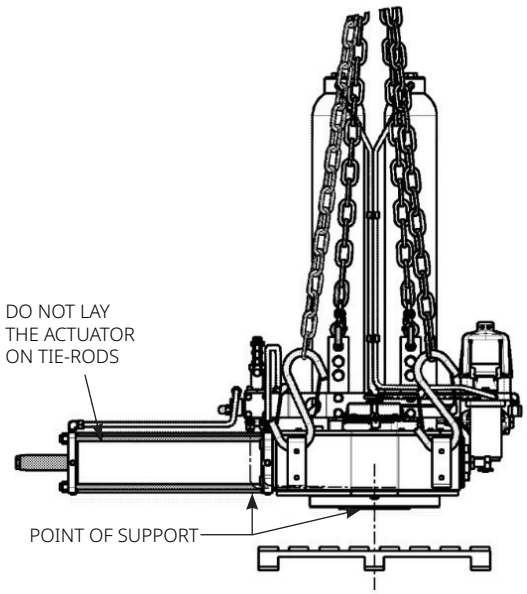


Figure 8. Lifting Points



- When lifting unbalanced loads, use ropes of different lengths or chains with adjustable length.
- Always check the conditions of all lifting equipment used and discard it if not in perfect working order.
- Do not knot or twist the ropes to not 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 (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 the actuator to lift the valve + actuator assembly.

Figure 9. Lifting Points Warnings

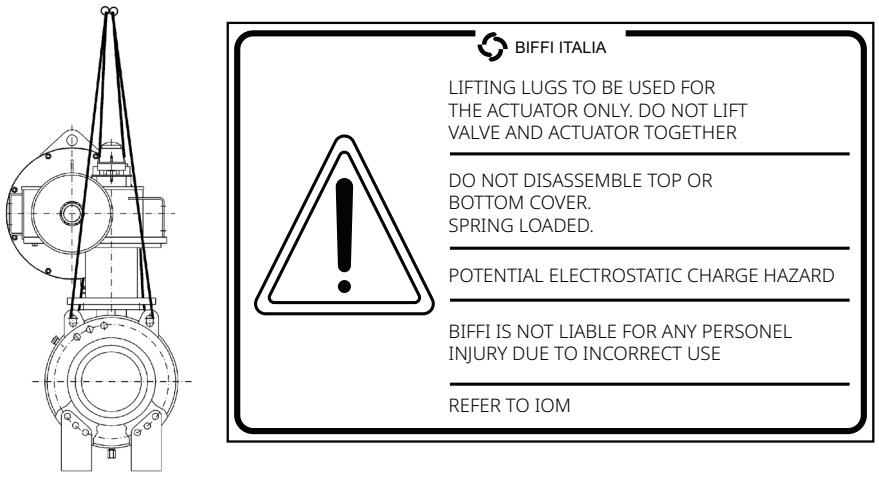
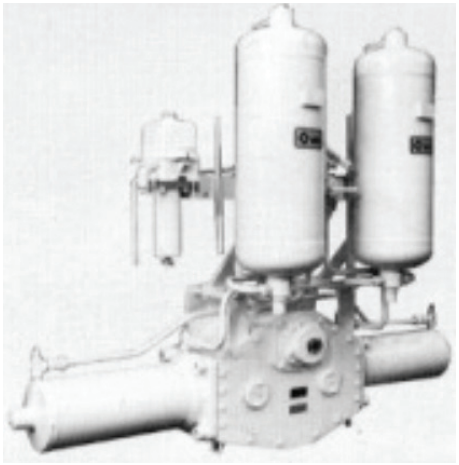


Figure 10. Horizontal Valve Stem - GPO Configuration



GPO suitable for mounting on valve with a horizontal stem.

2.2.1 Instruction for Transport with Gas-Hydraulic Tanks in Horizontal Position

NOTICE

GPO actuators always have to be maintained with the gas-hydraulic tanks in vertical position. This is in order to prevent the hydraulic oil from flowing out the pneumatic pipes and the control group.

The presence of oil in the pneumatic control group can be dangerous as it can form encrustations due to the presence of dust or sand. This could compromise the correct operation of the control valves. Additionally, the loss of some hydraulic oil from the gas-hydraulic tank compromises the correct functioning of the GPO actuator.

If the actuator, for reasons of saving space during transport, must be packaged in a horizontal position, it is mandatory to isolate the oil inside the gas-hydraulic tanks to avoid losses. The pneumatic pipes must be removed and their ends must be protected with plastic plugs, to prevent dirt from entering. They must also be fixed with the proper adhesive tape to avoid damage during transport.

⚠ WARNING

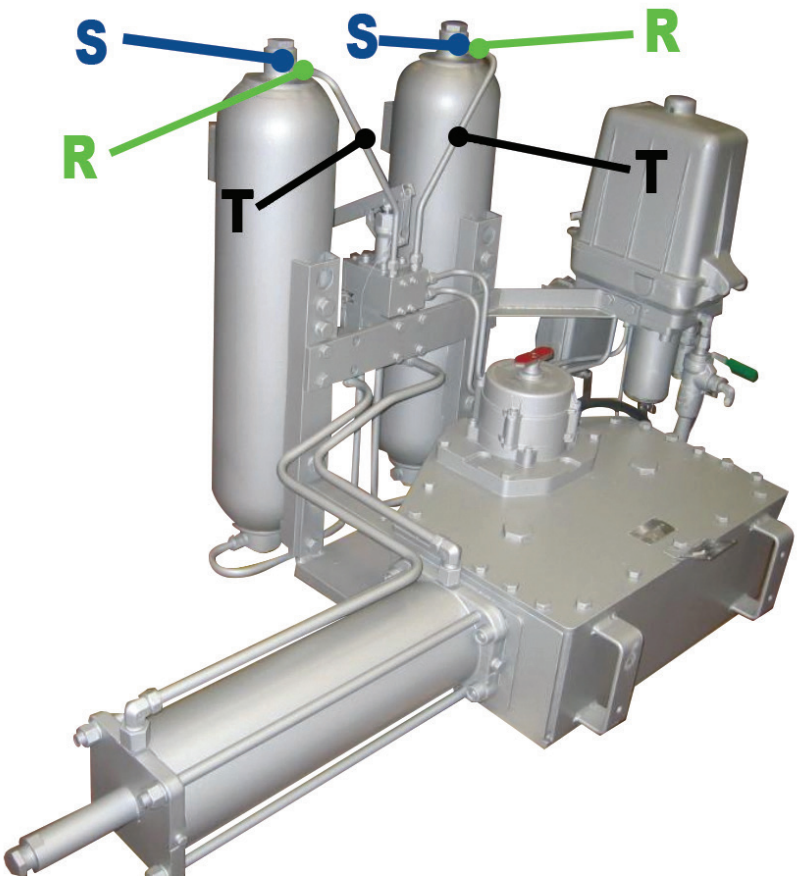
When transporting actuators with gas-hydraulic tanks in a horizontal axis, the packing has to provide adequate support for the tanks.

If the need for horizontal transport is known at the time of the order, Biffi Italia can provide two isolation ball valves at the inlet of the tanks. In this case it is very easy to isolate the oil tanks, by simply closing the stop valves before boxing.

For the correct procedure when transporting GPO actuators with gas-hydraulic tanks in a horizontal position, see Figure 11.

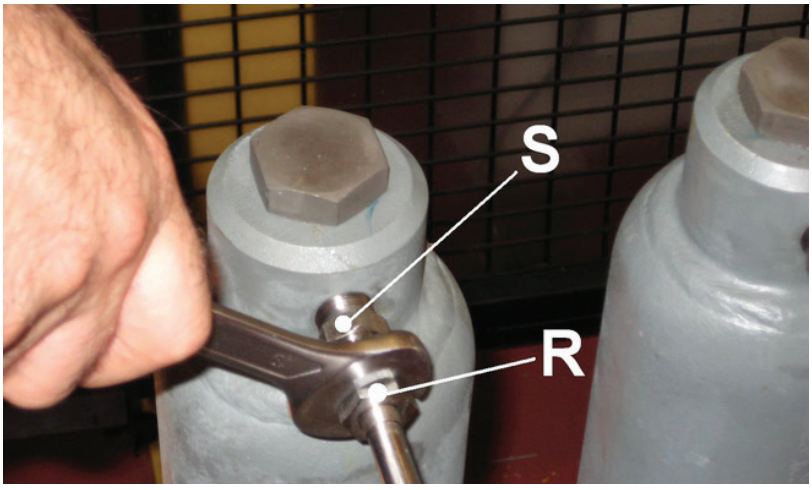
Disassembly for Shipping:

Figure 11. GPO - Main Parts to Consider for Shipping Preparations



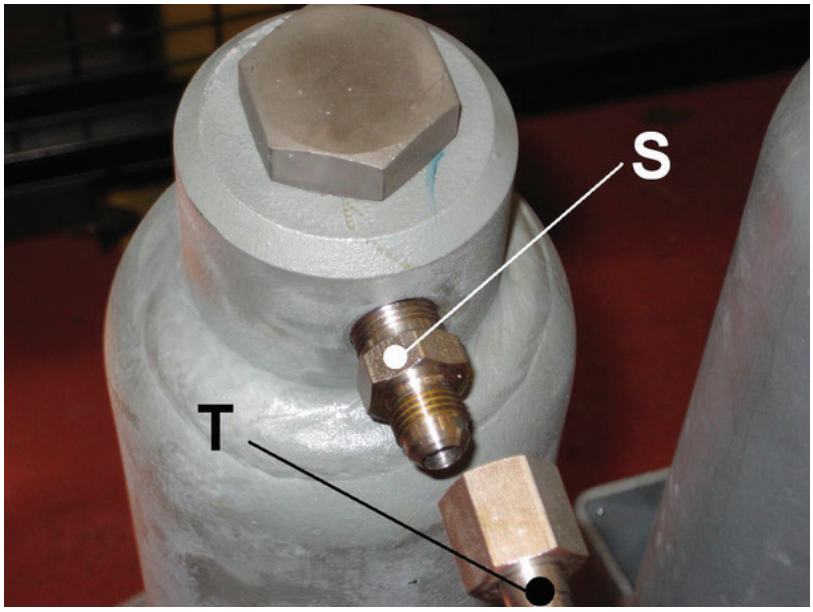
1. Loosen the nuts of the compression fittings (R) on the pneumatic connections nipples (S) (Figure 12).

Figure 12. Step 1



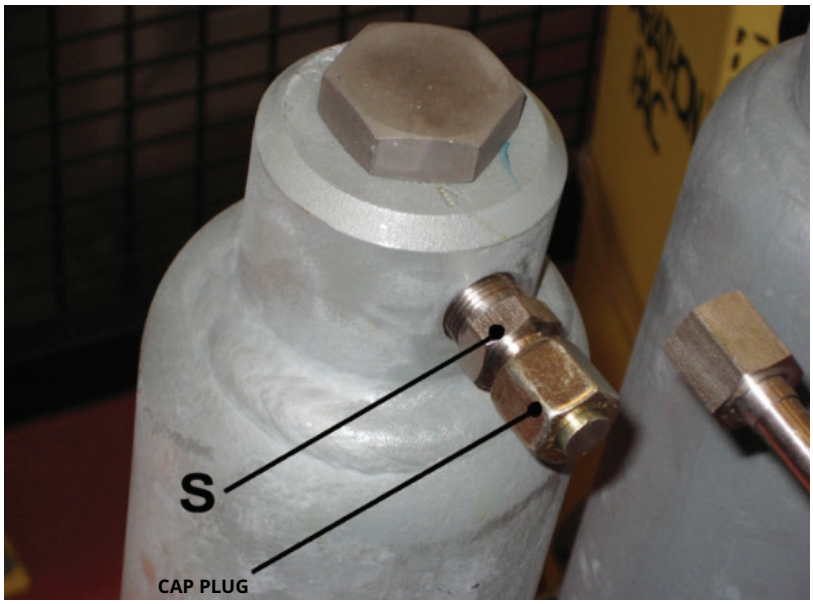
2. Remove pneumatic tubes (T) from connection nipple (S) (Figure 13).

Figure 13. Step 2



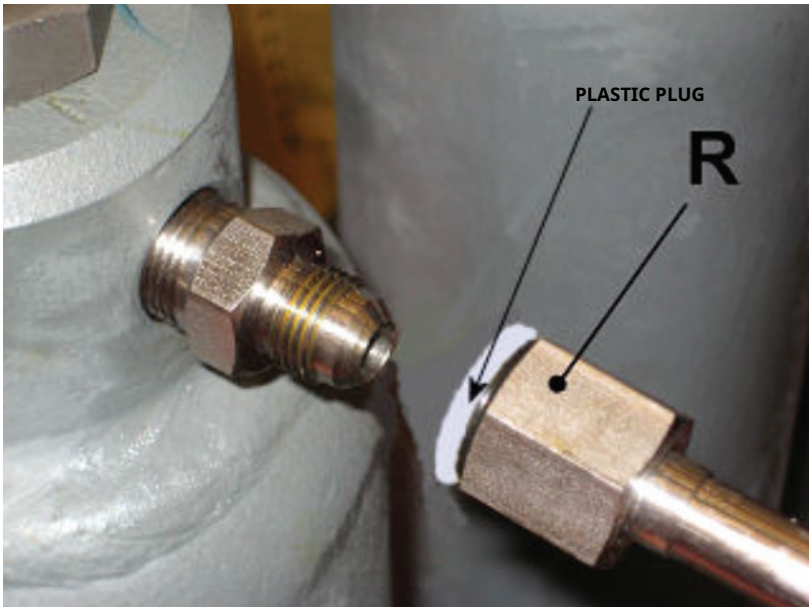
3. Plug the connection nipple (S) with proper cap plugs (Figure 14).

Figure 14. Step 3



4. Plug the pneumatic pipe ends with plastic plugs for fittings (Figure 15).

Figure 15. Step 4



Re-assembly before "start-up" of actuator:

1. Remove protection plugs from compression fittings (R) and connections (S).
2. Connect pneumatic tubes (T) to connections (S).

NOTICE

Check that the ferrule inside the conical seat of the fitting is aligned with the axis of the pneumatic tube end and the connection nipple.

3. Tighten the nuts of the compression fittings (R) to pneumatic connections (S).

NOTICE

After tightening the nuts of the pneumatic connections, a pneumatic test must be performed to check possible leakages.

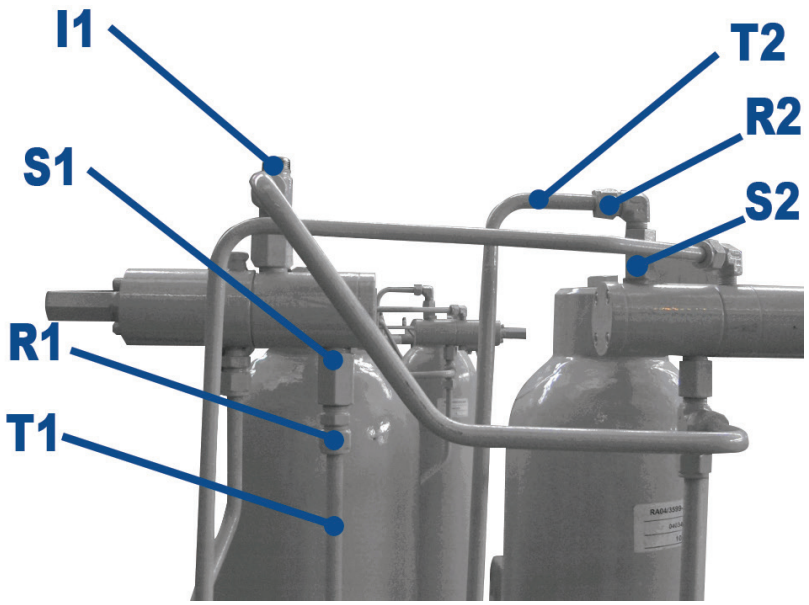
When torque limiting devices are furnished, proceeded as follows:

(See Figure 16)

Disassembly for shipping :

1. Remove tubes (T1 and T2) on connections (S1, S2) by loosening the nuts of the compression fittings (R).

Figure 16. GPO with Torque Limitng Devices Preparation for Shipping - Main Parts to Consider



2. Plug the torque limiting switch with proper cap plugs on the connections (S).
3. Plug the pipe ends with suitable plugs for fittings (R1-R2 connections).

Re-assembly before “start-up” of actuator:

1. Remove protection plugs on S and R connections.
2. Reassemble the fittings (R) for tubes (T) on connections (S).
3. Assemble the exhaust pole on the actuator and connect tube to the connection (I1) (if foreseen).

2.2.2 Procedure to Follow If Oil Leaks from the Tanks into the Pneumatic Valves

NOTICE

If the actuator tanks are kept in a horizontal axis by mistake, and the oil inside them flows into the pneumatic connection pipes and into the control pneumatic valves, it is necessary to wash the interior of valves and pipes with dry air (high flow, low pressure): connect an air or a dry nitrogen supply to the threaded hole of the actuator supply and disconnect the pipes that connect the support plate of the control valves to the tanks. Then, operate the valves so that the air flow removes the oil. Air should go out from the ends of the pipes to make sure that it also properly cleans the interior. This operation should be done as soon as possible after the oil spill.

Checking of the oil level of the tanks (also see Section 5.1)

The correct oil level can be verified by means of the oil dipsticks mounted on the top of each tank. To do this correctly, we must equalize the oil level of the two tanks.

1. Bring the actuator to the middle of the stroke (45° degrees rotation).
2. Rotate the oil distributor to the equalizing position.
3. Wait a few minutes until the oil in the two tanks have reached the same level.
4. Rotate again the hydraulic distributor to the position corresponding to the gas powered operation.

After this operation, bring the actuator to the end of the stroke (fully closed or fully open position). Then, check after the gas has been exhausted, the level of the oil by unscrewing the dipstick. Check if the oil level in the pressurized tank is at the minimum level line and if the oil level in the exhausted tank is at the maximum level line.

I.e. if the actuator is in the closed position, the closing tank (normally on the left side) must have the oil at the minimum level line; the opening tank must have the oil at the maximum level line. If the levels are lower than the dipstick lines, add some oil. Make sure to check the type and the grade of the oil to be used.

2.3 Storage

If the actuator needs to be stored before installation, follow these steps:

- Place it on a wooden surface in order to not deteriorate the area of the valve coupling.
- Make sure that plastic plugs are present on the pneumatic and electrical connections (if present).
- Check that the cover of the control group and of the limit switch box (if any) are properly closed.

If the storage is long-term or outdoors:

- Keep the actuator protected from direct weather conditions.
- Replace the plastic plugs of the pneumatic and electrical connections (if any) with metal plugs that guarantee perfect tightness.
- Coat with oil, grease or protection disc, the valve coupling area.
- Periodically operate the actuator (Section 3.3).

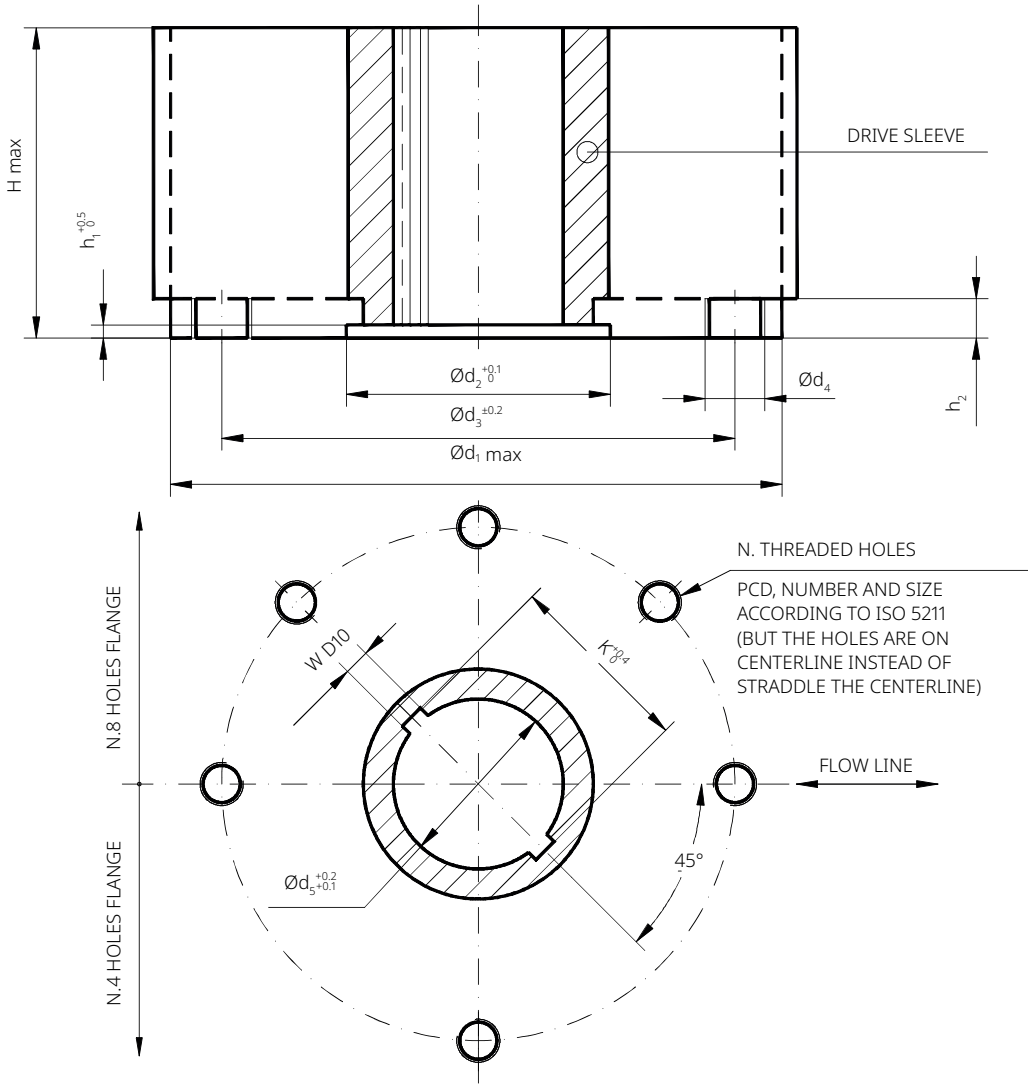
2.4 Actuator Assembly on the Valve

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; SCN6200-1; 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 6).

Figure 17. Coupling Dimensions - Actuator Models 0.3 to 6 (SCN6200 - Rev. 15/10/19)



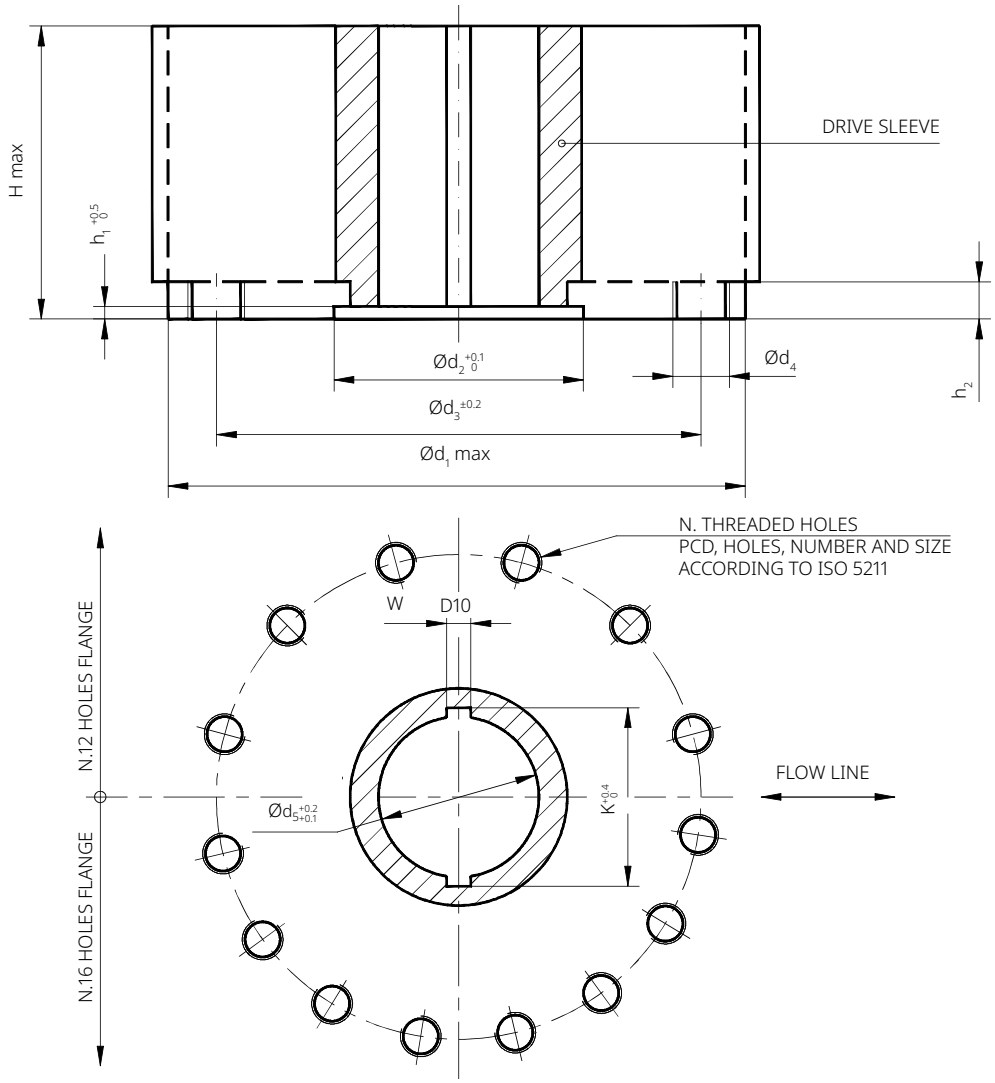
TOP VIEW OF THE SCOTCH YOKE MECHANISM (ACTUATOR SHOWN IN CLOSED POSITION)

Table 1. SCN6200 - Rev. 15/10/19

Actuator Model	Ød1	Ød2	Ød3	Ød4	N	h1	h2	H max	Ød5	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 18. Coupling Dimensions - Actuator Model 14 (SCN6201 - Rev. 16/06/20)



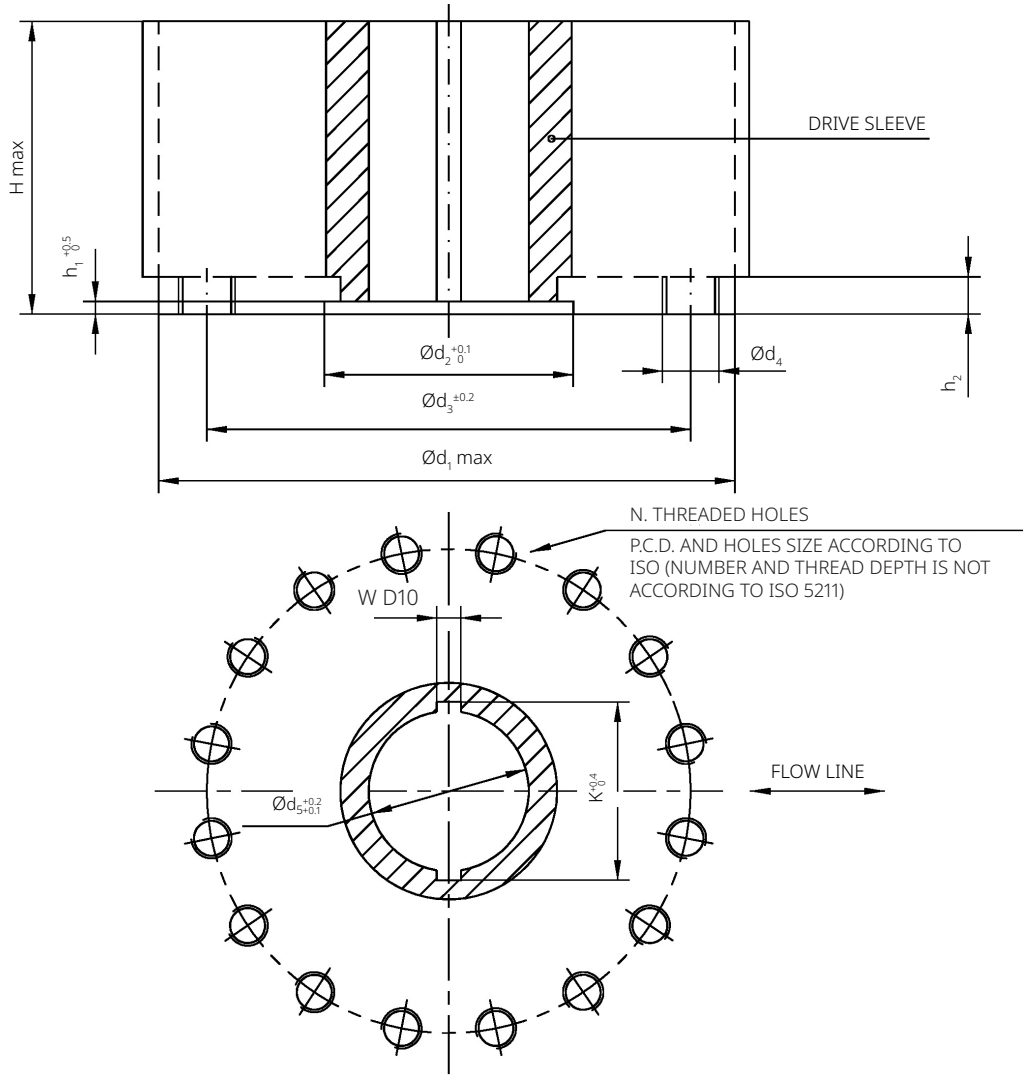
TOP VIEW OF THE SCOTCH YOKE MECHANISM (ACTUATOR SHOWN IN CLOSED POSITION)

Table 2. SCN6201 - Rev. 16/06/20

Actuator Model	$Ød_1$	$Ød_2$	$Ød_3$	$Ød_4$	N	h_1	h_2	H max	$Ød_5$	W	K
14	580	250	483	M36	12	10	29	340	170	45	195.8

NOTE:
All dimensions are in millimeters.

Figure 19. Coupling Dimensions - Actuator Models 18 and 32 (SCN6201 - Rev. 16/06/20)



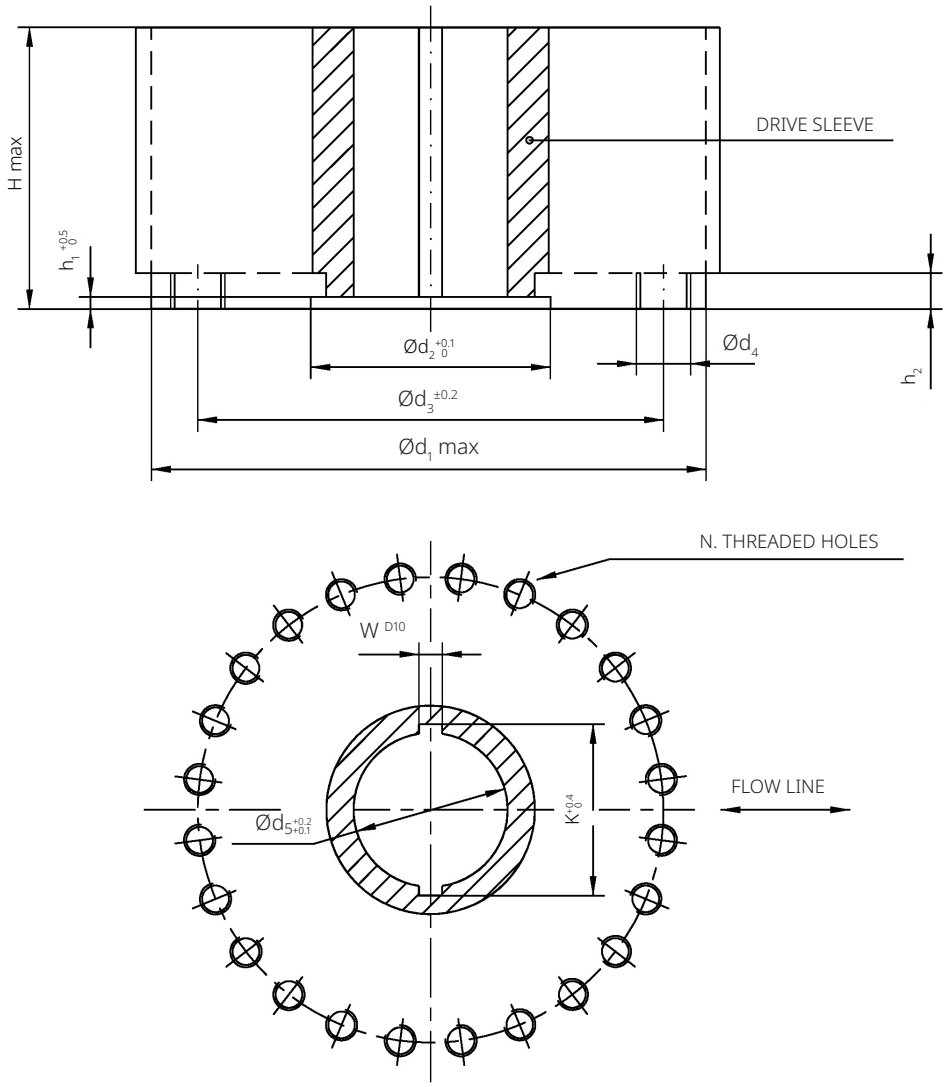
TOP VIEW OF THE SCOTCH YOKE MECHANISM (ACTUATOR SHOWN IN CLOSED POSITION)

Table 3. SCN6201 - Rev. 16/06/20

Actuator Model	$Ød_1$	$Ød_2$	$Ød_3$	$Ød_4$	N	h_1	h_2	H max	$Ød_5$	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 20. Coupling Dimensions - Actuator Model 50 (SCN6201-1 - Rev. 15/10/19)



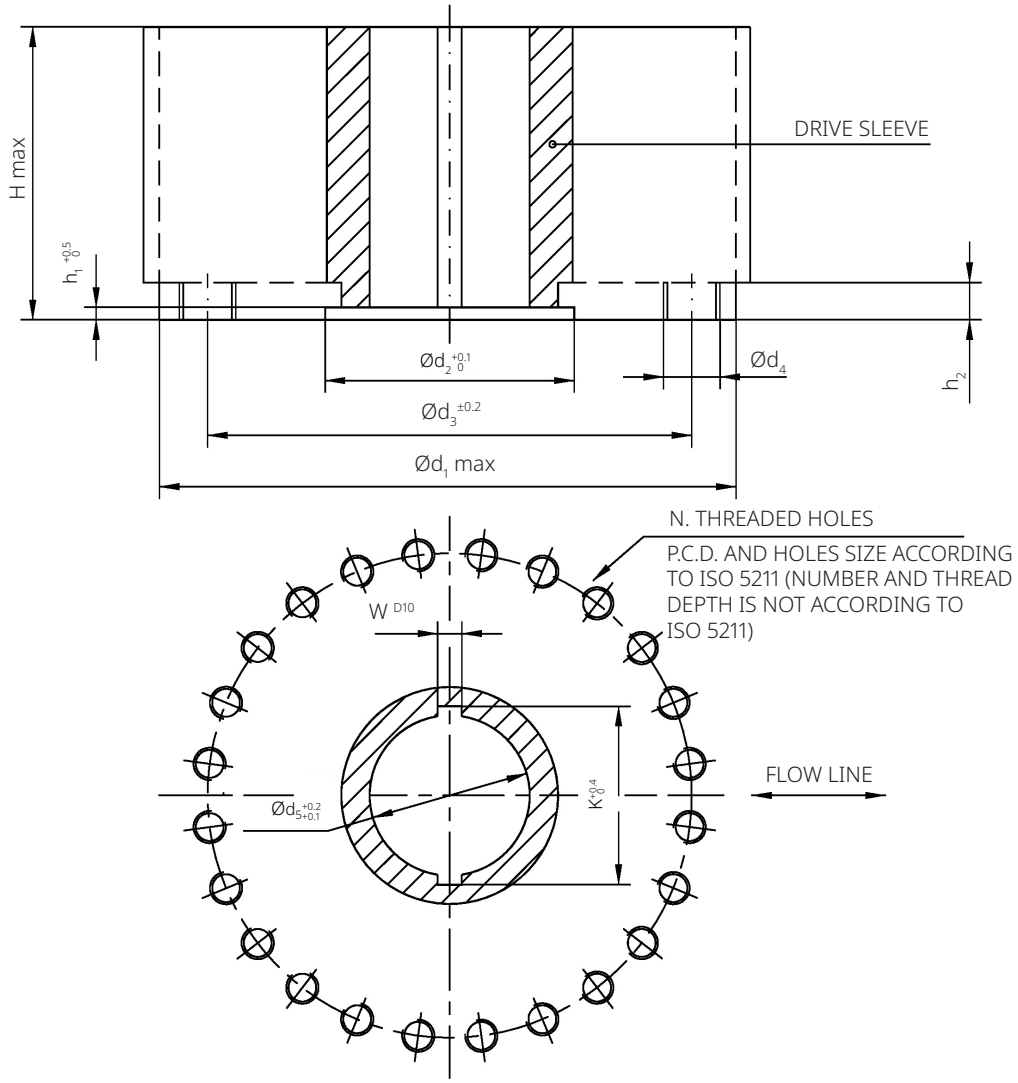
TOP VIEW OF THE SCOTCH YOKE MECHANISM (ACTUATOR SHOWN IN CLOSED POSITION)

Table 4. SCN6201-1 - 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 21. Coupling Dimensions - Actuator Models 65 and 80 (SCN6201-3 - Rev. 19/06/20)



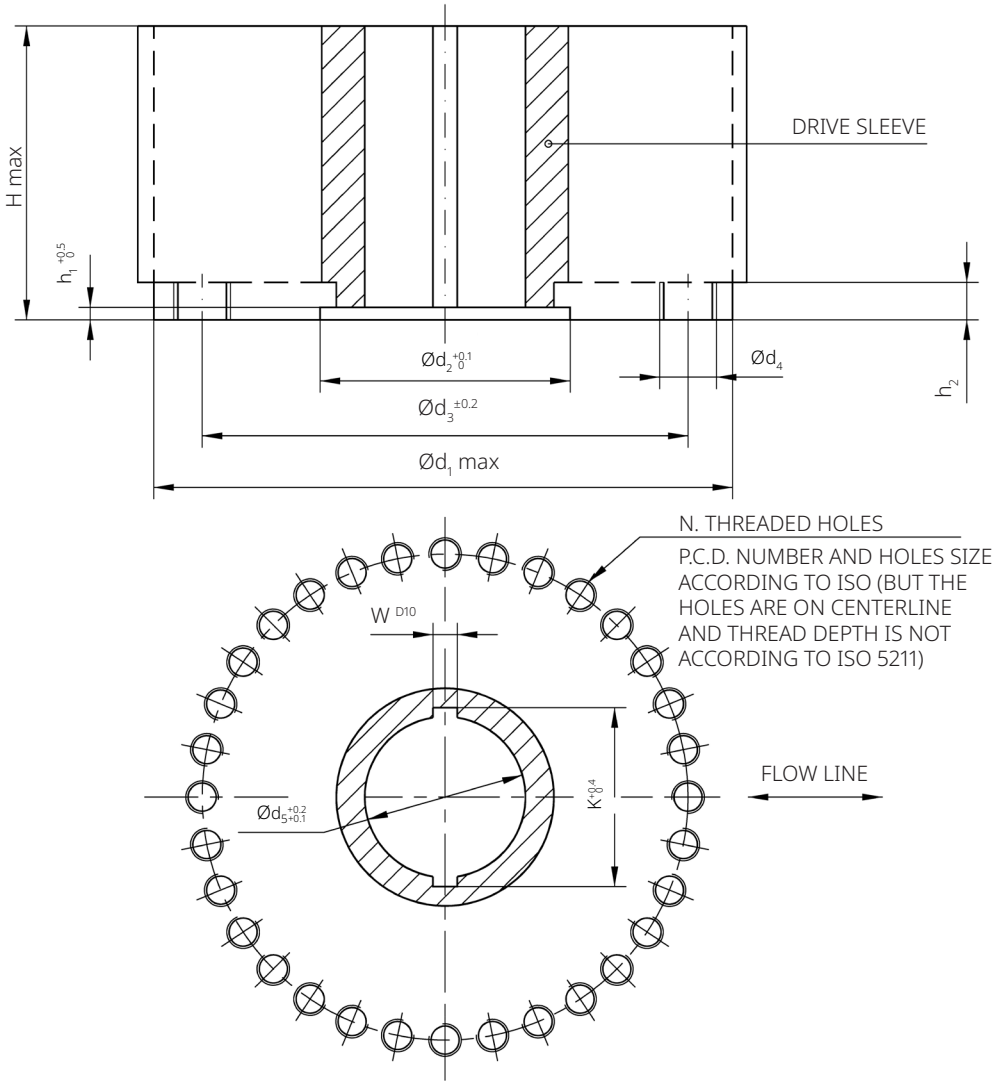
TOP VIEW OF THE SCOTCH YOKE MECHANISM (ACTUATOR SHOWN IN CLOSED POSITION)

Table 5. SCN6201-3 - 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.

Figure 22. Coupling Dimensions - Actuator Model 100 (SCN6201-5 - Rev. 22/07/22)



TOP VIEW OF THE SCOTCH YOKE MECHANISM (ACTUATOR SHOWN IN CLOSED POSITION)

Table 6. SCN6201-5 - Rev. 22/07/22

Actuator Model	$Ød_1$	$Ød_2$	$Ød_3$	$Ød_4$	N	h_1	h_2	H max	$Ød_5$	W	K
100	1200	450	1042	M42	32	8	57	600	300	70	328.8

NOTE:
All dimensions are in millimeters.

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 13. The particular execution of the flange and bushing allow the actuator to be rotated by 90° in 4 different positions according to Figure 23:

Figure 23. Insert Bush + Intermediate Coupling Flange

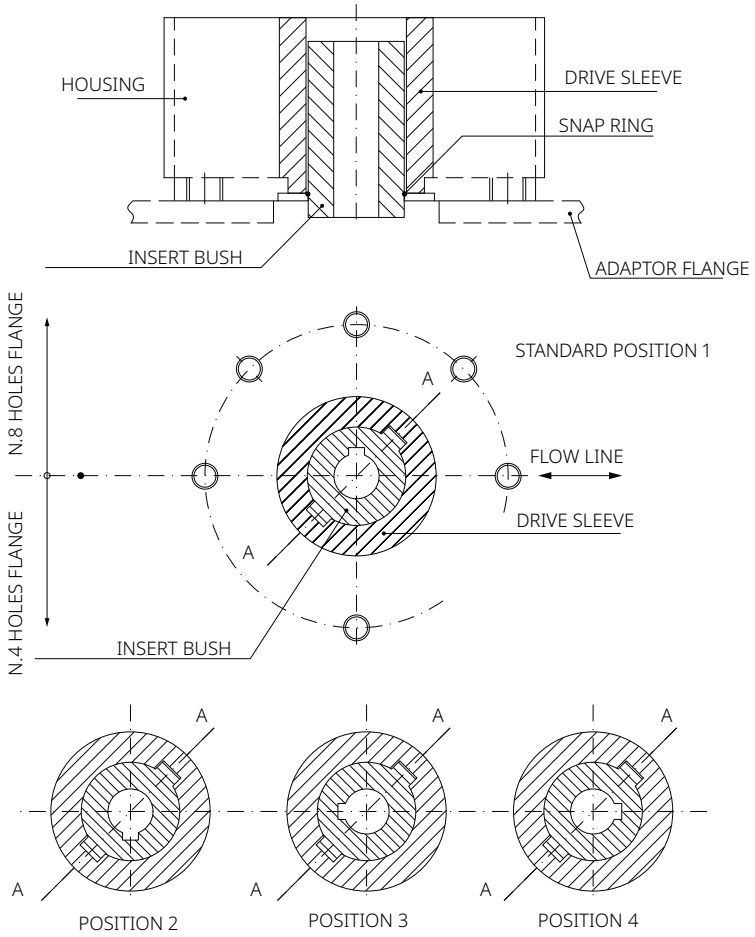


Table 7. Insert Bush Setting

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.

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 if the assembly position, as shown on the documentation, complies with the system's geometry. Check the consistency of the parts of the 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 8.

Table 8. 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 8 were calculated considering the materials ASTM A320 L7 for screws or tie rods and ASTM A194 Grade 2H for the nuts.

2.5 Pneumatic Connections

⚠ WARNING

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

NOTICE

The connections should be made by qualified staff. Use pipes and connections with the appropriate type of material and dimensions.

- Properly de-burr the ends of rigid pipes.
- Properly clean the interior of pipes sending through them plenty of the supply fluid used in the system.
- Mold and fasten the connection pipes so that no irregular strains at entries or loosening of threaded connections occur.
- Make the connections according to the operating diagram.
- Check the absence of leakages from pneumatic connections.

2.6 Electrical Connections (If Any)

⚠ WARNING

Use components appropriate as for type, material and dimensions.

NOTICE

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

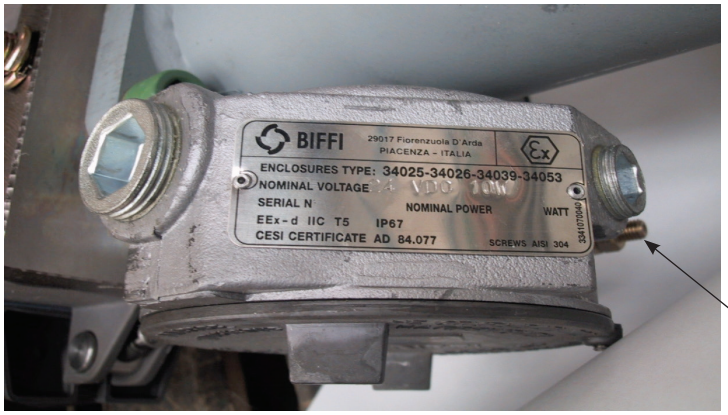
2004/108/EC: Directive for the electromagnetic compatibility (until19 April 2016) 2014/30/EU from 20 April 2016

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 24. Junction Box



2.7 Commissioning

NOTICE

Check that values of electrical supply to the control group (if foreseen) are compatible with those on the plate on the junction box (Figure 24).

⚠ WARNING

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

Upon actuator commissioning,please carry out the following checks:

- Check that the values of pneumatic supply available in the system are compatible with those reported on the identification plate of the actuator (Figures 2 and 3).
- Check that electrical values of supply to the control group comply with the ones reported on the junction box (Figure 24).
- Check that there are no leakages in the hydraulic connections.
- Check that paint is not be damaged during transport, if necessary, repair the damages to paint coat.
- Carry out all kinds of operations and check their proper execution (Section 3.3).
- Check that there are no leakages in pneumatic connections.
- Check proper operation of all the due signalling.
- Check oil level in gas-hydraulic tanks (Section 5.1.1).

Section 3: Operation and Use

3.1 Operation Description

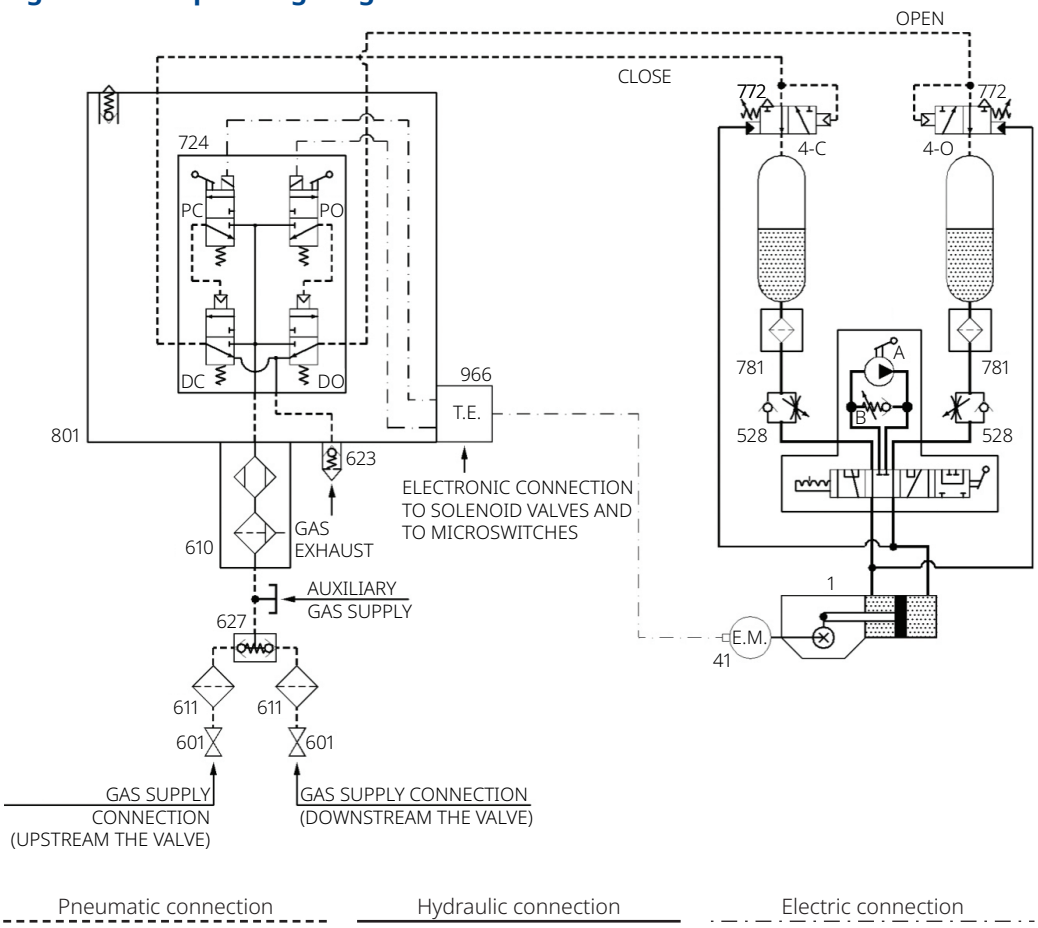
The supply gas pressurizes the oil contained in the gas-hydraulic tank relevant to the operation to carry out opening or closing (Figure 25).

Oil, (Figure 27), arrives to the manual hydraulic control group and pressurizes a chamber of the cylinder: this starts the linear motion of the piston and the consequent rotation motion of the scotch yoke, to which the valve stem is coupled.

Oil, discharged from the chamber of the cylinder, flows in the second tank going through the manual hydraulic control group and the flow control valve placed under it, that regulates the operation time being carried out (Section 3.6).

When the operation is over, the pressurized gas exhausted, is discharged through the valves placed in the control group. This allows having the actuator not in pressure except during the execution of the operation.

Figure 25. Operating Diagram



1 Double-acting gas over oil actuator
4 Gas-hydraulic tank
18 Hydraulic manual override
a - Hand pump
b - Adjustable relief valve
c - Hand operated directional control valve
41 Electric microswitches
528 Uni-directional flow regulator (adjustable setting)
601 Stop valve
610 Gas dehydrating filter/condensate separator
611 Mechanical filter
623 Dust excluder with check valve
627 Higher pressure shuttle valve (double check valve)
724 Double 3/2 N.C. solenoid valve with manual override
PC- 3/2 N.C. pil. solenoid valve. manual over ride (to close)
PO- 3/2 N.C. pil. solenoid valve. manual over ride (to open)
DC- 3/2 N.C. pneumatic pilot/ spring-return valve (to close)
DO- 3/2 N.C. pneumatic pilot/ spring-return valve (to open)
772 Torque limiting switch
781 Hydraulic filter
801 Control valves enclosure with vent valve
966 Terminals enclosure

Electric remote control to open and to close

Energize solenoid valve 724-P0 to open or 724-PC to close the actuator during all the valve stroke. Solenoid valves must be de-energized at the end of the actuator operation.

Local control to open and to close

Press lever on valve 724-P0 to open or 724-PC to close.

Manual operation

Select by the valve 18-C the opening or closing operation and actuate the hand pump 18-A.

Note: The directional control valve 18-C must be in “automatic”- position to allow the operation with gas supply.

Torque uniting device

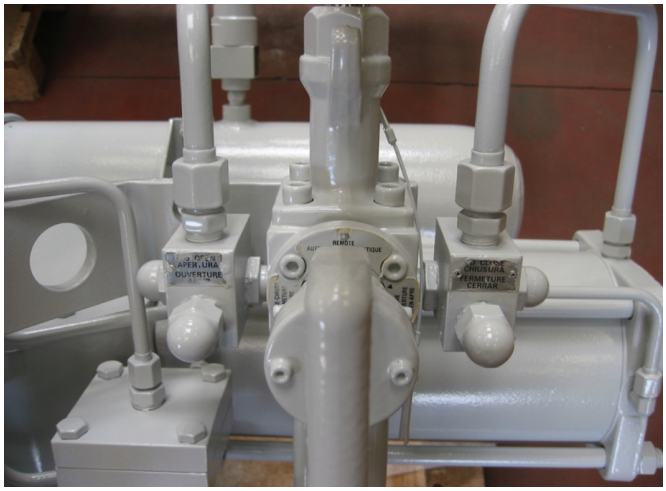
When the actuator output torque exceeds the set value, the torque limiting switch 772 stops the gas flow to the relevant gas-hydraulic tank 4 and the enclosed gas is exhausted.

Note: the operating diagram is drawn with solenoid valves coils not energized.

Figure 26. Torque Limiting Device

A pressure reducer or a “torque limiting device” (exclusive to Biffi) can be supplied when the gas supply pressure varies in a wide range and when the actuator output torque must not exceed a fixed value in order not to damage the valve. The pressure reducer limits the output torque of the actuator by reducing the gas supply pressure at a preset value. The torque limiting device consists of 2 valves, one for each gas-over-oil tank, which stops the gas flow coming from the pneumatic control valves of the actuator and exhaust the gas enclosed in the gas-over-oil tanks when the output torque exceed the preset value. When the gas supply to the actuator is not always available, a storage tank engineered and manufactured according to the applicable code and working conditions is provided. For any particular requirements, it is advisable to contact Biffi sales offices, which will provide the most suitable and convenient solutions to the various needs (Figure 26).

Figure 27. Flow Regulator Valves



The speed of operation can be adjusted on site by two flow control valves (see Figure 27 and Section 3.6)

3.2 Residual Risks

⚠ WARNING

It is recommended to pipe exhaust gas.
The actuator has parts under pressure.
Exercise the due caution. Use individual protections provided for by the laws and provisions in force.

3.3 Operations

3.3.1 Local Pneumatic Operation

⚠ WARNING

Use the proper safety measures to protect from any pressurized gas not piped and from excessive and harmful noise.

Figure 28. Double Solenoid Valve with Manual Control

- Arrange the distributor to the “Automatic” position (Figure 29).
- Operate the manual control lever of the double solenoid valve in the control group, relevant to the operation to carry out opening or closing (Figure 25).
- Check the correct operation of the actuator through the visual position indicator.
- Release the lever to terminate the operation.

3.3.2 Local Hydraulic Manual Operation

⚠ WARNING

Use the proper safety measures to protect from any pressurized gas not piped and from excessive and harmful noise.

- Operate the distributor to the “opening” or “closing” position according to the operation to make Figure 29.
- Operate the manual control lever (Figure 29).
- Check the correct operation of the actuator through the visual position indicator.
- If no other local operation is carried out, operate the distributor to the “Automatic” position (Figure 29).

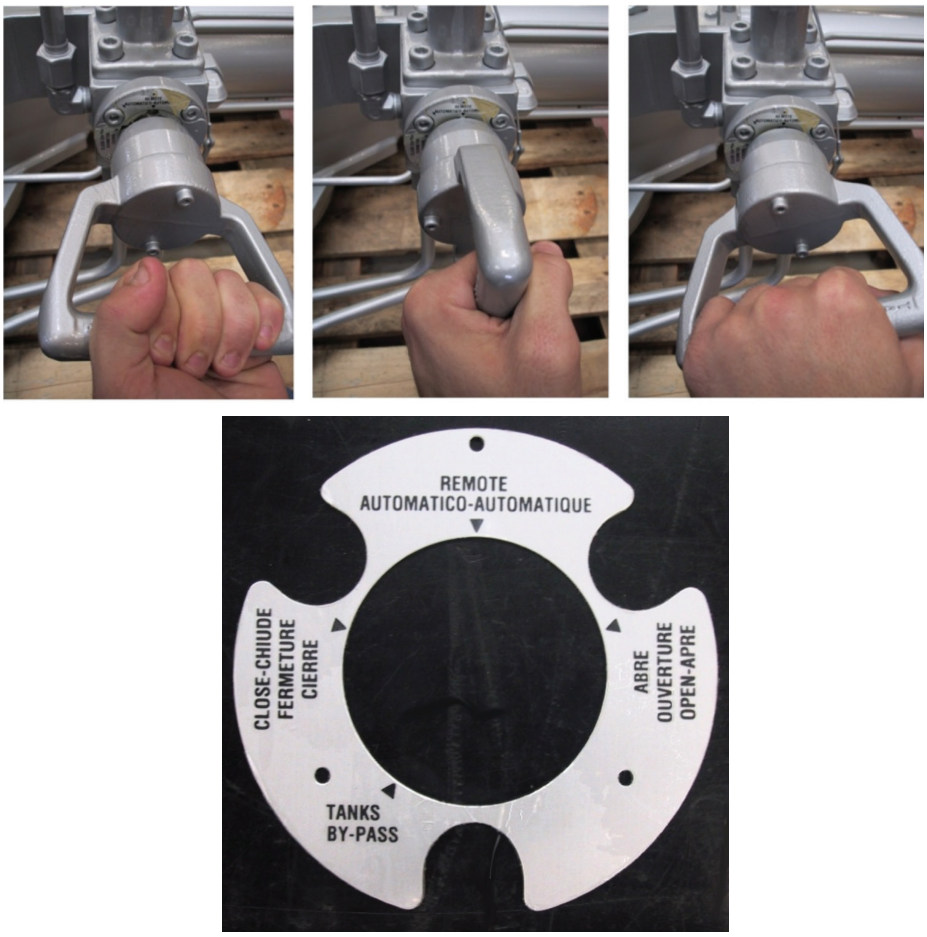
3.3.3 Remote Operation

- In case of remote control, arrange the distributor to “Automatic” position (Figure 29), and from the control room send the electric signal corresponding to the operation to carry out (opening or closing).

NOTICE

Do not use the by-pass position of the distributor to carry out operations.

Figure 29. Distributor in the Three Operation Positions



3.4 Calibration of the Angular Stroke

The angular stroke of the yoke can be adjusted between 82° and 98° (±4° 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 pneumatic cylinder (closing) (Figure 30).

Figure 30. Mechanical Stops

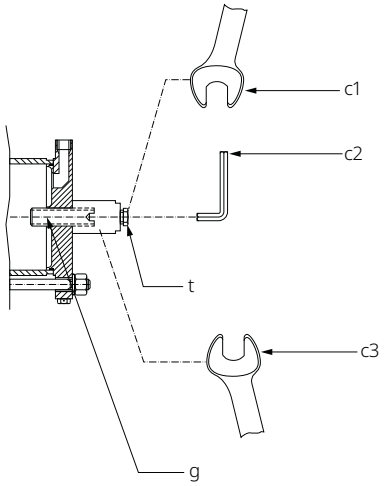
In case of an actuator with two cylinders (Figure 31), both mechanical stops are screwed on the end flanges of the cylinders.

Figure 31. Actuator with Two Cylinders

For the adjustment of the mechanical stop on the end flange of cylinder, follow these steps (Figure 32):

- 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).

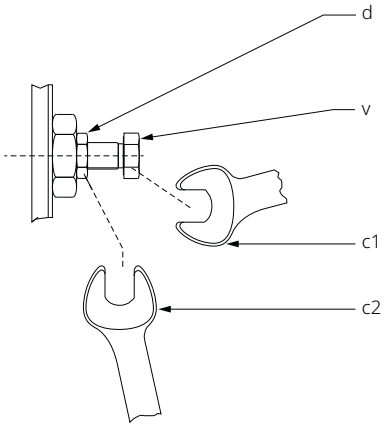
Figure 32. Mechanical Stop of the Cylinder



For the adjustment of the mechanical stop srewed into the left side of housing, follow these steps (Figures 33 and 34):

- 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 33. Mechanical Stop on the Housing



3.5 Calibration of Microswitches (If Foreseen)

(Refer to Safety Instructions Manual of the supplied limit switch box)

⚠ WARNING

Refer only to technical documentation related to installed switch-box model.

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.

Figure 34. Microswitches Box

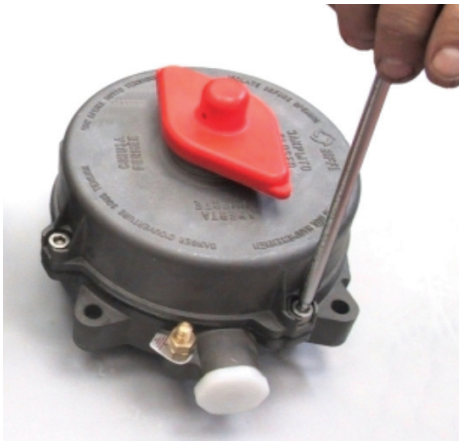
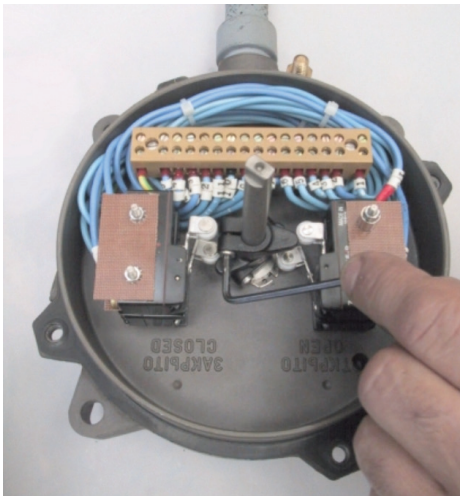


Figure 35. Cam Adjustment



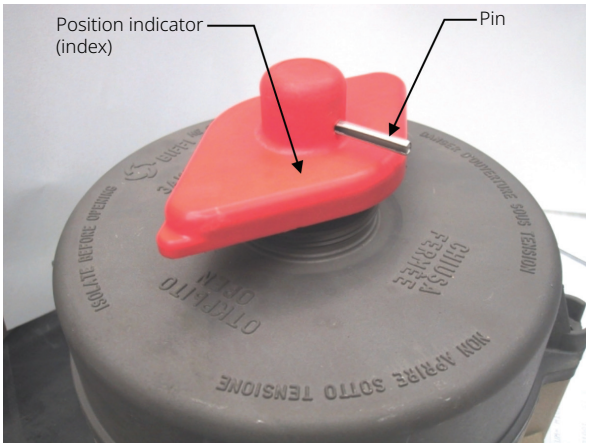
If the index (Figure 36), does not signal the proper position of the valve but is turned by 90°:

- 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.

NOTICE

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.

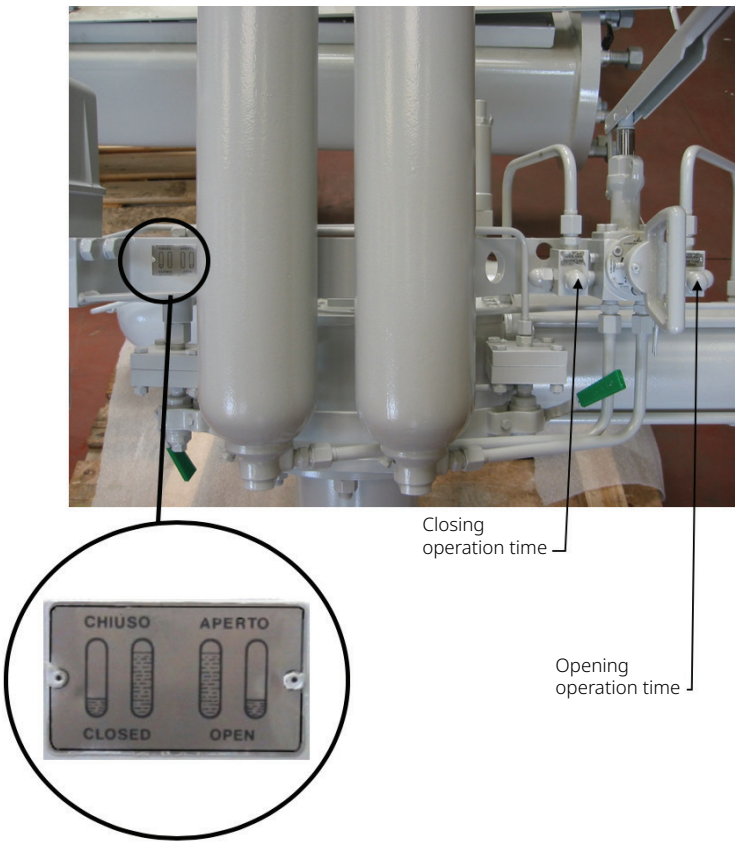
Figure 36. Position Indicator and Pin for Microswitches Box



3.6 Calibration of the Operation Time

The calibration of the operation time is made through two flow regulation valves placed next to the hydraulic manual distributor (Figure 37).

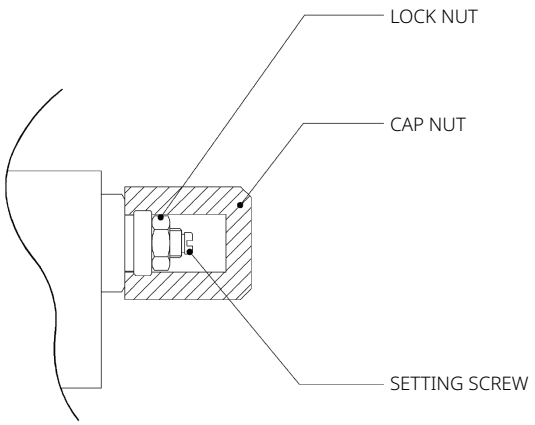
Figure 37. Adjustment of Operation Time and Oil Levels



To carry out the adjustment, use an adequate Allen wrench and follow these steps (Figure 38):

- 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 38. Flow Regulator



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 executing any maintenance operation, it is necessary to close the pneumatic supply line and discharge pressure from the cylinder of the actuator, from the control unit and from the accumulator tank (if foreseen).

⚠ WARNING

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

5.1 Periodic Maintenance

GPO 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. 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:

- Check that the actuator properly operates the valve.
- Check there are no hydraulic or pneumatic leakages.
- Check oil level (Figure 39).
- Check if the actuators did not undergo accidental damage with oil leakages found on site (Section 5.1.1).
- Check if the improper closing of control-group cover did not produce the presence of condensation on it.
- Check the integrity of worn out parts (gaskets, pads etc.).
- Replace, if any, the filter cartridge of the supply gas.

Figure 39. Level Measuring Stick

5.1.1 Check and Restore Oil Level in the Gas-Hydraulic Tanks

Bring the actuator to the completely open or completely closed position.

- Wait for a few minutes before checking.
- Check oil level with the special level sticks placed on top of gas-hydraulic tanks (Figure 39).
- Add oil (Table 9) if in one tanks the level is BELOW MINIMUM and at the same time in the other tank it is BELOW MAXIMUM (Figure 39).

⚠ WARNING

Oil level should not be ABOVE MINIMUM in one tank and at the same time ABOVE MAXIMUM in the other one.

If in one tank, level is at BELOW MINIMUM and at the same time the level in the other tank is at ABOVE MAXIMUM or the other way round, there is an imbalance of oil levels in the tanks. In this case follow these steps:

- Bring actuator to half angular stroke - 45°.
- Position distributor in “by-pass”.
- Operate the lever of the hydraulic pump to balance the oil levels of two tanks.
- Check that the level is restored with the special measuring sticks.
- Bring distributor back to previous position.

NOTICE

Do not leave the distributor in the by-pass position. For refill, use oil of the same brand as the one in the tanks, refer to related technical documentation supplied along with the actuator. Before using a different type of oil, refer to the provided oil data sheet and ask your supplier for an equivalent or better oil to use.

Table 9. Features of Hydraulic Oil Suggested for Refilling in Different Working Conditions

Standard Temperature Conditions (-30 to +85 °C):	
Producer	ENI®
Name	Arnica 22
Viscosity at 40 °C	20.9 mm^2/s
Viscosity at 100 °C	4.73 mm^2/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):	
Manufacturer	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 (Or equivalent)	0.87 kg/dm^3
(or equivalent)	
Low Temperature Conditions (to -60 °C):	
Manufacturer	SYNTESIS *
Name	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 (Or equivalent)	0.897 kg/dm^3
(or equivalent)	

NOTE:
* Contact 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 general sectional drawings in Section 7 and adopting the following procedures.

NOTICE

Contact Biffi customer care.

5.2.1 Lubrication of Mechanism

For normal operations, the scotch yoke mechanism of the actuator is lubricated "for life". In case of high load and high frequency of operation it may be necessary to periodically restore the 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.

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

ENI MU/EP/2 *

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 mm^2/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 Fiorenzuola. 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.

5.2.1 Replacing the Seals of the Cylinder

(Section 7.2 - Figure 41: Hydraulic Cylinder)

- Measure the protrusion edge of the setting-screw (11) referred to the surface of the end flange of the cylinder (13), so to easily restore the calibration (Section 3.4) once the maintenance operations are over
- Remove the locking screw protection (14) and unscrew the mechanical stop (11).
- Unscrew the nuts (16) from tie rods (10) on the side of the end flange. Nuts should be progressively unscrewed all together.
- Remove the end flange (13) and the rod (12).
- Remove the O-rings (3) from their seat in the head flange (2).
- Properly clean the slot and lubricate it with protective oil or with a layer of grease.
- Install a new O-ring (3) in the seat and lubricate again.
- Remove the O-ring (19), the tightness ring of the piston (9) and the guide ring (8) from their slots in the piston.
- Properly clean the seat of the guide ring (8) and lubricate it with a lot of grease so that it keeps the ring in its place at the moment in which the rod is put back in place.
- Properly clean the seat of the O-ring (19) and lubricate it with protective oil or with a layer of grease.
- Install a new O-ring (19) and the ring of the piston (9) in their seats and lubricate them again.
- Properly clean the interior of the rod (12) and check accurately the surface is intact.
- Lubricate the internal surface of the rod and the inlet chamfers.
- Insert the rod on the piston of around half its length, paying attention not to damage the O-ring (19). During this operation, the guide ring of the piston, passing, removes the grease from the rod surface: so lubrication should be carried out.
- Complete the axial motion of the rod until the head flange (2) of the cylinder is reached paying attention not to damage the O-ring (3).

NOTICE

After maintenance operations, carry out a few actuator operations (5 to 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.

-

5.3 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 Section 2.2.

If the actuator needs storage before demolition, see Section 2.3.

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 10. Troubleshooting

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 control group	Call Biffi 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)
	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	Distributor positioned on AUTOMATIC	Position the distributor on the indication of the operation to make
	Lack of oil in the gas-hydraulic tanks	Restore proper oil levels in the tanks (Section 5.1.1)
	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 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 all spare parts requests request to:

Biffi Italia - Spare Parts and After Sales Department

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 40. Scotch Yoke Mechanism

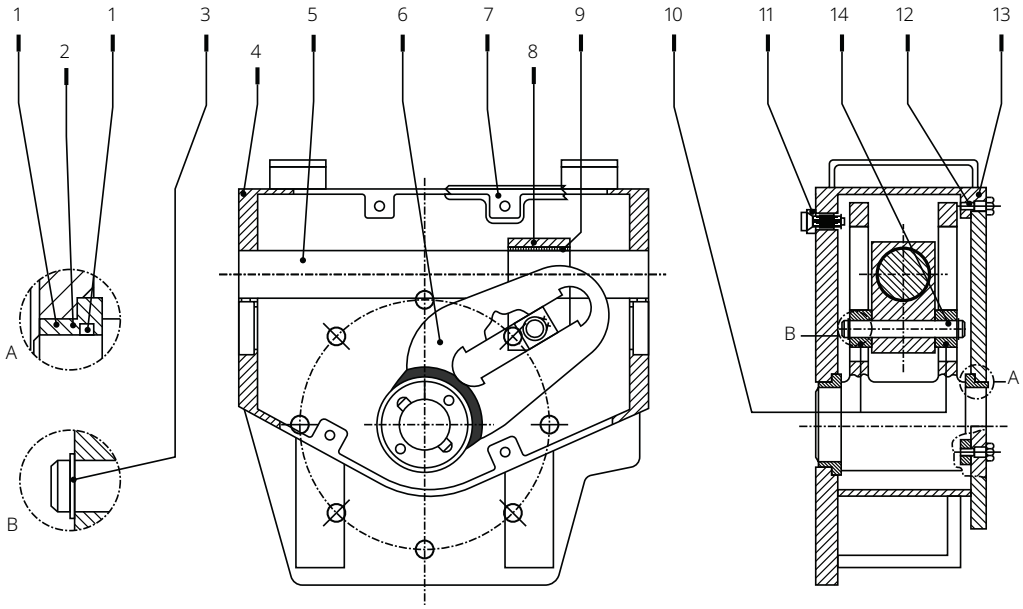


Table 11. Parts List

Item	Quantity	Description	Material
1	4	O-ring	Nitrile Butadiene Rubber (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 + Polytetrafluoroethylene (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 41. Hydraulic Cylinder

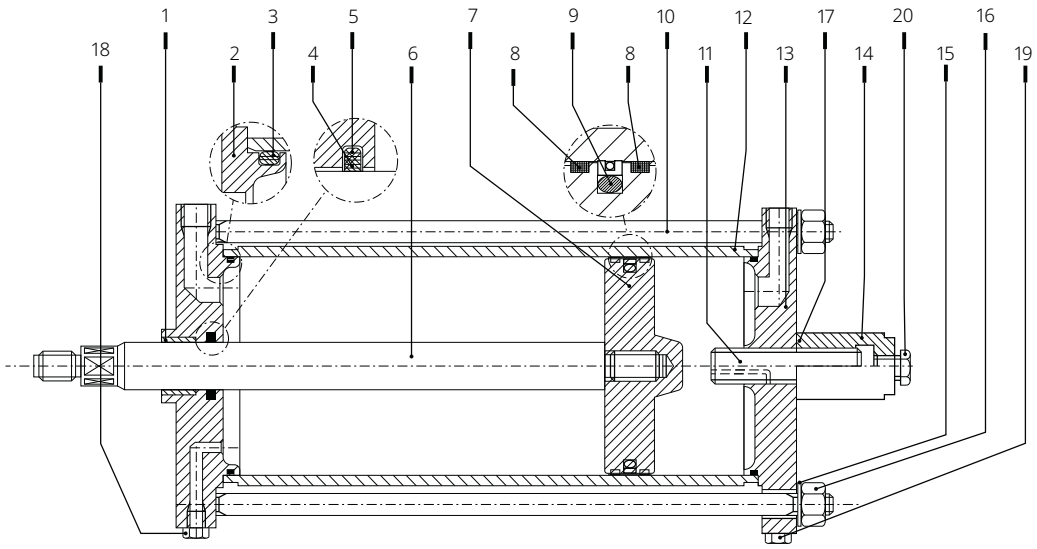


Table 12. Parts List

Item	Quantity	Description	Material
1	1	Piston rod bushing	Steel + Bronze + PTFE
2	1	Head flange	Carbon steel
3	2	O-ring	NBR *
4	1	Piston rod seal ring	PTFE * + Graphite
5	1	O-ring	NBR *
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 *
18	6	Plug	Carbon steel
19	1	Plug	Carbon steel
20	1	Plug	Carbon steel

NOTE:
* Recommended spare parts

Figure 42. Assembly Kit

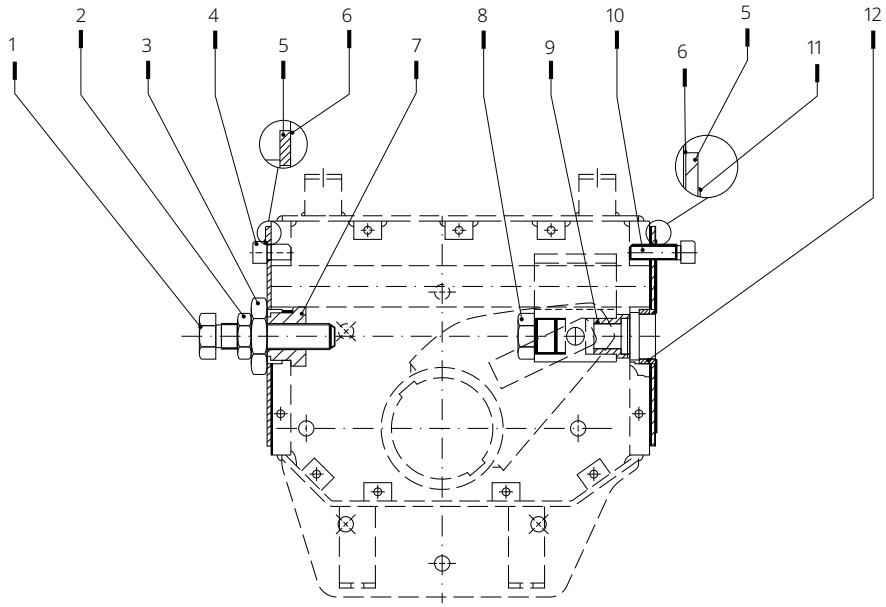


Table 13. Parts List

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 43. Hydraulic Manual Override

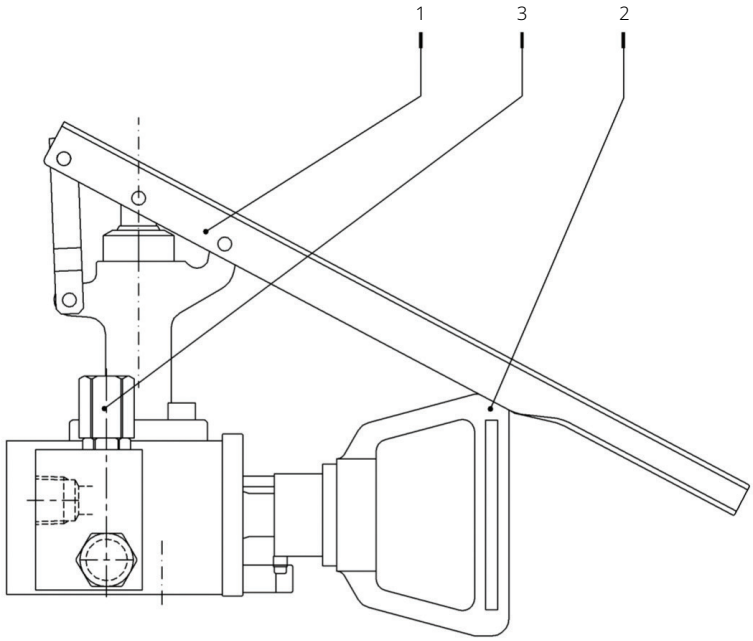


Table 14. Parts List

Item	Quantity	Description	Material
1	1	Hand pump	Carbon steel
2	1	Hand operated directional control valve	Carbon steel
3	2	Hydraulic flow control valve	Carbon steel

Figure 44. Hand Pump

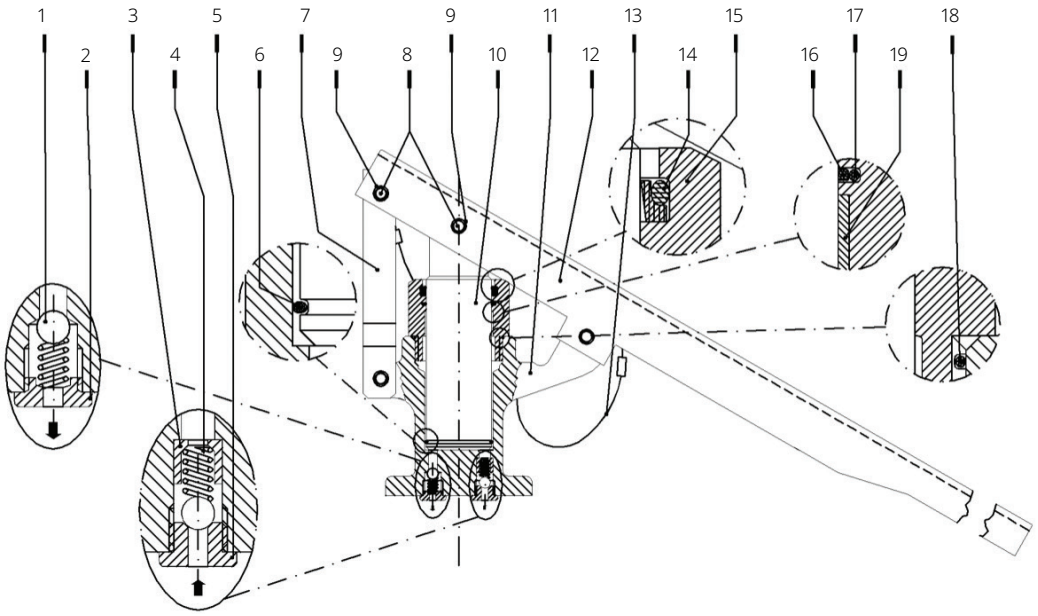


Table 15. Parts List

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	Chromium plated 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	Nitrile rubber *
18	1	O-ring	Nitrile rubber *
19	1	Piston rod bushing	Steel + Bronze + PTFE

NOTE:
* Recommended spare parts

Figure 45. Hand Operated Directional Control Valve

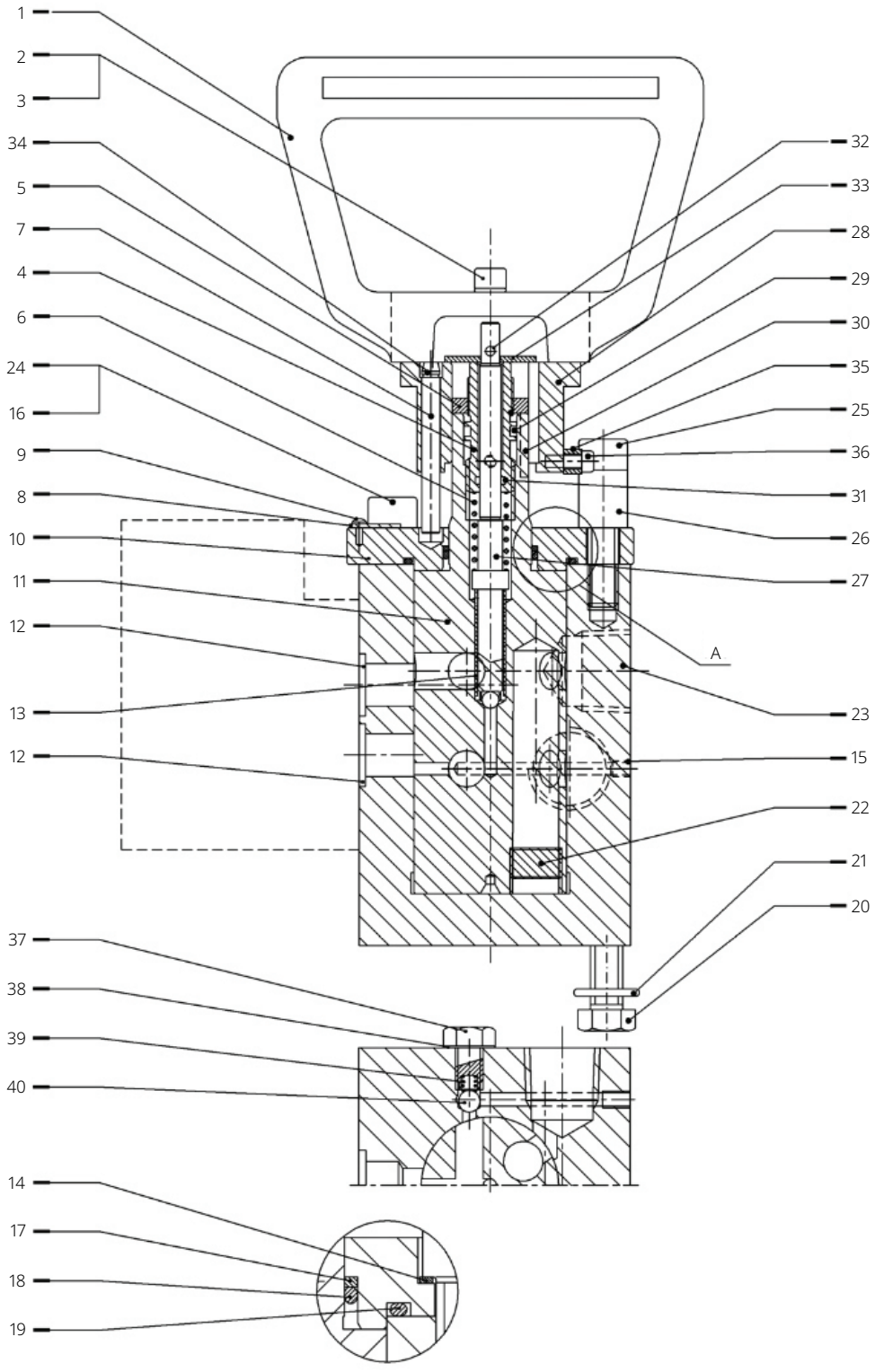


Table 16. Parts List

Item	Quantity	Description	Material
1	1	Handle	Aluminum
2	2	Screw	Carbon steel
3	2	Spring washer	Stainless steel
4	1	Setting screw of relief valve	Bronze
5	1	Lock ring nut	Carbon steel
6	1	Spring	Stainless steel
7	1	Pin	Stainlees steel
8	1	Indicator plate	Stainless steel
9	3	Rivet	Aluminum
10	1	Cover	Stainless steel
11	1	Cylindrical distributor	Alloy steel
12	2	O-ring	NBR *
13	1	Strangling ring	Stainlees steel
14	1	Back-up ring	PTFE *
15	1	Screw	Stainlees steel
16	4	Spring washer	Alloy steel
17	1	Back-up ring	PTFE *
18	1	O-ring	NBR *
19	1	O-ring	NBR *
20	4	Screw	Carbon steel
21	4	Spring washer	Alloy steel
22	2	Screw	Stainless steel
23	1	Body	Carbon steel
24	4	Screw	Carbon steel
25	1	Screw	Carbon steel
26	1	Spacer	Stainless steel
27	1	Operating rod	Stainless steel
28	1	Handle hub	Carbon steel
29	1	O-ring	NBR *
30	1	Key	Stainless steel
31	1	O-ring	NBR *
32	1	Split pin	Stainless steel
33	1	Washer	Stainless steel
34	1	Benzing	Stainless steel
35	2	Spacer	Stainless steel
36	2	Screw	Stainless steel
37	1	Lock ring nut	Carbon steel
38	1	Washer	Stainless steel
39	1	Spring	Stainless steel
40	1	Ball	Stainless steel

NOTE:
* Recommended spare parts

Figure 46. Hydraulic Flow Control Valve

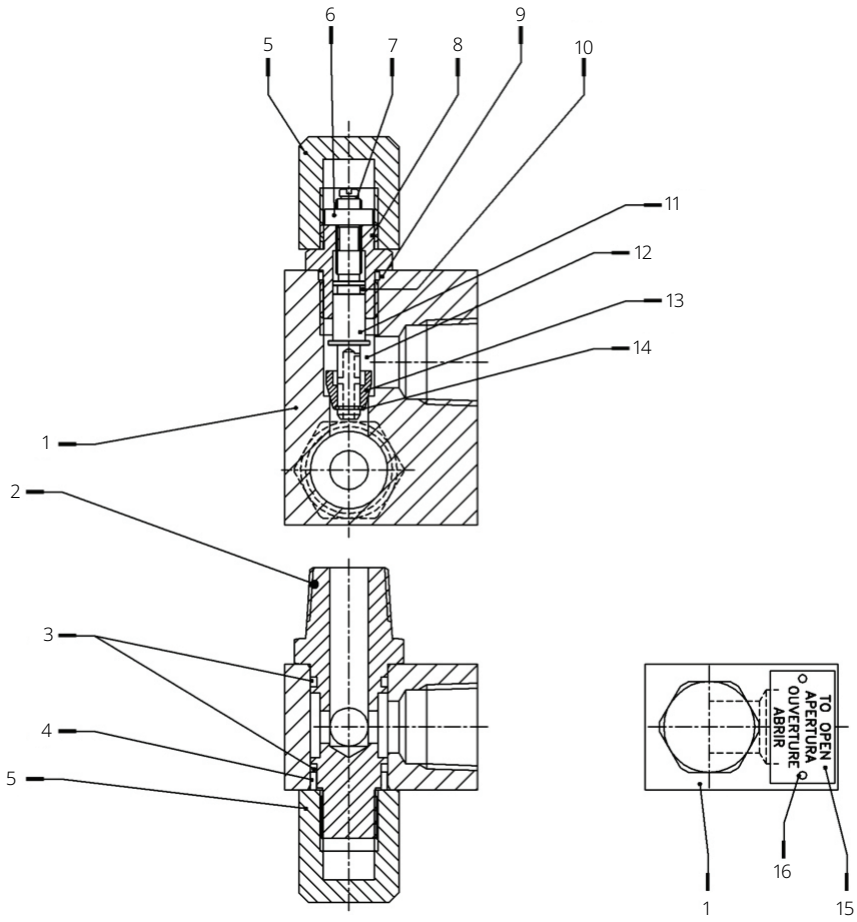


Table 17. Parts List

Item	Quantity	Description	Material
1	1	Body	Carbon steel
2	1	Body	Carbon steel
3	1	O-ring	NBR *
4	1	Seal ring	PTFE * + Graphite
5	2	Nut	Carbon steel
6	1	Nut	Carbon steel
7	1	Retainer ring	Spring steel
8	1	Flow control valve flange	Carbon steel
9	1	O-ring	NBR *
10	1	O-ring	NBR *
11	1	Flow control valve setting screw	Stainless steel
12	1	Spring	Spring steel
13	1	Plug	Stainless steel
14	1	Retainer ring	Spring steel
15	2	Data plate	Stainless steel
16	4	Rivet	Aluminum

NOTE:
* Recommended spare parts

Figure 47. Gas-Hydraulic Tank

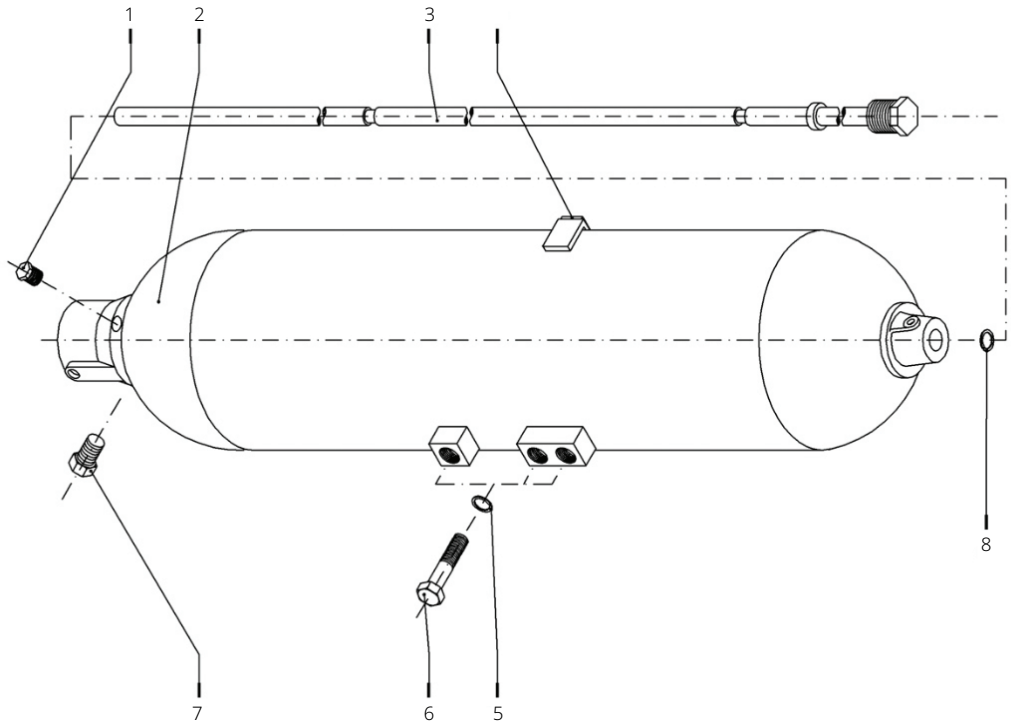


Table 18. Parts List

Item	Quantity	Description	Material
1	1	Plug	Carbon steel
2	1	Tank	Carbon steel
3	1	Level stik	Carbon steel
4	1	Plate	Carbon steel
5	3	Spring washer	Carbon steel
6	3	Screw	Carbon steel
7	1	Plug	Carbon steel
8	1	O-ring	NBR *

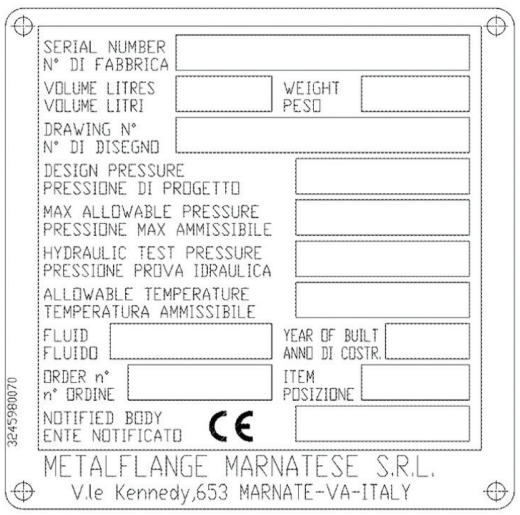
NOTE:
* Recommended spare parts

Section 8: Gas-Hydraulic Tanks

8.1 Installation, User and Maintenance Manual

1. The tank is supplied internally painted on specific demand of the customer and of the manufacturer of the oil-pneumatic driven actuator on which it will be installed. The tank is supplied as per project drawing, without any accessory, as for example: filters, valves, safety valves, gaskets, circulating fluids, etc.
2. After the tank is tested and marked CE, it is forbidden for anyone to make any modification or any variation to the manufacturing features that may alter in some way its safety requirements.
3. If provided for, any inspection openings placed on the tank coat, will be closed with ASTM A105 threaded forged steel plugs adequately sealed before the final hydraulic test. These plugs will be removed only to allow any internal inspections of the tank scheduled every 10 years as of the date of first installation. Openings will be closed again with the same mode as provided for by the first paragraph of Section 1.3.
4. The transportation of tanks marked CE from manufacturer to user, is made in lots of around 5/100 parts according to their capacity, they will be transported with palletized metallic containers paying attention to avoiding shocks that may damage the nozzles and any threaded supports as well as the structural parts of the tank.
5. The user shall check that internal paint is not damaged, and in case renovate it according to the specification supplied.
6. The threads of nozzles and of any threaded supports will be protected for transportation and for the next phase of external sandblasting for painting preparation with adequate PVC plastic plugs easy to remove and recycle after use.
7. It is forbidden to expose the tanks to heat sources > 100 °C if there is no adequate protective coating.
8. Specialized firms in compliance with the regulations in force should dispose of the tank.

Figure 48. Gas-Hydraulic Tank Nameplate



Technical data	
Supply fluid	Natural gas / nitrogen / air
Operating temperature	from -29 to +100 °C
Maximum supply pressure	100 bar

Section 9: 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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