BIFFI ALGA DOUBLE ACTING PNEUMATIC ACTUATOR

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

Before installation these instructions must be fully read and understood

TABLE OF CONTENTS

1 GENERAL WARNINGS

IMPORTANT

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

1.1 Generalities

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

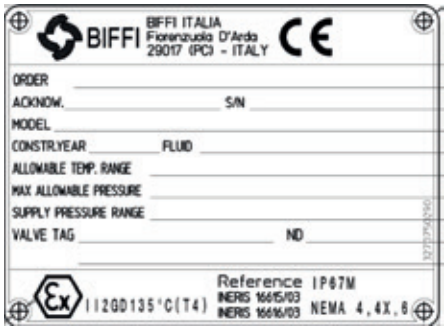
1.1.1 Applicable regulation

EN ISO 12100-1: 2005: Safety of machinery - Basic notions, general design principles. Part 1-Basic terminology, method.
EN ISO 12100-2: 2005: Safety of machinery - Basic notions, general design principles. Part 2-Technical principles and specification.
2006/42/EC: Machine directive.
97/23/EC: Directive for pressure PED equipment.
2006/95/EC: Directive for low voltage equipment.
2004/108/EC: Directive for the electromagnetic compatibility.
94/9/EC: Directive and safety instructions for use in hazardous area.

1.1.2 Terms and conditions

Biffi guarantees that all the items produced are free of defects in workmanship and manufacturing materials and meet relevant current specifications, provided they are installed, used and serviced according to the instructions contained in 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.

FIGURE 1
Data plate



1.2 Identification plate
It is forbidden to modify the information and the marks without previous written authorization by Emerson.
The plate fastened on the actuator contains the following information (figure 1).

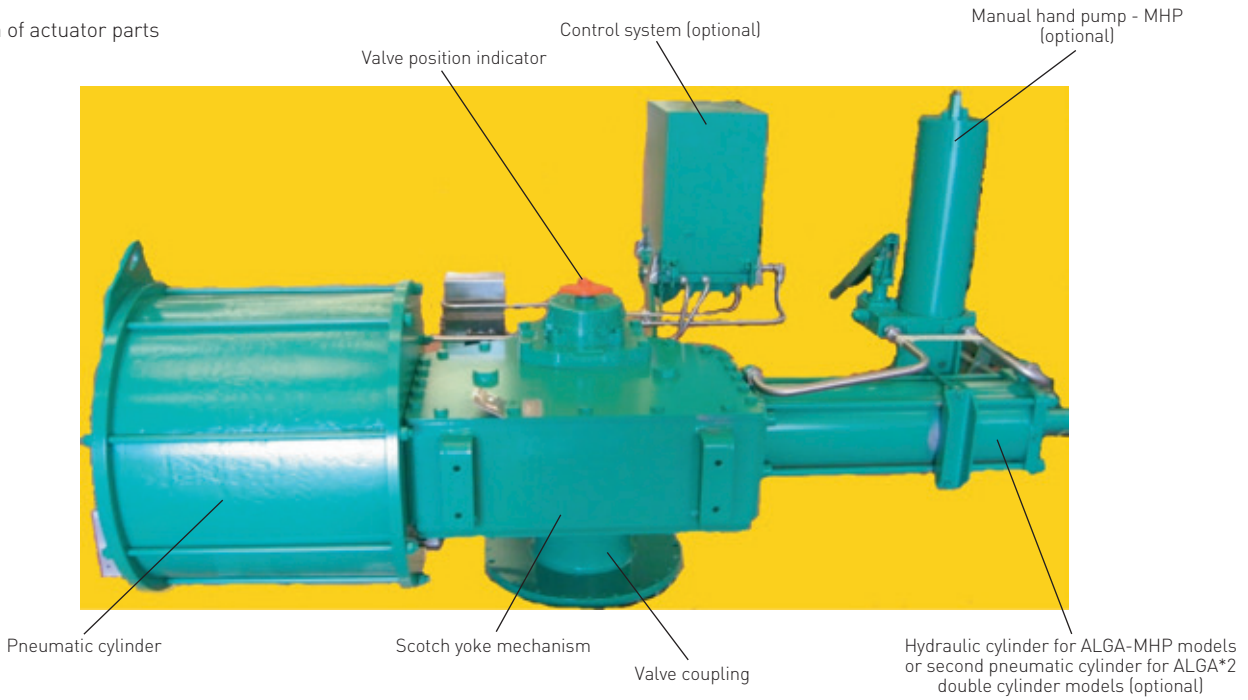
1.3 Introducing the actuator
The ALGA actuator is engineered and manufactured to provide maximum torque output with minimum supply pressure.
ALGA actuators are suitable for the operation of any quarter turn operation such of ball, plug, butterfly valves or dampers, in both On-Off and Modulating heavy duty service.

The actuator (see figure 2) is made up of a weatherproof Scotch yoke mechanism transforming the linear movement of the pneumatic cylinder (on closing or opening) into the rotary movement, which is necessary for operation. The angular stroke of the yoke is adjustable between 82° and 98° by means of the external mechanical stops screwed into the left wall of the mechanism housing and into the end flange of the pneumatic cylinder. The cover of the Scotch yoke mechanism is arranged for the assembly of the required accessories (positioner, signalling limit switches, position transducer, etc.) by means of proper matching units. The above mentioned accessories are operated by the actuator drive sleeve. The housing of the Scotch yoke mechanism has a flange with threaded holes to fix the actuator to the valve either directly or, if required, with the interposition of an adaptor flange or a mounting bracket. The actuator yoke has a hole with keyways suitable for the assembly of an insert bush the internal hole of which is machined (by Biffi or at customer's care), according to the shape and dimensions of the valve stem. Biffi can supply different types of control system following customer's requirements.
The expected lifetime of actuator is approximately 30 years.

1.4 Data sheet

Supply fluid	Air, nitrogen or sweet gas, special version available for sour gas
Operating temperature	Standard: from -30°C to +100°C Optional: from -60° to +200°C
Supply pressure	Please refer to technical document: 'Actuator data sheet'
Output torque	Up to 750,000 Nm (higher value with special version)

FIGURE 2
Identification of actuator parts



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 order confirmation (section 1.2).
- Check that the actuator is equipped with the fittings as provided for by order confirmation.
- Check that the actuator was not damaged during transportation: if necessary renovate the painting according to the specification reported on the order confirmation.
- If the actuator is received already assembled with the valve, its settings have already been made at the factory.
  If the actuator is delivered separately from the valve, it is necessary to check, and, if required, to adjust, the settings of the mechanical stops (section 3.3) and of microswitches (if any) (section 3.4).

2.2 Actuator handling

IMPORTANT
The lifting and handling should be made by qualified staff and in compliance with the laws and provisions in force.

WARNING
The fastening points are appropriate for the lifting of the actuator alone and not for the valve and actuator assembly.
Avoid that during the handling, the actuator passes above the staff.
The actuator should be handled with appropriate lifting means. The weight of the actuator is reported on the delivery bill.

2.3 Storage

If the actuator needs storage, before installation follow these steps:

- Place it on a wood surface in order not to deteriorate the area of 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 outdoor:

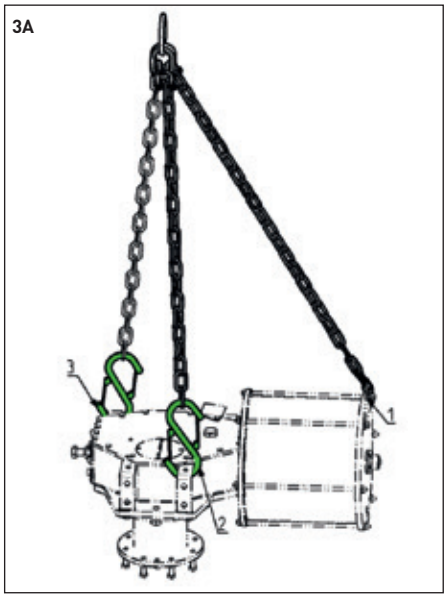
- Keep the actuator protected from direct weather conditions.
- Replace plastic plugs of pneumatic and electrical connections (if any) with metal plugs that guarantee perfect tightness.
- Coat with oil, grease or protection disc, the valve coupling area.
- Periodically operate the actuator (section 3.3).

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 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 can not 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 (see next pages).

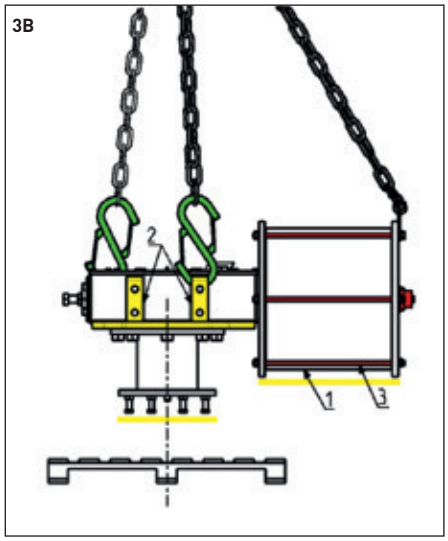
FIGURE 3A, 3B
Lifting points for ALGA / ALGA-MHP / ALGA-MSJ actuators

3A



1, 2 = Lifting points (obligatory)
3 = Balancing point

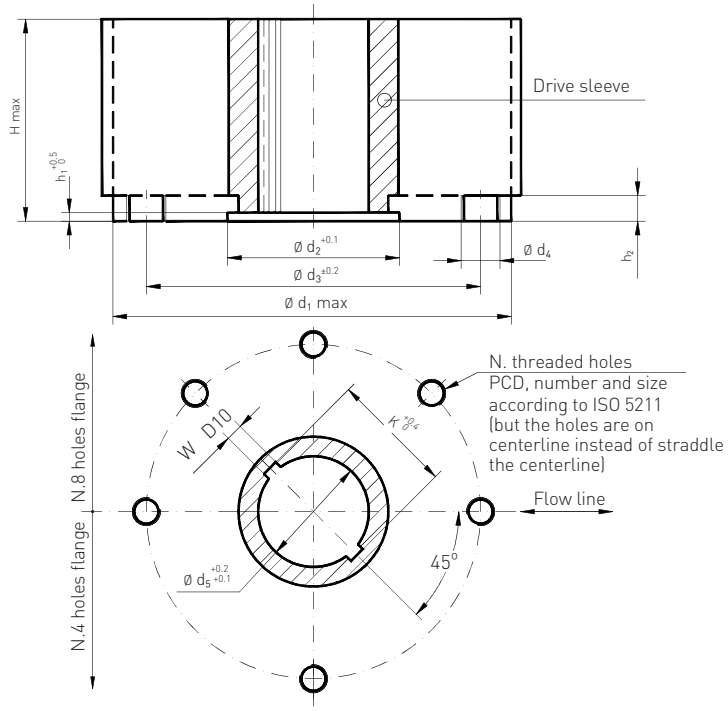
3B



1 = Point of support
2 = Supports for lateral positioning

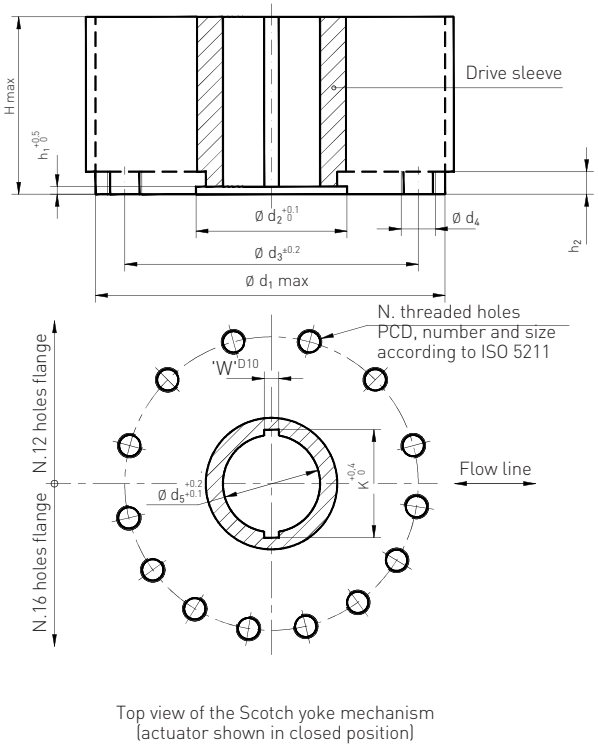
WARNING
3 = Do not lay the actuator on tie rods of cylinder /s and do not lay the actuator on accessories (manual hand pump, manual jackscrew, pneumatic control group etc.)

FIGURE 4A
Actuator models 0.3 to 6



Top view of the Scotch yoke mechanism
(actuator shown in closed position)

FIGURE 4B
Actuator models 14 to 42



Top view of the Scotch yoke mechanism
(actuator shown in closed position)

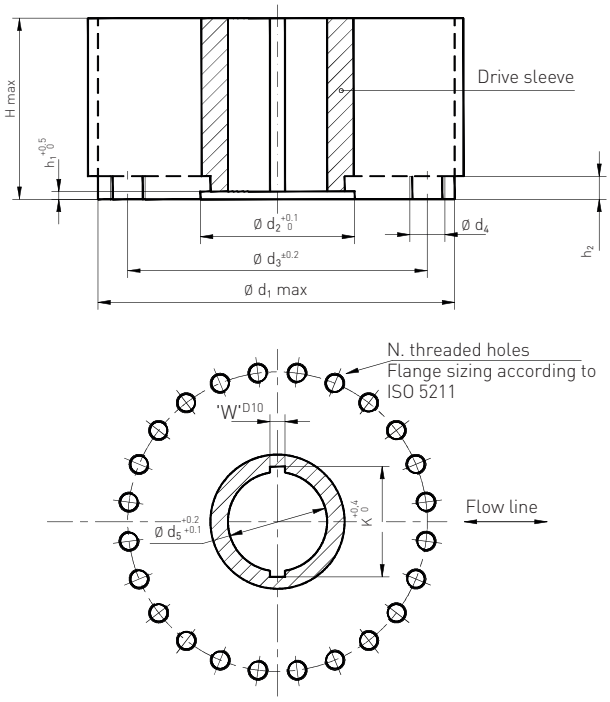
COUPLING DIMENSIONS MODELS 0.3 TO 0.6 (mm)

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	96.6
1.5	360	144	298	M20	8	6	19	190	112	18	119
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

COUPLING DIMENSIONS MODELS 14 TO 42 (mm)

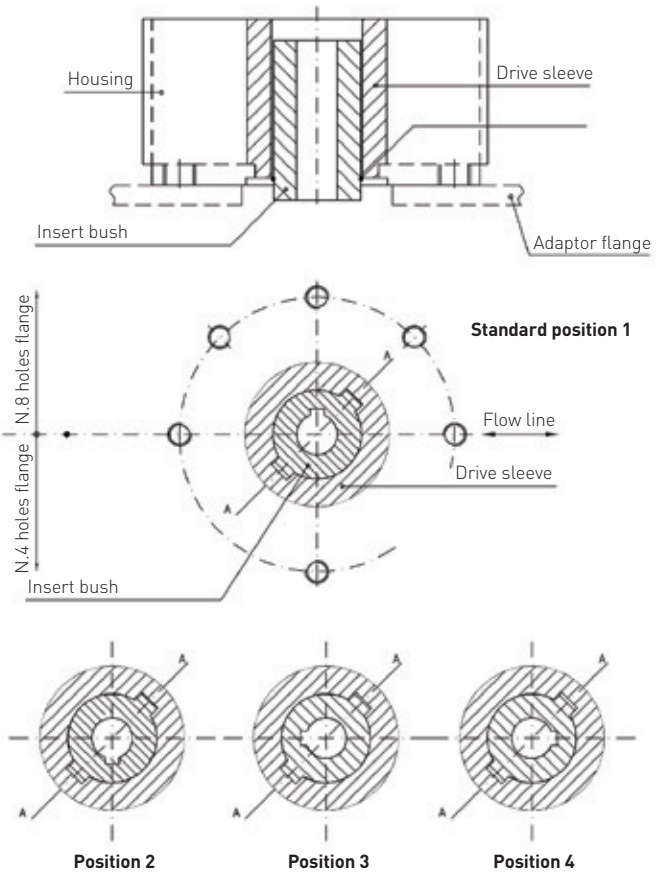
Actuator model	Ø d_1	Ø d_2	Ø d_3	Ø d_4	N	h_1	h_2	H max	Ø d_5	W	K
14	580	250	483	M36	12	10	29	340	175	45	195.8
18	680	290	603	M36	16	12	32	350	200	45	220.8
32	780	290	603	M36	16	12	32	400	220	50	242.8
35	780	315	603	M36	16	11	32	400	240	50	242.8
42	840	310	603	M36	16	12	32	400	220	50	242.8

FIGURE 4C
Actuator models 50 and 60



Top view of the Scotch yoke mechanism
(actuator shown in closed position)

FIGURE 4D
Insert bush + intermediate coupling flange



COUPLING DIMENSIONS MODELS 50 AND 60 (mm)

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 un-machined 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 doc.: TN1005. The particular execution of the flange and bushing allow the actuator to be rotated by 90° in 4 different positions according to figure 4D.

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.

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	

2.4.2 Assembly procedure

IMPORTANT
Failure to comply with the following procedures may impair 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:

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

- Operate the actuator so that it reaches the position matching valve position (section 3.3).
- Lubricate valve stem with oil or grease.
- Properly clean and remove grease from coupling flange surfaces.
- Connect, if supplied separately, the adjustment insert to valve stem and fasten it with the special fastening pins.
- Lift the actuator using the special lifting points (section 2.2).
- Install the actuator so that valve stem inserts in the coupling area. This coupling should be made without forcing.
- Fasten the two parts with the threaded connections (screws, tie rods, nuts). If holes of coupling flanges are not aligned, adequately operate the actuator if necessary move the mechanical stops backwards (section 3.3).
- Fasten threaded connections. Please refer to table 1.

The screwing values in table 1 were calculated considering the materials ASTM A320 grade L7 for screws or tie rods and ASTM A194 grade 2H for the nuts.

TABLE 1 - 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

2.5 Pneumatic connections

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

WARNING
The connections should be made by qualified staff. Use pipes and connections appropriate as for type, 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.
- Mould 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)

IMPORTANT
Use components appropriate as for type, material and dimensions.

WARNING
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.
2004/108/EC: Directive for the electromagnetic compatibility.
94/9/CE: Directive and safety instructions for use in hazardous area

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.

2.7 Commissioning

WARNING
Check that values of electrical supply to the control group (if foreseen) are compatible with those on the plate on the junction box (figure 5). Installation, commissioning and maintenance and repair works should be made by qualified staff.

FIGURE 5
Junction box on control group (if foreseen)

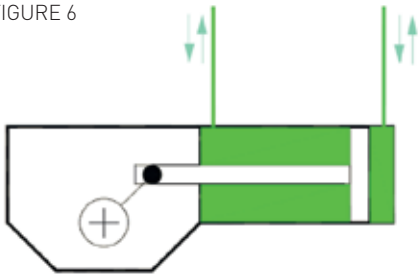
Upon actuator commissioning please carry out the following checks:
- Check that paint is not be damaged during transport, if necessary repair the damages to paint coat.
- Check that the pressure and quality of the gas supply (filtering degree, dehydration) are as prescribed. Check that the feed voltage values of the electric components (solenoid valve coils, microswitches, pressure switches, etc.) are compatible with those reported on the identification plate of the actuator (figure 1).
- Check that the setting of the components of the actuator control unit (pressure regulator, pressure switches, flow control valves, etc.) meet the plant requirements.
- Carry out all kinds of operations and check their proper execution (section 3.3).
- Check the absence of leakages in the pneumatic connections. If necessary tighten the nuts of the pipe-fittings.
- Check proper operation of all the due signalling (valve position, gas supply pressure etc.).
- Make a complete functional test in order to verify all the operations are executed according to operating schematic diagram supplied.

3 OPERATION AND USE

3.1 Operation description

In the normal operating situation, the ALGA actuator is fed by pressurized gas which flows into the relevant cylinder chamber (for example opening). The cylinder piston stroke causes the actuator operation and the consequent valve movement to the operational position requested (in this case to the 'open' position). Upon a demand, the closing chamber the cylinder is fed by pressurized gas and at the same time the gas is discharged from the open chamber into the return line: the actuator performs the closing operation driven by the piston movement, and the valve moves from the open position to the close (safety-related) position.

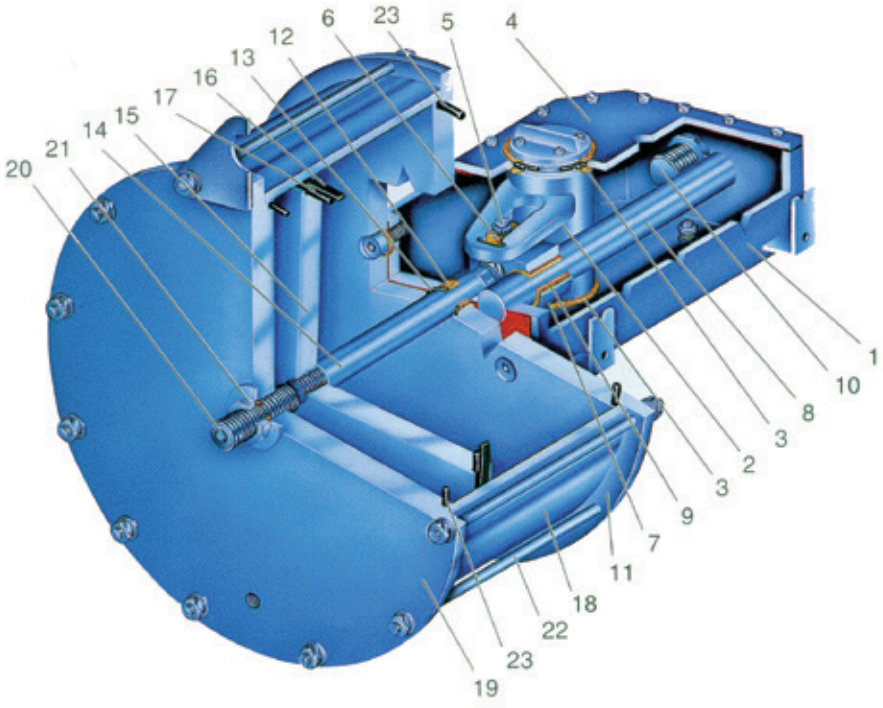
FIGURE 6



Pneumatic connection

For local or remote operations, please refer for information only to section 3.3 and prior to technical documentation furnished with actuators.
Typical schematics for various applications are follow attached for information only, the function described are furnished only on specific customer demand.
For all the relevant information please refer to the specific technical documentation supplied with actuators.

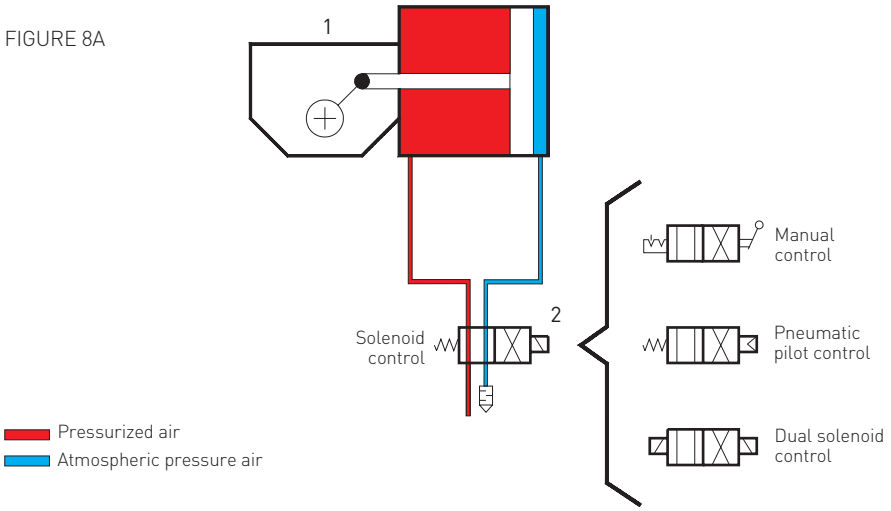
FIGURE 7



PARTS LIST

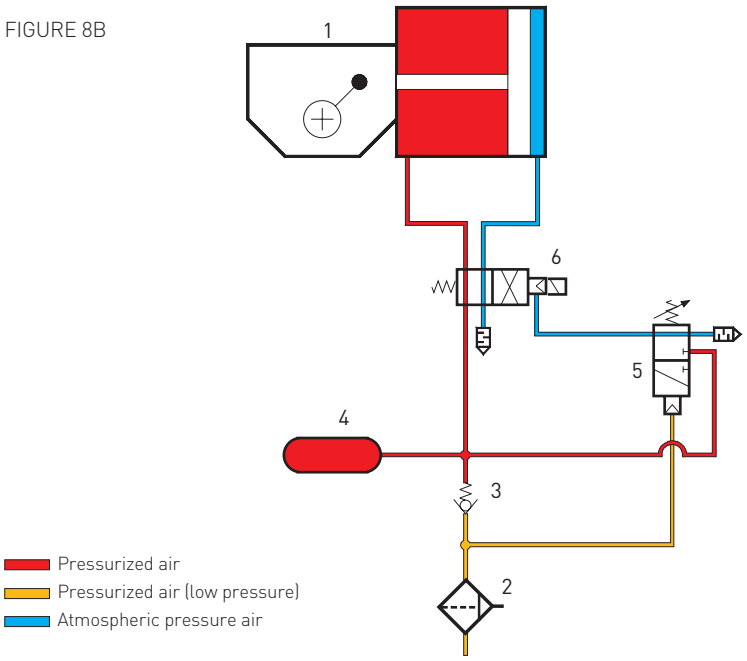
Item	Name
1	Housing
2	Yoke
3	Yoke bushing
4	Cover
5	Guide block pin
6	Sliding block
7	Guide block
8	Guide bar
9	Guide block bushing
10	Travel stop screw
11	Cylinder head flange
12	Piston rod bushing
13	Piston rod seal
14	Piston rod
15	Piston
16	Piston guide sliding ring
17	Piston seal ring
18	Cylinder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

FIGURE 8A



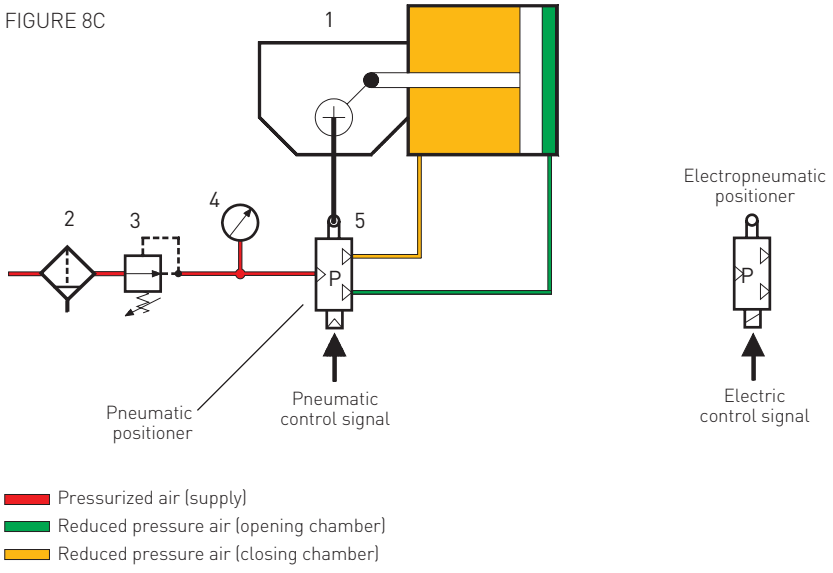
On-Off service: four way control valve
The diagram shows the simplest On-Off control. The gas supply pressure is applied to one side of the cylinder and exhausted from the opposite side. When the control valve (2) is actuated the connection of supply and exhaust to the cylinder chambers are reversed. The control valve can have many types of actuating devices (solenoid, manual control, pneumatic pilot, spring, etc.). The spring return control valves allow 'fail safe' operation.

FIGURE 8B



On-Off service: air fail safe system
The system allows 'fail safe' operation when the pressure in the gas supply line drops below a set value. The diagram shows the actuator in the 'fail safe' condition. When the gas supply pressure drops below the pressure switch (5) set point, the pneumatic supply to the solenoid valve (6) pilot is exhausted and the actuator moves to the 'fail safe' position by using the gas stored in the tank (4).The tank is connected to the gas supply through the check valve (3).

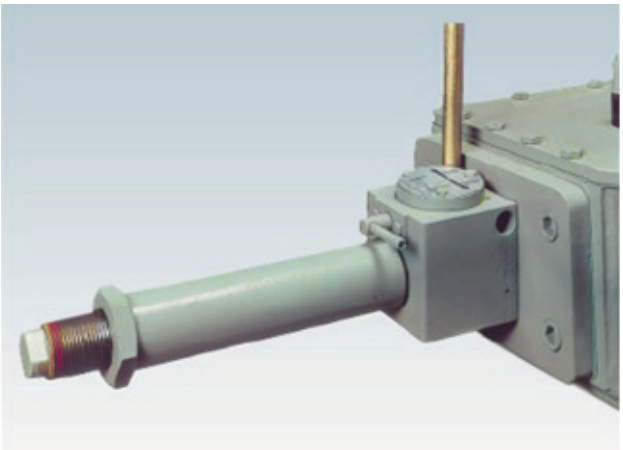
FIGURE 8C



Modulating service
When modulating control is required as a function of a pneumatic or electric control signal, a positioned (5) is used, which controls the supply to the actuator cylinder to keep the valve in the required angular position.
The positioner has a mechanical linkage to the actuator, for a feedback of the valve position.

The MHW - MSJ jackscrew manual override can be supplied for model up to 3. The override is mounted on the left side of the actuator, the jackscrew end is screwed into the guide block. A bronze split screw nut is mounted inside the body. By rotating the engagement lever, the screw nut is engaged with the jackscrew. When the screw nut is engaged with the jackscrew manual operation follows by rotating the body of the screw container by a lever (for MSJ models) or by a handwheel (for MHW models).

FIGURE 9A
Emergencency manual override



The MHP hydraulic manual override is used to manually operate the actuator in lack of air supply. It also allows to accurately adjust the actuator operating times, independently in opening and in closing, by way of the hydraulic regulators which work on the oil flow from one chamber to the other of the hydraulic cylinder during pneumatic operation. Moreover it permits a smooth angular speed all along the stroke. During manual operation the flow regulators are by-passed to make the force on the hand pump lever easy. The MHP unit consists of a hydraulic cylinder mounted directly on the actuator. The piston rod end is screwed into the guide block. The compact hydraulic control unit consists of a hand pump, directional control valve, oil tank, relief valve and two unidirectional flow regulators. The directional control valve has three operating positions: 'remote': the actuator is operated by pneumatic supply; 'to open': the actuator operation is opening by hand pump. On request the hydraulic manual override type MHP2 (double hand pump version) can be supplied, which allows the remote control to automatically override manual operation.

FIGURE 9B
MHP hydraulic manual override

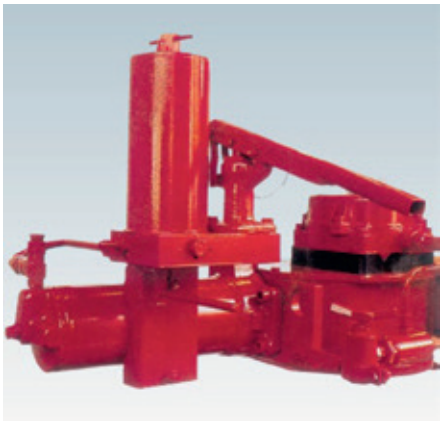


FIGURE 10A - Pneumatic operation
The diagram is drawn with actuator under pneumatic operation in opening.
The flow regulator Fa allows control of the stroke time.

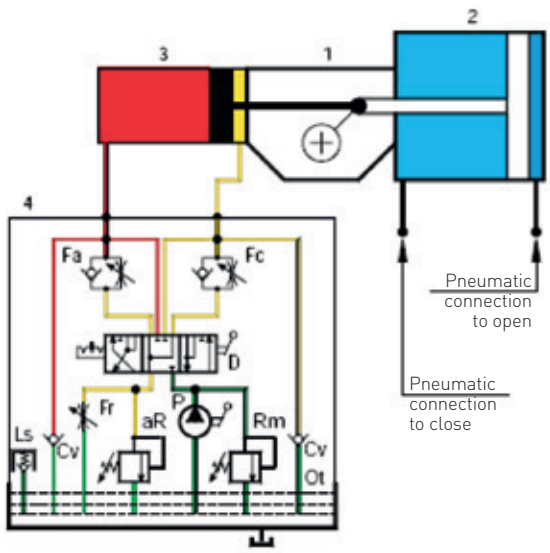
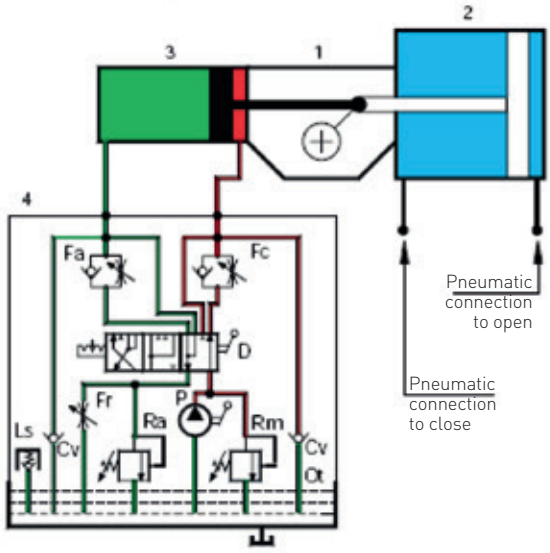


FIGURE 10B - Manual operation
The diagram is drawn with actuator under manual operation towards open.
The operation to be performed is selected by the directional control valve D.



1 – Scotch yoke mechanism
2 – Pneumatic cylinde
3 – Hydraulic cylinder
4 – Hydraulic manual override
– High pressure oil
– Intermediate pressure oil
– Low pressure oil
– Pressurized air
– Atmospheric pressure air

Ra = Relief valve for automatic operation
Rm = Relief valve for manual operation
P = Hand pump
D = Hand operated directional control valve
Fa = Unidirectional flow regulator (opening operation)
Fc = Unidirectional flow regulator (closing operation)
Fr = Bidirectional flow regulator
Cv = Check valve
Ot = Oil tank
Ls = Level stick with relief valve

3.2 Residual risks

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

3.3 Calibration of the angular stroke
The angular stroke of the yoke can be adjusted between 82°÷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) (figures 11A and 11B).

In case of an actuator with two cylinders (figure 12), both mechanical stops are screwed on the end flanges of the cylinders.

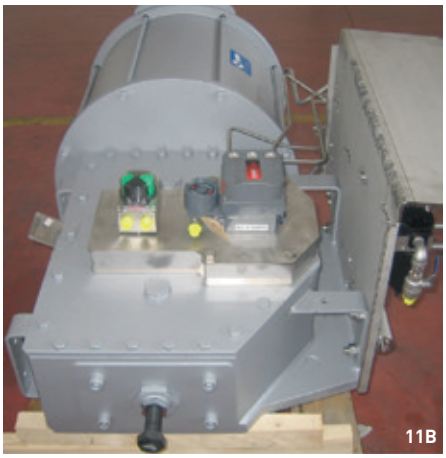


FIGURE 11A, 11B
Mechanical stops

FIGURE 12
Actuator with two cylinders

For the adjustment of the travel stop screws proceed as follows (see figures 13A, 13B):

1. Loosen the lock nut (2) with a proper wrench (c2).
2. If the actuator angular stroke is stopped before reaching the end position (fully open or closed), unscrew the stop screw (1) by turning it anticlockwise with a proper wrench (c1) , 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 (3) does not withdraw together with the screw.
3. If the actuator angular stroke is stopped beyond the end position (fully open or closed valve), screw the stop screw by turning it clockwise until the valve reaches the right position.
4. Tighten the lock nut (2).

Pneumatic cylinder size	Wrench c1 (mm)	Wrench c2 (mm)
85	30	41
100	30	41
135	30	30
175	30	30
235	30	30

Pneumatic cylinder size	Wrench c1 (mm)	Wrench c2 (mm)
280	17	55
335	17	55
385	17	55
435	17	55
485	17	55
535	17	55
585	17	55
635	17	55
735	17	55
785	17	55
835	17	55
885	17	55
935	17	55
1000	17	55
1100	17	55
1200	17	55
1300	17	80
1450	17	80

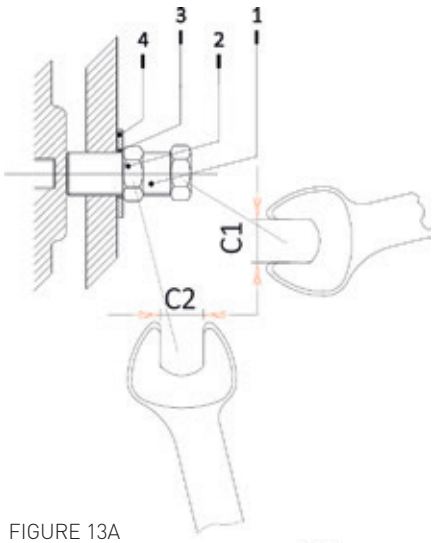


FIGURE 13A

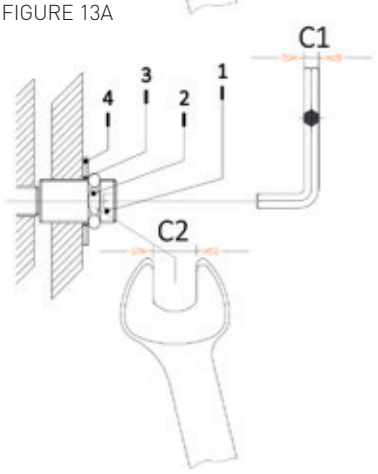


FIGURE 13B

For the adjustment of the mechanical stop srewed into the left side of housing, follow these steps (figures 11 and 14A):

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

Actuator model	Wrench c1 (mm)	Wrench c2 (mm)
0.3	30	30
0.9	30	30
1.5	41	41
3	41	41
6	46	46

Actuator model	Wrench c1 (mm)	Wrench c2 (mm)
14	17	60
18	17	60
32	17	60
50	17	60

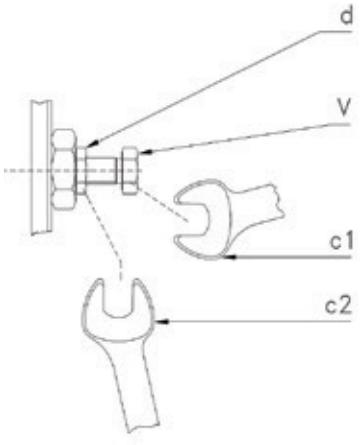


FIGURE 14A
Mechanical stop on the housing

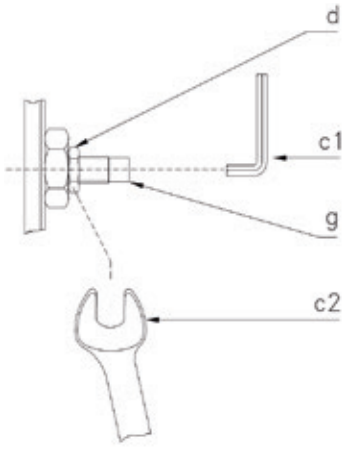
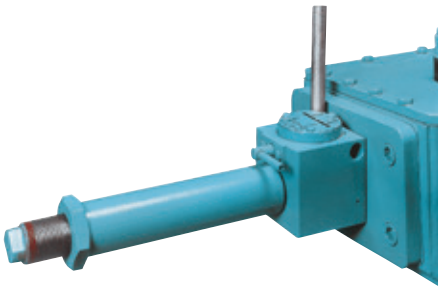


FIGURE 14B
Mechanical stop on the housing

FIGURE 15
Optional (if foreseen)



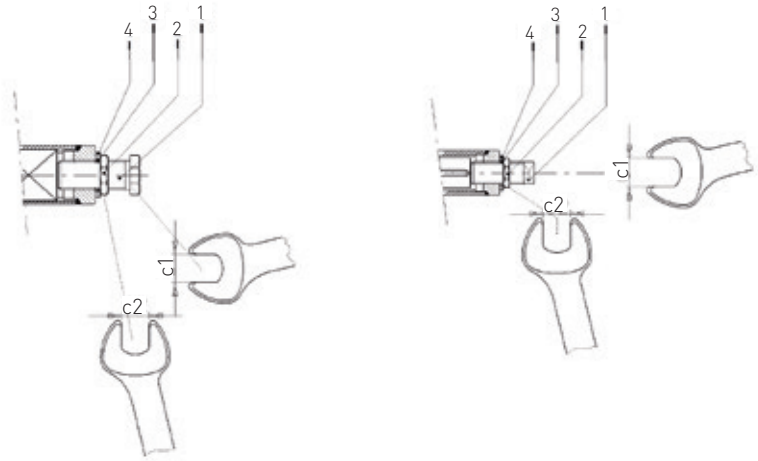
For the adjustment of the mechanical stop screwed on the end flange of manual override (see section 7.2 figure 33: sectional drawing for manual jackscrew MSJ - MHW).

FIGURE 16
Optional (if foreseen)

For the adjustment of the mechanical stop on the end flange of hydraulic cylinder of MHP, follow these steps (figure 18):

- 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 counter-clockwise to increase the angular stroke, turn clockwise to decrease it.
- When the adjustment is over tighten the plug (t).

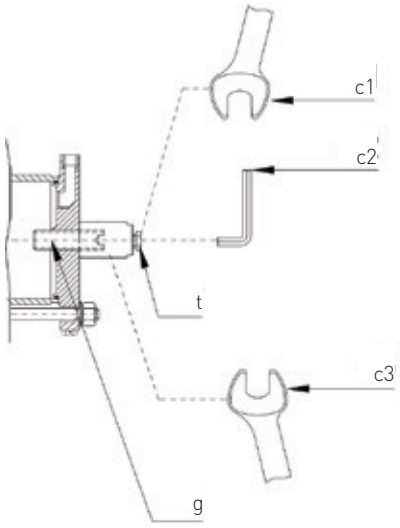
FIGURE 17
Mechanical stop on the end flange of manual override



Actuator size	Wrench c1 (mm)	Wrench c2 (mm)
0.3	34	34
0.9	34	34

Actuator size	Wrench c1 (mm)	Wrench c2 (mm)
1.5	24	65
3	24	65

FIGURE 18
Mechanical stop of the MHP cylinder



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

3.4 Calibration of microswitches (with safety instructions for limit switch box)

If the actuator is delivered separately from the valve, it is necessary to check, and, if required, to adjust, the settings of the position signalling microswitches.

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

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

IMPORTANT
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.

WARNING
Do not open when energized or when an explosive atmosphere is present.

WARNING
Electrostatic hazard, clean only with damp cloth.

3.5 Calibration of the operating time (optional - if foreseen)

The calibration of the operating time is made according to customer requirements and to technical data sheet included in technical documentation. If necessary it's possible to modify or reset the operating time through two flow regulation valves placed between the control valves enclosure and the pneumatic cylinder (figure 28).

To carry out the adjustment, use an adequate Allen wrench and follow these steps (figure 28):

- Loosen the locknut.
- Screw with a screwdriver the setting screw to increase the operating time.
- Unscrew with a screwdriver the setting screw to decrease the operating time.
- After the adjustment is over screw the locknut.

For ALGA actuator models with manual hand pump (MHP), the operating time is adjustable through two regulation valves placed on manual hand pump body (see section 7.2 figure 37: sectional drawing for hydraulic control unit MHP).
To carry out the adjustment, use a suitable Allen wrench and follow these steps (figure 14B):

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

FIGURE 28
Example of operating time adjustment (if foreseen)

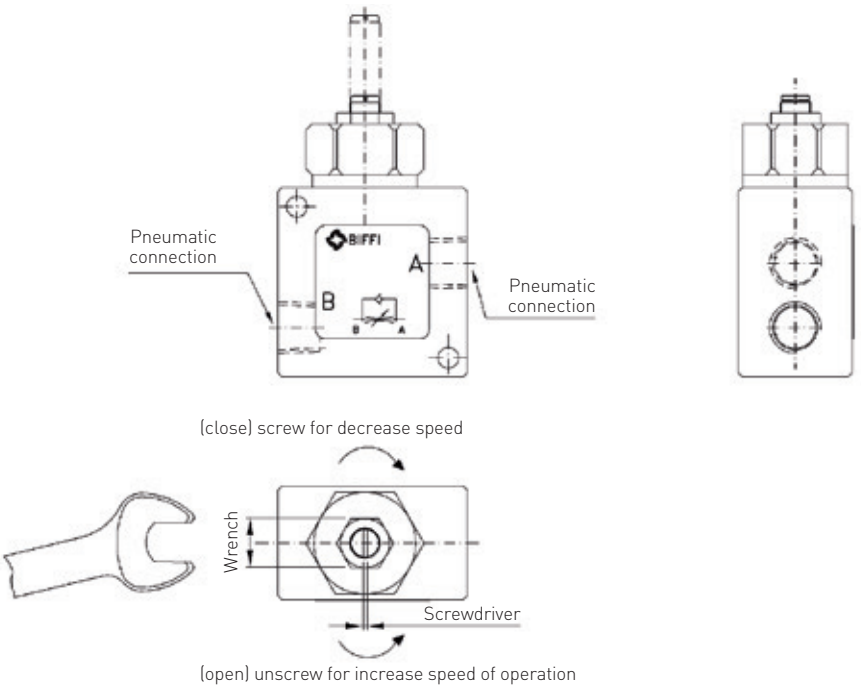
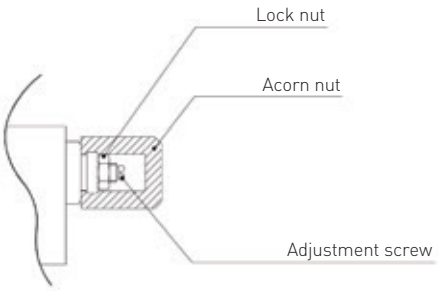


FIGURE 29
Flow regulators placed on manual hand pump - MHP (optional - if foreseen)



4 OPERATIONAL TESTS AND INSPECTIONS

IMPORTANT
To ensure the guaranteed SIL Level, according to IEC 61508, the functionality of actuator must be checked with regular intervals of time, as described following.

For safety related applications, the following test operation has to be performed:
1. Full stroke of actuator once a year.
2. Partial stroking test at least every six months (if applicable, please refer to operating diagram and operate accordingly).
3. Visual inspection-checks , according to section 5.1, but with a frequency of once a year.

For standard applications please refer to section 5.1.

5 MAINTENANCE

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

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

5.1 Periodic maintenance

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

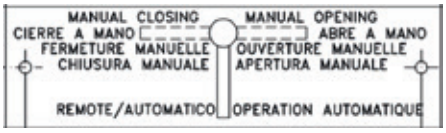
IMPORTANT
Periodicity and regularity of inspections is particularly influenced by specific environmental and working conditions.
They can be initially determined experimentally and then be improved according to actual maintenance conditions and needs.

Anyway every 2 years of operation the following is recommended:
- 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 (refer to specific operating diagram, in technical documentation furnished with actuators).
- Check there are no hydraulic or pneumatic leakages.
- Check oil level (figure 29) into the hydraulic control unit (see section 5.1.1)

FIGURE 29
Level measuring stick

- Check the actuators did not undergo accidental damage with oil leakages found on site (section 4.1.1).
- Check that 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 mechanical filter of the supply gas (refer to section 5.1.2)

5.1.1 Check and restore oil level in the hydraulic manual override
(refer to section 7.2 figure 37)
- Operate the distributor lever to 'closing manual operation'.
- Move the actuator into his 'fail to close' position.
- Unscrew the dipstick (1).
- Check that the oil level into the tank (4) is in correspondence of the 'MAX LEVEL' notch of the dipstick.
- Screw and tighten the dipstick.
- If necessary substitute or add the oil, proceeding as follows:
- Remove the dipstick (1) from the tank cover (22).
- Unscrew the plug (27) and the washer (9) to drain all the oil.
- If some dirt or/and sludge is found in the oil drained from the tank, before filling with new oil in the tank, disassemble the oil tank tube, by unscrewing the two cap nuts (2), and clean the internal surfaces of the tank. If necessary substitute the gaskets (21) of the tank.
- Replace the plug (27) and the washer (9) into the plate (11) and tighten.
- Pour the new oil into the tank through the dipstick hole (1) on the cover (22).
- Replace the dipstick (1).
- Add oil (refer to table 2) if in the tank the oil level is BELOW THE MINIMUM (figure 29: minimum level is in correspondence to the end of dipstick) until to reach the optimal (MAXIMUM) oil level.
- Operate the distributor lever to 'Remote' position.



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

TABLE 2
Features of hydraulic oil suggested for refilling in different working conditions

Standard temperature conditions (-30°C/+85°C)	
Producer	AGIP
Name	ARNICA 22
Viscosity at 40°C	20.9 mm²/s
Viscosity at 100°C	4.73 mm²/s
Viscosity index ASTM	153
Flash point	192°C
Pour point	-42°C
Specific weight (at 15°C)	0,857 kg/l
Equivalent oils	SHELL TELLUS PLUS 22
	CHEVRON HYDRAULIC OIL AW ISO 22
	MOBIL DTE22
	EXXON UNIVIS N22
	EQUIVIS ZS22
	BP ENERGOL HLP-HM22
	CASTROL DYSPIN AWS22
Low temperature conditions (down to -46°C)	
Manufacturer	SHELL
Name	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	5.3 cST
Viscosity index (ISO 2909)	>200
Flash point	105°C
Pour point	<-60°C
Specific weight	0.87 kg/dm³
(Or equivalent)	
Low temperature conditions (down to -60°C)	
Manufacturer	SYNTESIS
Name	SYNTRASS-CS 500
Viscosity at -60°C	580 cST
Viscosity at -30°C	39cST
Viscosity at 20°C	5.8 cST
Viscosity at 50°C	2.1 cST
Flash point	152°C
Pour point	-68°C
Specific weight	0.897 kg/dm³
(Or equivalent)	

5.1.2 Gas supply dehydrating filter maintenance (if foreseen)

The gas supply filter is fitted with a mechanical filter and a drain valve to discharge periodically the water generated by the condensation of the humidity inside the gas supply.

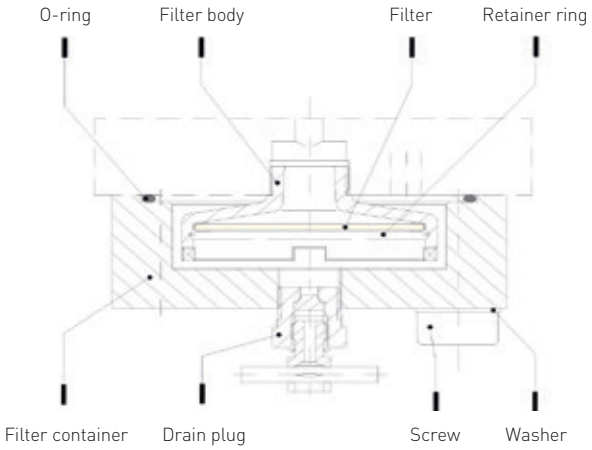
During the routine maintenance it is recommended to check and clean the mechanical filter and replace it in case of heavy dirty conditions.

To disassemble the filter proceed as follows:

a. close the stop valve at the inlet of pressure supply line;
b. discharge the pressure from the drain valve;
c. Remove the lover enclosure screws,
d. remove the mechanical filter;
e. clean or replace the filter;

Reinstall all parts carefully paying attention to avoid any damage to the O-ring.

FIGURE 30



5.2 Extraordinary maintenance
If there are leaks in the hydraulic cylinder, pneumatic 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 following general sectional drawing and adopting the following procedures.

5.2.1 Replacement of cylinder seals
(refer to figure 31)

IMPORTANT
Before executing any maintenance operation, it is necessary to intercept the supply line and discharge pressure from the cylinder of the actuator.
If the actuator can be operated, it is essential to take it to fail safe position, otherwise the actuator should be disassembled from the valve and follow these steps:

1. Remove the nuts (16) and the washers (24) from the tie rods (18) at the end flange (22) side.
2. Slide off the end flange (22) and the tube (19).
3. Remove the screw (2) and the cover (1).
4. Unscrew the piston rod (20) threaded end from the adaptor bush (30) of guide block (14).
5. Slide off the piston rod (20) from the head flange (17).
6. Disassemble the head flange (17) from the mechanism housing (8) by removing the screw (15) only if the gasket (36) has to be replaced because damaged.

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 oil (SHELL OMALA S4 WE or equivalent). If the O-ring must be replaced, remove the existing one from its groove, clean the groove carefully and lubricate it with protective oil film. Assemble the new O-ring into its groove and lubricate it with a protective oil film.

1. Replace the O-rings (39-40) of the head flange (17).
2. Replace the O-ring (42) and the guide sliding ring (41) of the piston (21). Replace the O-ring (40) of the end flange (22).

If the sealing washer (43) has to be replaced, measure the protrusion of the stop screw (26) with reference to the end flange (22) surface, so as to be able to easily restore the setting of the actuator mechanical stop in the closed valve position, once the maintenance procedures have been completed.

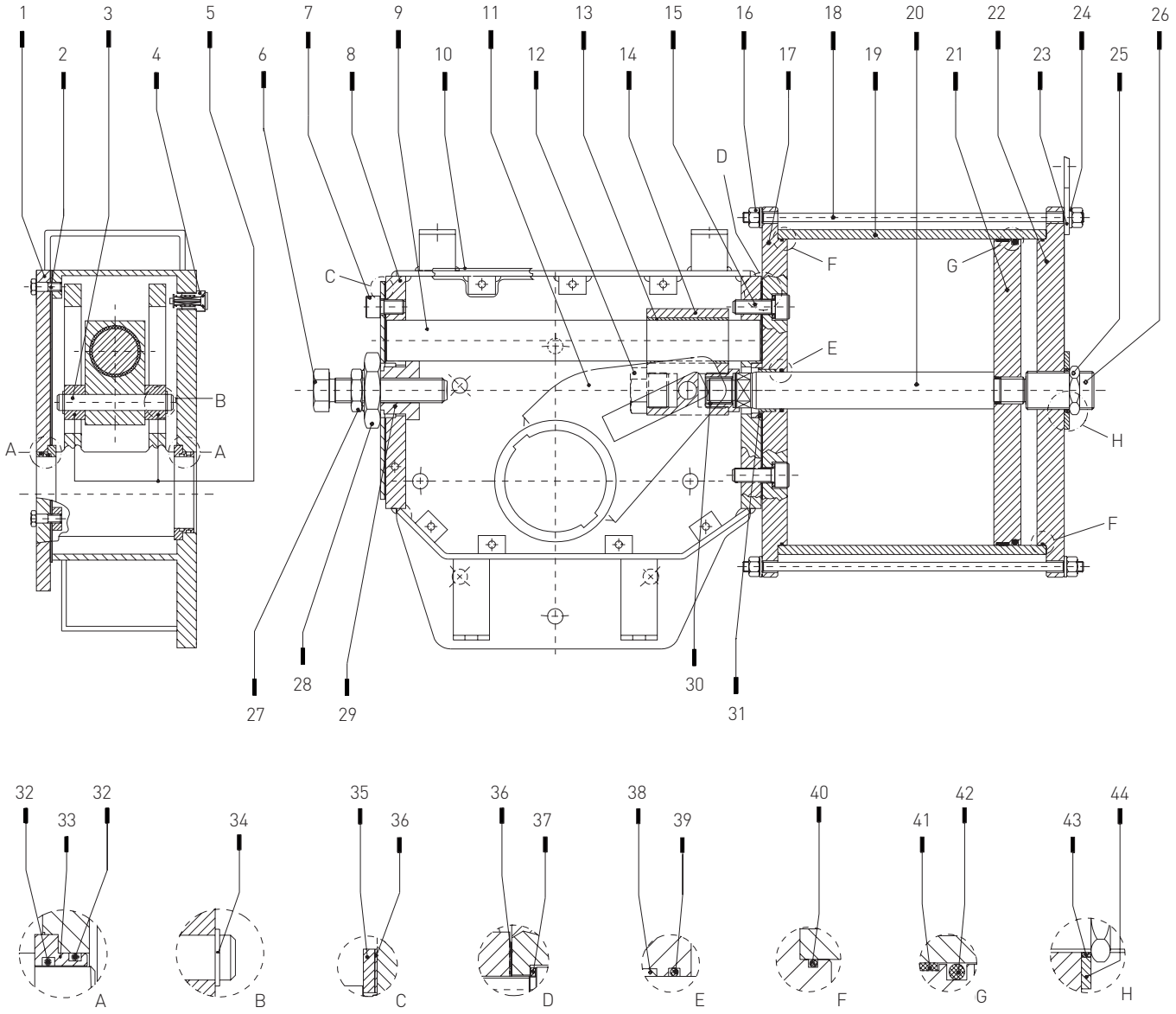
1. Loosen the lock nut (25) and unscrew the stop screw (26) until it is removed together with the nut (25), the washer (44) and the sealing washer (43).
2. Remove the sealing washer (43) from the stop screw (26). Carefully clean and lubricate the stop screw thread and the surface of the end flange area, on which the sealing washer works.
3. Screw the new sealing onto the stop screw until it touches the nut (25).
4. Assemble the washer (44) onto the sealing washer (43).
5. Screw the stop screw into the threaded hole of the end flange until it reaches its original position (the same protrusion with reference to the flange surface).
6. Check that the sealing washer (43) and the washer (44) are in contact with the flange surface.
7. Tighten the lock nut (25).

Reassemble

1. Assemble the new gasket (36) after cleaning the surfaces of housing (8) and head flange (17), which are in contact.
2. Assemble the head flange (17), replace the washers (37) if damaged, tighten the screws (15) to the recommended torque.
3. Lubricate the piston rod (20) surface, with a protective oil film and introduce it into the head flange hole, taking care not to damage the O-ring (39). Carefully clean the threaded end of the piston rod (20) and the threaded hole of the adaptor bush (30) of guide block (14). Spreads some sealant LOCTITE 452, or equivalent, on the rod threaded end and screw into the adaptor bush (30) threaded hole and tighten.
4. 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 (42) and the head flange O-ring (40).
5. Assemble the end flange by centring it on the inside diameter of the tube, taking care not to damage the O-ring (40).
6. Assemble the washers (24) and the nuts (16) onto the tie rods (18). Tighten the nuts to the recommended torque, alternating between opposite corners.
7. Restore a generous coating of grease on the contact surfaces of the yoke (11) and the bushing (33), on the yoke grooves, on the sliding block (5), on guide bar (9).
8. Assemble the new gasket (10) after cleaning the surfaces of the housing (8) and cover (1).
9. Lubricate with protective oil the O-ring (32).
10. Assemble the cover (1) and the screw (2). Tighten the screws to the recommended torque.
11. Carry out a few actuator operations to check that its movement is regular and that there is no air leakage through the seals.

IMPORTANT
AFTER MAINTENANCE OPERATIONS CARRY OUT A FEW ACTUATOR OPERATIONS TO CHECK THAT ITS MOVEMENT IS REGULAR AND THAT THERE IS NO AIR LEAKAGE THROUGH THE SEALS.

FIGURE 31
ALGA double acting pneumatic actuator



PARTS LIST

Item	Description
1	Cover
2	Screw
3	Guide block pin
4	Vent valve
5	Sliding block
6	Screw
7	Screw
8	Housing
9	Guide bar
10	Cover gasket
11	Yoke
12	Plug
13	Bushing
14	Guide block
15	Screw
16	Nut

Item	Description
17	Head flange
18	Tie rod
19	Cylinder tube
20	Piston rod
21	Piston
22	End flange
23	Lifting eyelet
24	Spring washer
25	Nut
26	Stop setting screw
27	Nut
28	Nut
29	Stopper bush
30	Adaptor bush
31	Washer
32	O-ring

Item	Description
33	Yoke bushing
34	Retainer ring
35	Flange
36	Gasket
37	Washer
38	Piston rod bushing
39	O-ring
40	O-ring
41	Guide sliding ring for piston
42	O-ring
43	Sealing washer
44	Washer

b2) Replacement of hydraulic cylinder seals
(see figure 32)
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 sectional drawing and adopting the following procedures:

1. Remove the nuts (item 16) and the washers (item 15) from the tie rods (item 10) at the end flange (item 13) side.
2. Slide off the end flange and the tube (item 12).
3. Remove the screws (item 2-Fig. 31) and the cover (item 1-Fig. 31).
4. Unscrew the piston rod (item 6) threaded end from the adaptor bush (item 30-Fig. 31) of guide block (item 14-Fig. 31).
5. Slide off the piston rod from the head flange (item 2).
6. Disassemble the head flange from the mechanism housing (item 8-Fig. 31) by removing the screws (item 7-Fig. 31) only if the gasket (item 36-Fig. 31) has to be replaced because damaged.

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 oil (SHELL OMALA S4 WE or equivalent). If the O-ring must be replaced, remove the existing one from its groove, clean the groove carefully and lubricate it with protective oil film. Assemble the new O-ring into its groove and lubricate it with a protective oil film.

1. Replace the O-rings (3) of the head flange (2).
2. Replace the O-ring (3) of the end flange (13).

For replacement of piston rod seal ring (4) and of the O-ring (5) proceed as follows:

1. Remove the existing PTFE seal ring (4) and the O-ring (5) from their groove.
2. Clean the groove carefully and lubricate it with a protective oil film.
3. Assemble the new O-ring into its groove and lubricate it with a protective oil film.
4. Assemble the new PTFE seal ring (4) into the flange groove, on the rubber O-ring (5), by bending it: take care that the bending radius is as large as possible to avoid damaged the seal. Then enlarge the seal ring with your fingers so as to restore its round shape: pay attention not to utilize any tools, which can damage the seal ring.

To replace the piston seal ring (9) and the O-ring (19) proceed as follows:

1. Remove the existing PTFE seal ring (9) and the O-ring (19) from their groove.
2. Clean the groove carefully and lubricate it with a protective oil film.
3. Assemble the new O-ring into its groove and lubricate it with a protective oil film.
4. Assemble the new PTFE seal ring (9) on its rubber O-ring (19) by introducing one side of it into the groove and then enlarge it with your fingers so as to introduce it into the groove: take care to enlarge it uniformly without any tools which could possibly damage it. The elastic memory of the kind of PTFE type the seal ring is made of allows the ring to shrink back to its previous dimension after a short time.

If the O-ring (17) has to be replaced, measure the protrusion of the stop screw (11) with reference to the end flange (13) surface, so as to be able to easily restore the setting of the actuator mechanical stop in the open valve position, once the maintenance procedures have been completed.

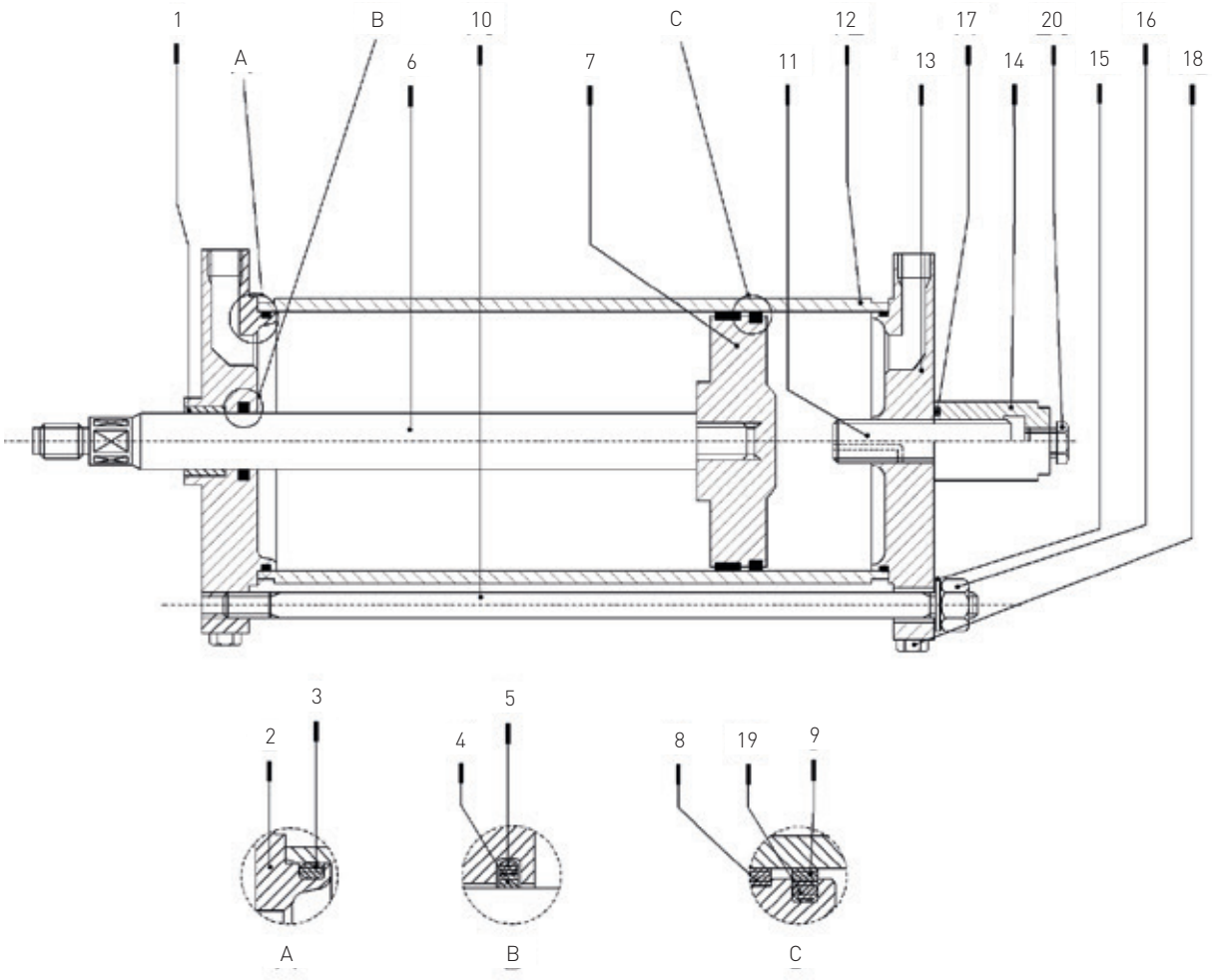
5. Loosen the stop setting screw cover (14) and unscrew the stop screw (11).
6. Remove the O-ring (17) from the stop screw (11). Carefully clean and lubricate the stop screw thread and the surface of the end flange area, on which the O-ring works.
7. Screw the new O-ring onto the stop screw until it touches the cover (14).
8. Screw the stop screw into the threaded hole of the end flange until it reaches its original position (the same protrusion with reference to the flange surface).
9. Check that the O-ring (17) is inside the groove into the end flange and in contact with the groove bottom surface.

Reassemble

1. Assemble the new gasket (item 36-Fig. 31) after cleaning the surfaces of housing (item 8-Fig. 31) and head flange (item 2) which are in contact.
2. Assemble the head flange and tighten the screws (item 7-Fig. 31) to the recommended torque.
3. Clean and lubricate the piston rod (item 6) surface, particularly that of the bevel, with a protective oil or grease film and introduce it into the head flange hole, taking care not to damage the PTFE seal ring (item 4): the piston rod bevel has to enlarge smoothly the seal ring.
4. Carefully clean the threaded end of the piston rod and the threaded hole of the adaptor bush (item 30-Fig. 31) of guide block (item 14-Fig. 31). Spread some sealant LOCTITE 452, or equivalent, on the rod threaded end and screw into the adaptor bush threaded hole and tighten.
5. Carefully clean the inside of the tube (item 12) and check that the entire surface, particularly that of the bevels, is not damaged. Lubricate with protective oil film the tube inside surface and the bevels at the ends. Slide the tube onto the piston taking care not to damaged the PTFE seal ring (item 9): the tube bevel has to smoothly compress the seal ring.
6. Take care also not to damage the head flange O-ring (item 3).
7. Assemble the end flange (item 13) by centring it on the inside diameter of the tube, taking care not to damage the O-ring (item 3).
8. Assemble the washers (item 15) and the nuts (item 16) onto the tie rods (item 10). Tighten the nuts to the recommended torque, alternating between opposite corners.
9. Restore a generous coating of grease on the contact surfaces of the yoke (item 11-Fig. 31) and the bushings (item 13-Fig. 31), on the yoke grooves, on the sliding blocks (item 5-Fig. 31), on guide bar (item 9-Fig. 31).
10. Assemble the new gasket (item 36-Fig. 31) after cleaning the surfaces of the housing (item 8-Fig. 31) and cover (item 1-Fig. 31)
11. Lubricate with protective oil the O-ring (item 32-Fig. 31).
12. Assemble the cover (item 1-Fig. 31) and the screws (item 2-Fig. 31). Tighten the screws to the recommended torque.

IMPORTANT
AFTER MAINTENANCE OPERATIONS CARRY OUT A FEW ACTUATOR OPERATIONS TO CHECK THAT ITS MOVEMENT IS REGULAR AND THAT THERE IS NO OIL LEAKAGE THROUGH THE SEALS.

FIGURE 32
Hydraulic cylinder



PARTS LIST

Item	Description
1	Piston rod bushing
2	Head flange
3	O-ring
4	Piston rod seal ring
5	O-ring
6	Piston rod
7	Piston
8	Guide sliding ring for piston
9	Piston seal ring
10	Tie rod
11	Stop setting screw
12	Cylinder tube
13	End flange
14	Stop setting screw cover
15	Spring washer
16	Nut
17	O-ring
18	Plug
19	O-ring
20	Plug

5.3 Lubrication of mechanism

For normal duty 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 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 re-lubrication, see table.

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 mm²/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/m³ 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 so to allow any kind of movement without problems of further risks created by work-site.

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.

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 2.2).
If the actuator needs storage, before demolition, see section 2.3.

IMPORTANT
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.

6 TROUBLESHOOTING

6.1 Failure or breakdown research

Event	Possible cause	Remedy
Actuator does not work	1. Lack of power supply	1. Restore it
	2. Lack of pneumatic supply	2. Open line interception valve
	3. Blocked valve	3. Repair or replace
	4. Wrong position of the distributor of the manual hydraulic group	4. Restore correct position
	5. Failure of the control group	5. Call Biffi Customer Service
	6. Low supply pressure	6. Restore (section 1.4)
Actuator too slow	1. Low supply pressure	1. Restore (section 1.4)
	2. Wrong calibration of flow regulator valves	2. Restore (section 3.5)
	3. Wear of the valve	3. Replace
Actuator too fast	1. High supply pressure	1. Restore (section 1.4)
	2. Wrong calibration of flow regulator valves	2. Restore (section 3.5)
Leakages on hydraulic or pneumatic circuits	1. Deterioration and/or damage to gaskets	1. Call Biffi Customer Service
Incorrect position of the valve	1. Wrong adjustment of mechanical stops	1. Restore (section 3.3)
	2. Wrong warning of microswitches	2. Restore (section 3.4)
Hydraulic manual pump does not work	1. Handle positioned on remote control	1. Re-position the operation indication handle to manual (make)
	2. Leakages on the check valve of the hydraulic control group	2. Call Biffi Customer Service

7 LAYOUTS

7.1 Spare parts order

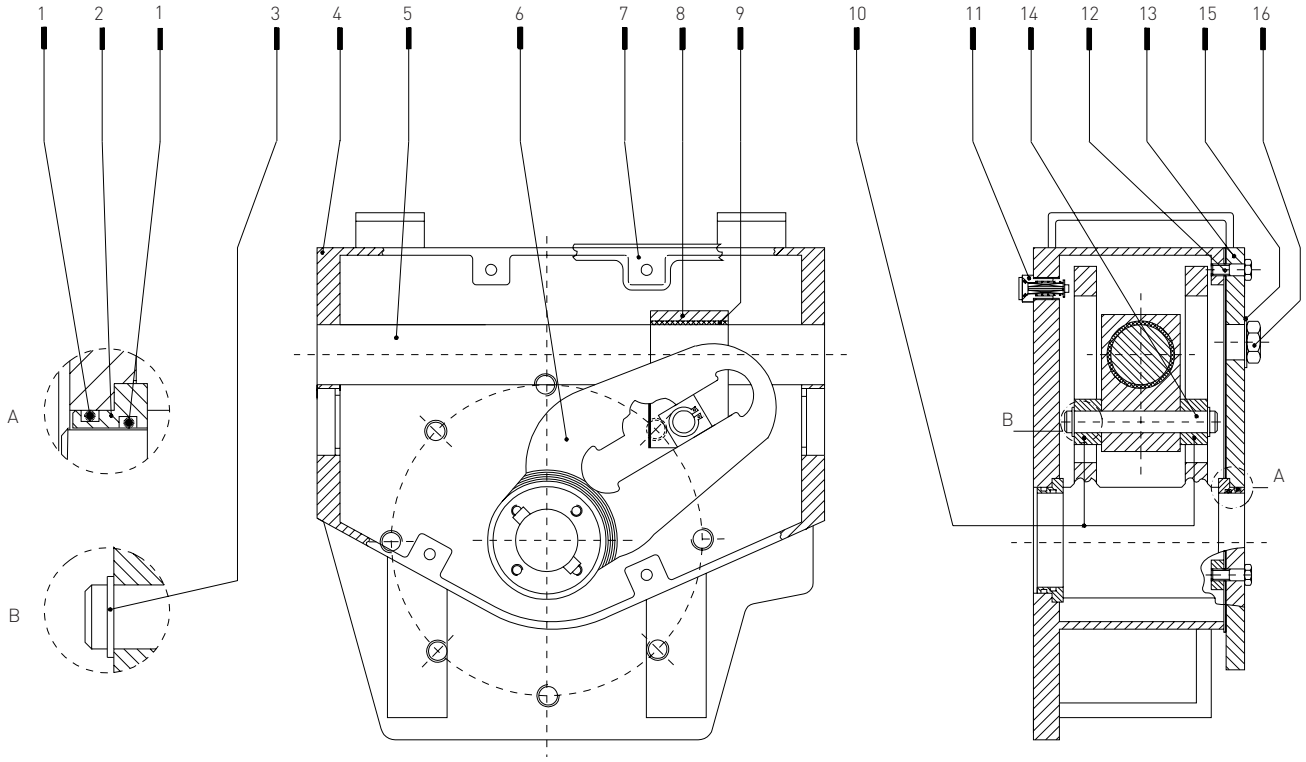
For spare parts order to the relevant Biffi office please make reference to Biffi order confirmation concerning all the supply, and serial number of the actuator (section 1.2) for any specific spare part for a specific actuator model.

Please send every spare-parts request to:
Biffi Italia S.r.l.
Servizio Assistenza Tecnica Clienti
E-mail: spareservice@biffi.it

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 33
Scotch yoke mechanism

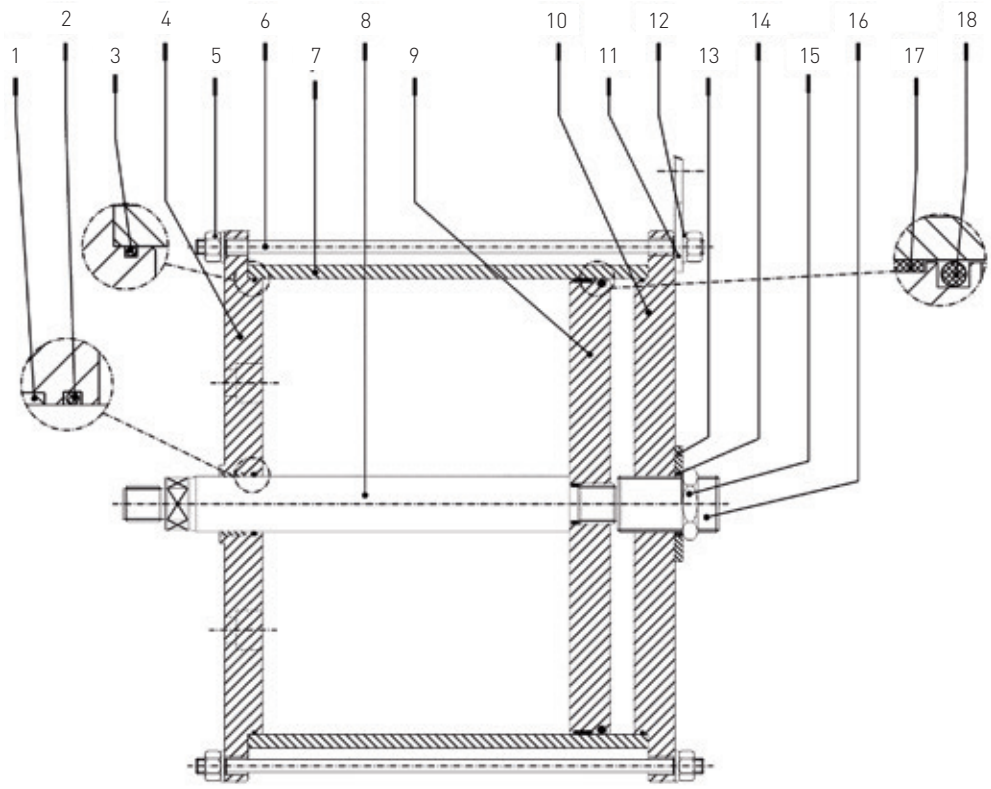


PARTS LIST

Item	Q.ty	Description	Material
1*	4	O-ring	NBR
2	2	Yoke bushing	Bronze
3	2	Retainer ring	Stainless steel
4	1	Housing	Carbon steel
5	1	Guide bar	Alloy steel
6	1	Yoke	Carbon steel
7*	1	Cover gasket	Fiber
8	1	Guide block	Carbon steel
9	1	Bushing	Steel + bronze + PTFE
10	2	Sliding block	Bronze
11*	1	Vent valve	Stainless steel
12	12	Screw	Carbon steel
13	1	Cover	Carbon steel
14	1	Guide block pin	Alloy steel
15	1	Washer	Copper
16	1	Inspection plug	Carbon steel

* Recommended spare parts

FIGURE 34
Pneumatic cylinder

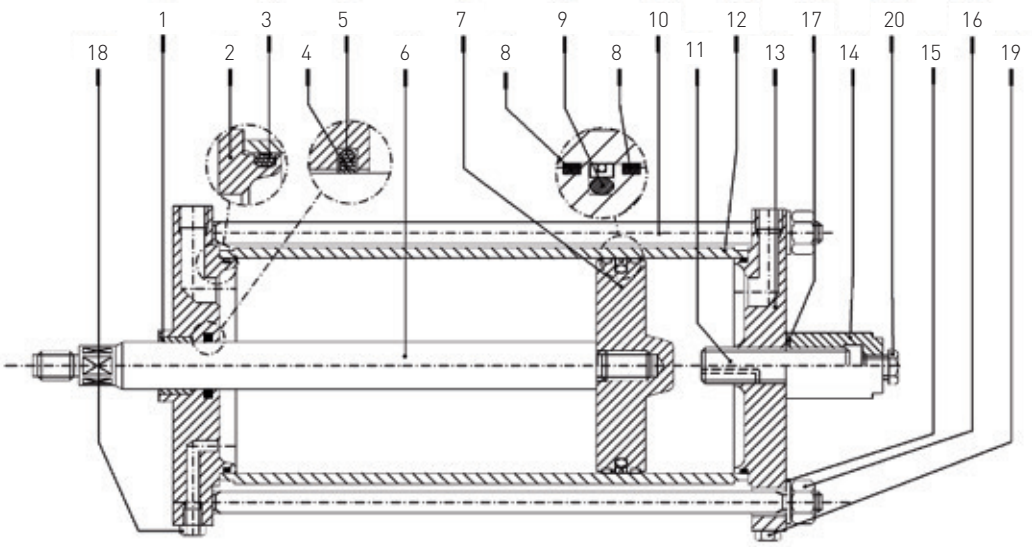


PARTS LIST

Item	Q.ty	Description	Material
1	1	Piston rod bushing	Steel + bronze + PTFE
2*	1	O-ring	NBR
3*	2	O-ring	NBR
4	1	Head flange	Carbon steel
5	12	Nut	Carbon steel
6	6	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	Liftting eyelet	Carbon steel
12	2	Spring washer	Carbon steel
13	1	Washer	Carbon steel
14*	1	Sealing washer	PVC
15	1	Nut	Carbon steel
16	1	Stop setting screw	Carbon steel
17*	1	Guide sliding ring for piston	PTFE + graphite
18*	1	O-ring	NBR

* Recommended spare parts

FIGURE 35
Hydraulic cylinder (optional: only for ALGA-MHP hydraulic handwheel manual override)

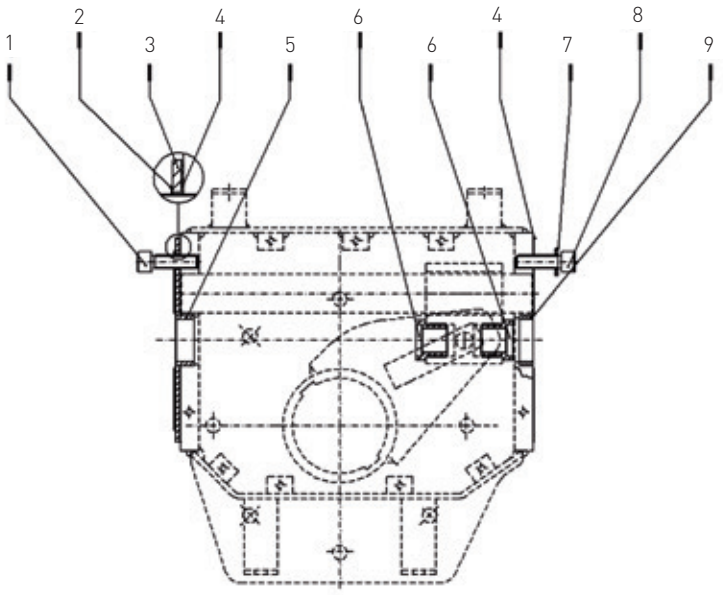


PARTS LIST

Item	Q.ty	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 gr. 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 gr. 7
17*	1	O-ring	NBR
18	6	Plug	Carbon steel
19	1	Plug	Carbon steel
20	1	Plug	Carbon steel

* Recommended spare parts

FIGURE 36
Assembly kit

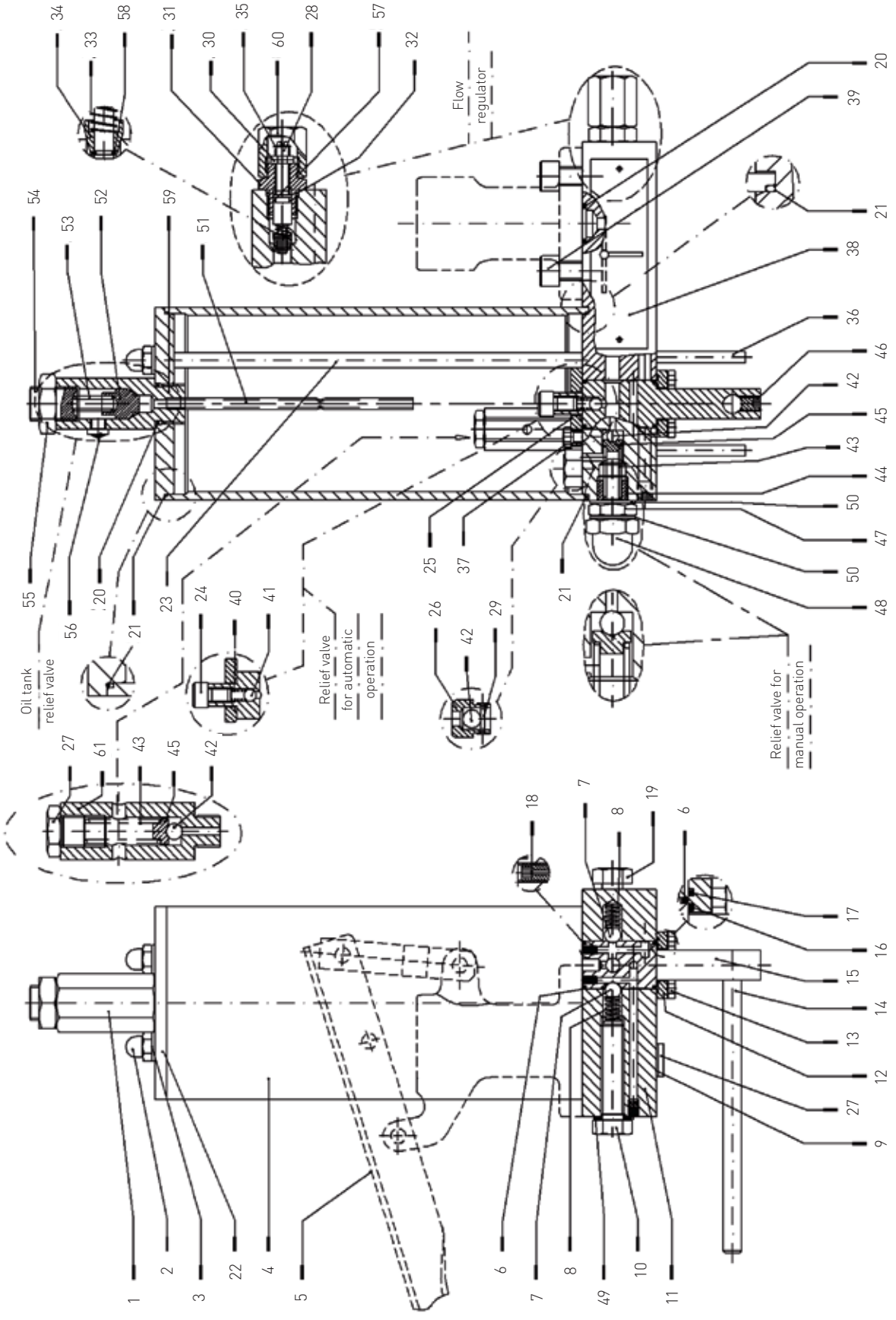


PARTS LIST

Item	Q.ty	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	2	Adaptor bush	Alloy steel
7	4	Washer	Copper
8	4	Screw	Alloy steel
9	1	Washer	Carbon steel

* Recommended spare parts

FIGURE 37
Hydraulic control unit MHP

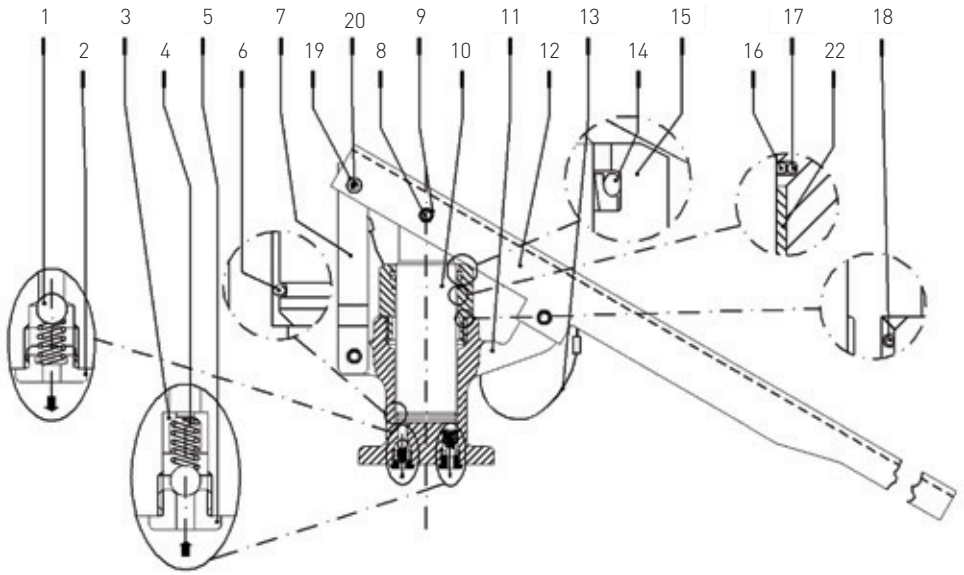


PARTS LIST - HYDRAULIC CONTROL UNIT MHP

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

* Recommended spare parts

FIGURE 37A
Hand pump

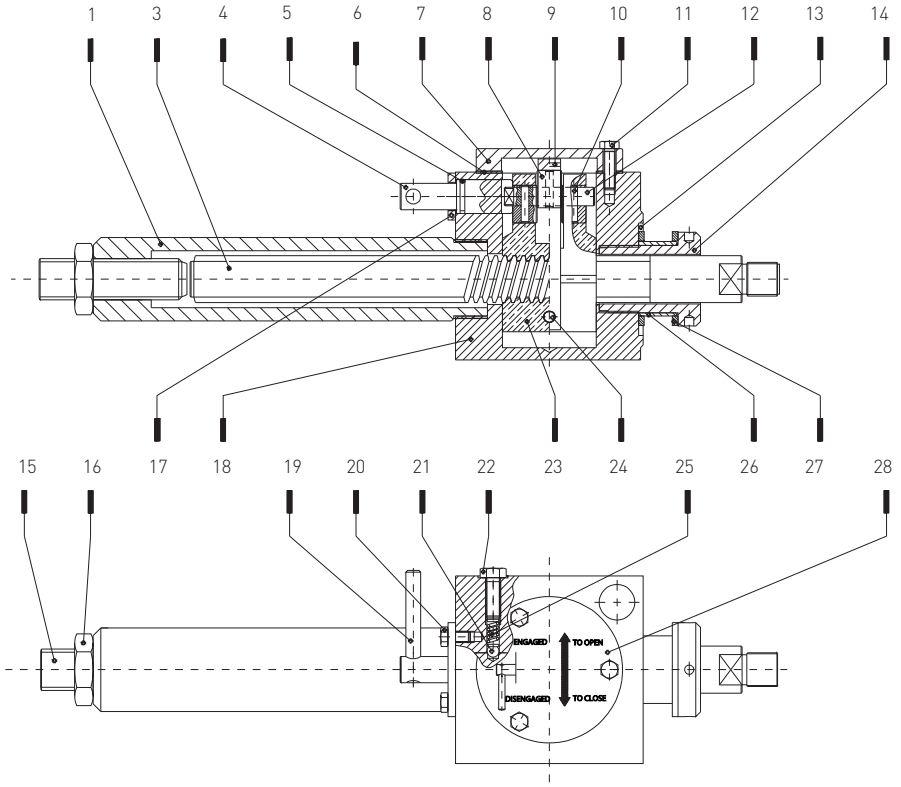


PARTS LIST

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

* Recommended spare parts

FIGURE 38
Jackscrew manual override MSJ or MHW



PARTS LIST

Item	Q.ty	Description	Material
1	1	Protection pipe	Carbon steel
2	-	-	-
3	1	Jackscrew	Carbon steel
4	1	Engagement lever pin	Stainless steel
5*	1	O-ring	Fluorosilicon rubber
6*	1	Cover gasket	Fiber
7	1	Cover	Carbon steel
8	3	Cam	Alloy steel
9	1	Fork	Carbon steel
10	3	Spring pin	Stainless steel
11	3	Screw	Carbon steel
12	1	Screw nut operating cam	Alloy steel
13*	1	O-ring	Fluorosilicon rubber
14	1	Thrust nut operating cam	Alloy steel
15	1	Screw	Carbon steel
16	1	Nut	Carbon steel
17	1	Flange	Carbon steel
18	1	Body	Carbon steel
19	1	Spring pin	Spring steel
20	2	Screw	Carbon steel
21	1	Ball ¼"	Stainless steel
22	1	Screw	Carbon steel
23	1	Screw nut	Bronze
24	1	Pin	Carbon steel
25	1	Spring	Spring steel
26	1	Bush	Bronze
27	2	Thrust shoulder washer	Bronze
28	1	Operating instruction plate	Aluminium

* Recommended spare parts

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): .....

Biffi Italia S.r.L.
Località Caselle San Pietro, 420, 29017 Fiorenzuola d'Arda (PC) ITALY Ph: +39 (0)523 944 411 E-mail: biffi_italia@biffi.it **www.biffi.it**