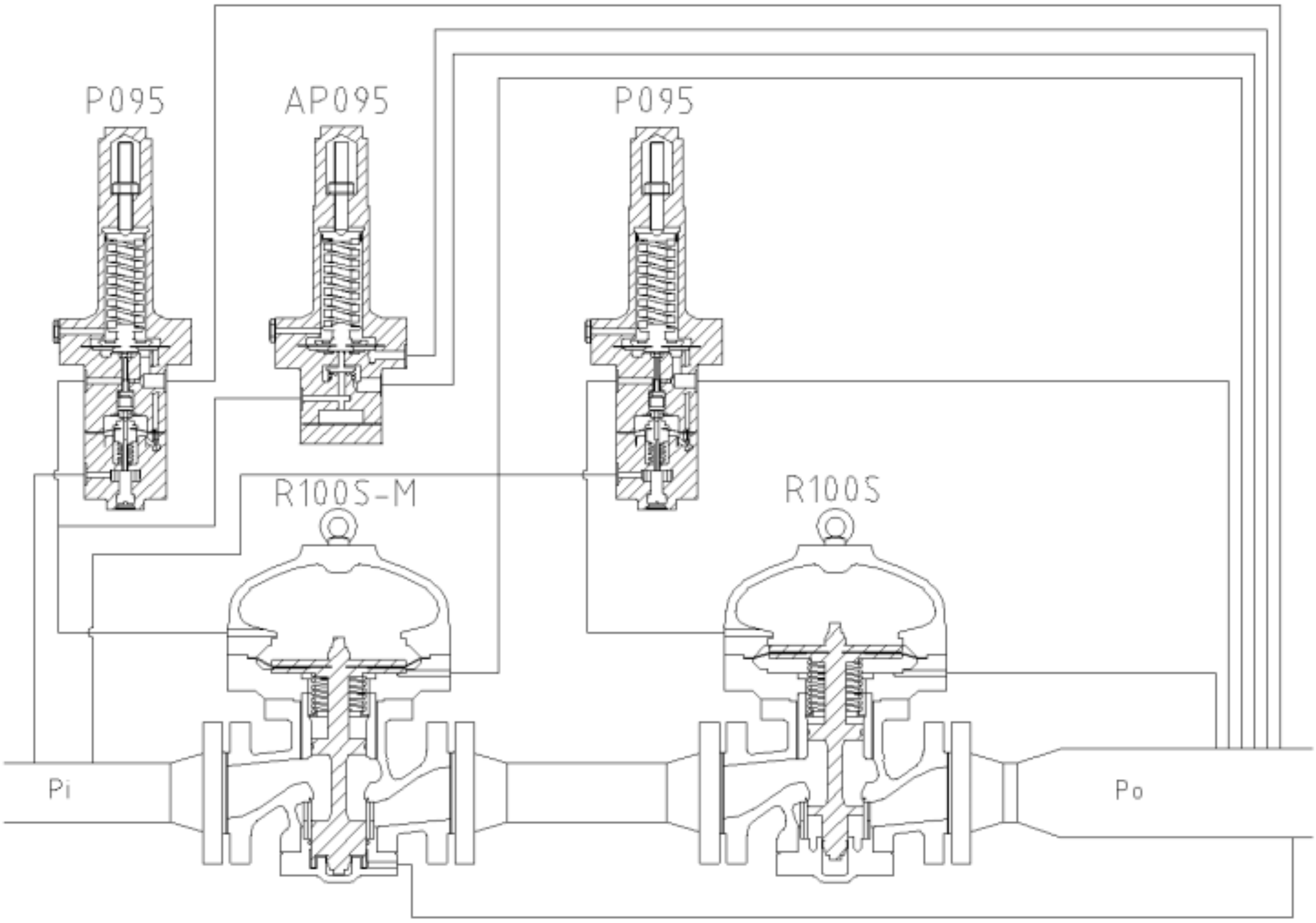
CONTROLS SUPPLY CHAIN
VALVES ACTUATORS INSTRUMENTATIONS

Gas Pressure Regulating System R100S - (M)

OPERATING AND MAINTENANCE MANUAL



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VALVES ACTUATORS INSTRUMENTATIONS

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1.1 System components

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- Gas pressure regulator BAAI-R100S
- Pilot (also called pressure control regulator) BAAI P095-xPS-y

Monitor regulator system:
- Monitor regulator execution BAAI-R100S-M
- Pilot (also called pressure control regulator) BAAI P095-xPS-y
- Acceleration pilot BAAI AP095-xP-y (optional)

1.2 Area of application

Gas pressure regulating and metering installations for inlet pressures up to 100 bar, where high demands are set for reliability in operation as well as regulating precision. Both active regulating and the monitor regulator system are medium controlled.

Besides its application in transport and distribution systems, the BAAI regulating system is especially suitable for gas pressure reduction at end users where a combination of stability and a high speed of response is required at a strongly varying demand pattern.

In addition, the regulating system is highly suitable in those situations where a very small pressure drop across the installation is required. This often concerns bottlenecks in the transport and distribution network. The BAAI basic regulating system requires less than 0.5 bar pressure difference to be able to function. Moreover, the system has a high regulating precision, enabling pressure equation within an installation to be kept within limits. A predictive calculation or simulation may be made for critical situations.

Because of its unique construction, the silent execution of the regulating system is especially suitable for situations where high demands are set to the level of acoustic pressure and/or capacity. If required, Gorter Controls B.V. can make a predictive calculation of the acoustic pressure level belonging to the process conditions concerned. The monitor regulator system may also be supplied in a silent execution.

The addition of a monitor regulator to the system ensures greater operational reliability combined with overpressure protection. If the active regulating system open fails, the monitor regulator takes over pressure control and the gas supply is not cut off like with safety valves. The acceleration pilot is used in those cases when quick take-over is required. The pilot for a monitor regulator is the same as for the active regulator.

Both the active and monitor regulators are gas controlled regulators where regulation consists of a direct solid regulating circuit and an indirect regulating circuit which realises high regulating precision because of its integrating action.

Applications of the P095

The most common application, however, is its use as a pressure control regulator (pilot) for its own medium-controlled gas pressure reducing devices. The P095-xPS is optimised for use with a BAAI R100S(M) gas pressure regulator but experience has taught that it also functions extremely well on other types (makes) of gas pressure regulators. The BAAI P095-xPS is suitable for inlet pressures up to 100 bar and controlled outlet pressures up to 60 bar.

Other applications are:

A
The BAAI P095-xPS as a two-stage gas pressure regulator with a small capacity suitable for inlet pressures up to 100 bar and controlled outlet pressures up to 60 bar.

B
The BAAI P095-xP as a 1-stage regulator without stabiliser with as its function limitation regulator or as a working monitor acceleration pilot.

The limitation regulator serves to limit the flow in a gas pressure reducing device and to prevent overloading of a turbine gas meter.

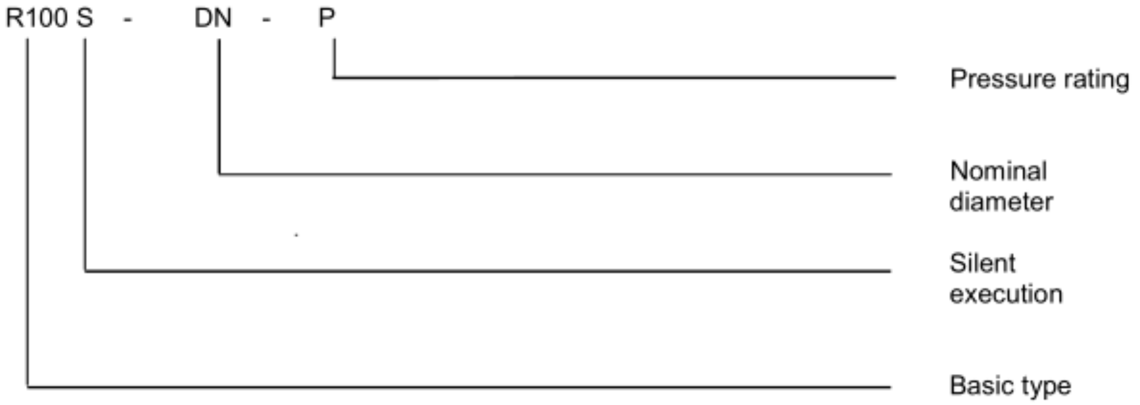
The working monitor acceleration pilot serves to take over the function of the regulator in a working monitor arrangement at the instant it fails open. The working monitor arrangement consists of an active monitor which takes care of the initial pressure reduction and a regulator which finally regulates the required outlet pressure.

C
An execution with pneumatic, or electronic, drive is also available, thus allowing for the possibility of remotely adjusting the setpoint. The type indication of this execution is PL095-xPS.

You may contact Gorter Controls B.V. for a fuller description of A, B and C applications. This documentation is aimed at the main use of the P095 only, that is as a pressure control regulator.

1.3 Type indication system components

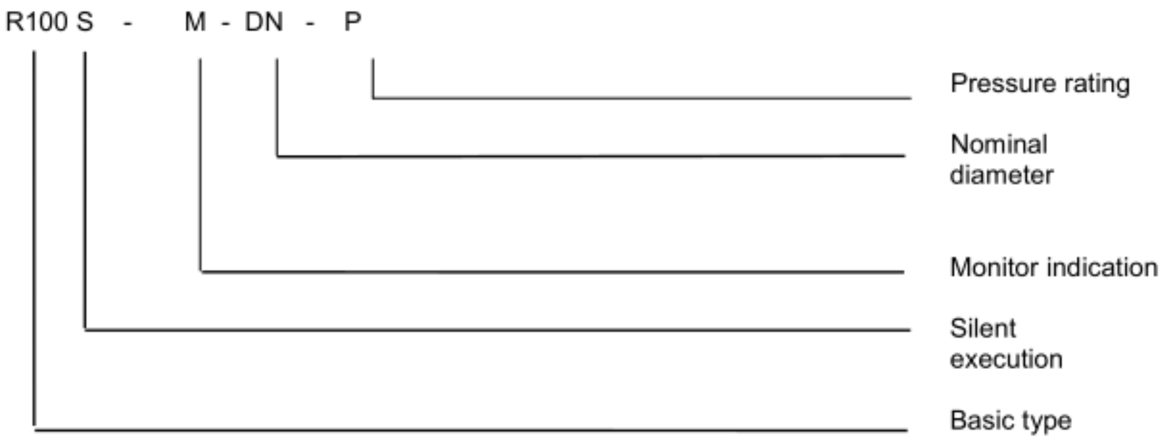
Active regulator



Example: R100S-4”-600

A silent execution of the BAAI gas pressure regulator with a nominal diameter of 4” and belonging to pressure rating ANSI 600

Monitor regulator



Example: R100S-M-4”-600

A silent execution of the BAAI monitor regulator with a nominal diameter of 4” and belonging to pressure rating ANSI 600

Pilot

P095 – x PS

Stabiliser = auxiliary pressure regulator (first pressure reduction stage)

Pilot (second pressure reduction stage)

Pressure range
M : **M**edium pressure range from 0.5 to 15 bar
H : **H**igh pressure range from 10 to 60 bar

Basic type indication

Example:

P095-MPS

A pilot with stabiliser for a pressure range up to 12 bar, carried out with a breather opening to the environment and a connection for a breather pipe and an extra seal at the adjusting screw (if unacceptable, in case of diaphragm fracture, that a small flow runs into the arrangement space).

Acceleration pilot:

AP095 - xP

Pressure range
M : **M**edium pressure range from 0.5 to 15 bar
H : **H**igh pressure range from 10 to 60 bar

Basic type indication

Example:

AP095-MP

An acceleration pilot for a pressure range up to 15 bar , carried out with a breather opening to the environment and a connection for a breather pipe and an extra seal at the adjusting screw (if unacceptable, in case of diaphragm fracture, that a small flow runs into the arrangement space).

1.4 Technical specifications regulating system

Pressure category regulators	: ANSI 300 \ ANSI 600***
Pressure category pilots	: ANSI 600 \ PN 100
Nominal diameter regulators	: ½" up to 8" ****
Range stabiliser pressure pilots	: Po + 2.0 bar up to Po + 6.0 bar
Inlet pressure	: up to 100 bar
Outlet pressure range (Wh)	: from 0.5 to 60 bar
Operating temperature	: -20° to +60°C
Ambient temperature	: -30° to +80°C
Design	: acc. DIN3380, EN334
Maintenance interval	: approx. 4 years under normal operating conditions **
Regulating character	: direct + indirect
Failing behaviour at main diaphragm fracture	: fail to close, spring closing (FO at request)
Minimum required pressure difference across regulating system for proper operation	: 0.5 bar

Classification according to EN334:

	precision category	closing pressure category	closing pressure zone
Po < 1bar	AC5	SG10	SZ=5 *)
Po < 3 bar	AC5	SG10	SZ=5 *)
Po >= 3bar	AC1*	SG5*	SZ=5 *)

*) *values are given for standard configuration of pilot/regulator and test rig acc.EN334*

Classification according to DVGW (DIN3380):

DVGW registration numbers : NG-4301AU0385

	precision category	closing pressure category
Po <3 bar	RG5	SG10
Po >= 3bar	RG1	SG2,5

*
Precision depends on process conditions.
High precisions are only guaranteed for applications with a wide temperature range and temperatures far below 0° C if the pilots are heated.

**
Clean and dry natural gas without constituents damaging to the materials used.

***
Other pressure categories are available on request.

****
Also available: 12" x 10"

1.5 Technical specifications regulators

Capacity

To determine the capacity, the following formulas may be used:

$$Qn = \frac{13.94}{\sqrt{d(Te + 273)}}.Cg.\sqrt{(Pi - Po).Po} \qquad \text{if } \frac{Po}{Pi} \geq 0.5$$

$$Qn = \frac{6.97}{\sqrt{d(Te + 273)}}.Cg.Pi \qquad \text{if } \frac{Po}{Pi} < 0.5$$

with

Qn	= flow rate in m_n^3/h
Pi	= inlet pressure in bara
Po	= outlet pressure in bara
Cg	= capacity rate in $m_n^3/(h.bar)$
d	= relative density (air=1)
Te	= temperature gas in the inlet side of the regulator
ρ_n	= gas density under normal conditions (with T=273 Kelvin)

To natural gas with ρ_n =0.83 kg/m^3 applies: d= 0.643

To gasses other than natural gas applies: d= ρ_{ngas} / 1.29

In the above formula, the Cg value of the combination monitor regulator and active regulator should be filled in. This value (Cg_tot) can be calculated as follows:

$$Cg\_tot = \sqrt{\frac{1}{\left(\frac{1}{Cg\_regulatingvalve}\right)^2 + \left(\frac{1}{Cg\_monitor}\right)^2}}$$

For the Cg values specific to device and diameter, the values shown in the table below may be used.

Nominal diameter	R100\R100-M	R100S\R100S-M
1"	400	370
2"	2000	1210
3"	4000	2800
4"	6760	4970
6"	14400	10100
8"	27100	19700

Table 1: Cg values regulators of the R100 series

Dimensions & weight

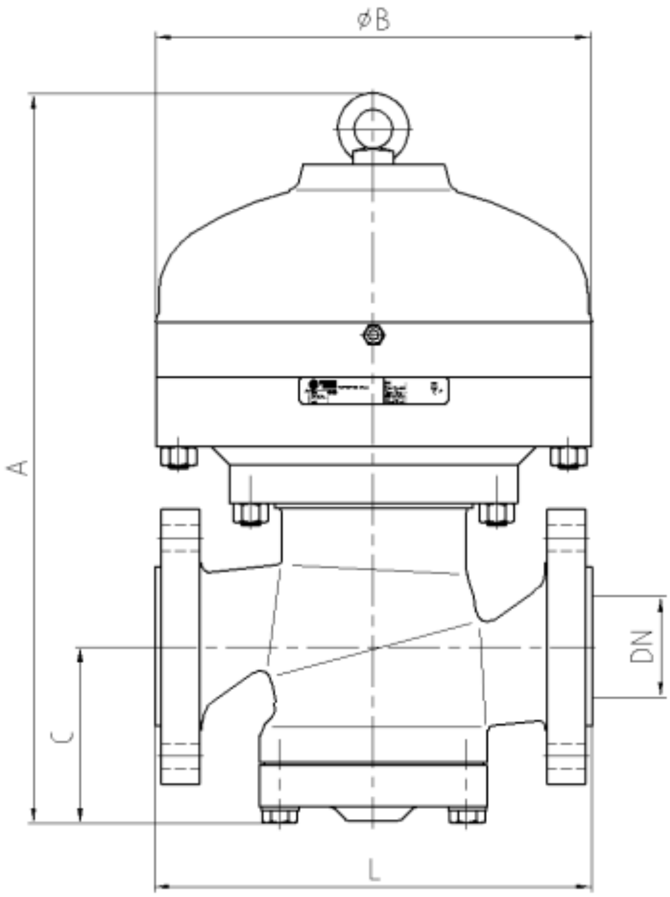


Figure 1 dimensional drawing regulators R100S/R100S-M

DN	A	B	C	L	Weight	
					Cl.300	Cl.600
1”	400	230	95	216	50	50
2”	540	290	120	292	93	95
3”	640	350	150	356	157	160
4”	725	430	175	432	270	280
6”	980	625	250	559	661	690
8”	1210	655	310	660	910	950

Table 2: dimensions and weight regulators R100S / R100S-M

Dimensions are in mm and weight in kg.

Materials regulators

Pressurised parts : A352-LCC (1" S355J2G3)
3.1 certified
Guides : CuZn
Other internal components : Mainly steel (SS trim on request)
Diaphragm : NBR with nylon insert
O-rings : FPM and NBR

Execution of the regulating system for corrosive media on request.

1.6 Technical specifications pilot P095

Setpoint range stabiliser pressure: Po +2 to Po +6 bar

Setpoint range outlet pressure:

Art.number	**Range (MPS) barg**	**Colour**
850523ST12660	0.5 - 2.5	green
850523ST12670	1.5 - 5.0	blue
850523ST12680	3.0 -11.0	red
850523ST12690	6.0 -15.0	yellow
Art.number	**Range (HPS) barg**	**Colour**
850523ST12680	10 - 35	red
850523ST12690	20 - 60	yellow

Table 3: setpoint range pilot P095-xPS (x='M'or x='H')

If the required setpoint lies in the overlapping range between two springs, it is recommended to take the spring with the lowest setpoint range. This way maximum regulating precision is achieved. This also applies in the event that the required Po lies in the overlapping range of the two pilot types MPS and HPS. In this case it is recommended to opt for the MPS execution. As far as construction is concerned, the MPS and HPS types only differ in their diaphragm package, which makes it easy to alter a MPS into a HPS type and vice versa.

Weight: approx. 8 kg

Dimensions:

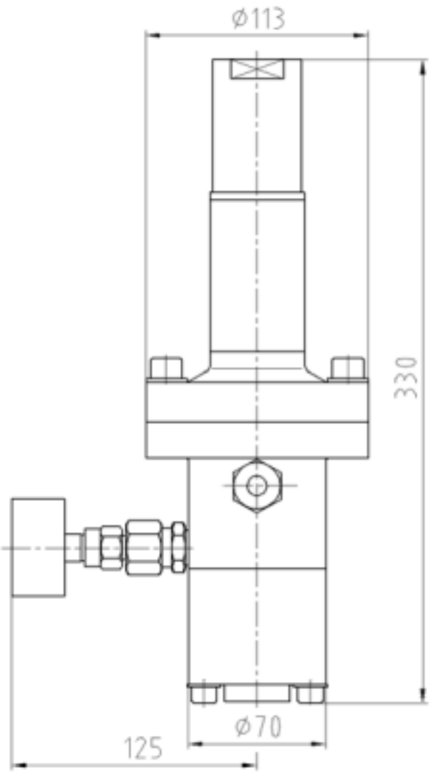


Figure 2: dimensional drawing P095-xPS

NB. distance 125 to pressure gauge only applies to standard execution with steel couplings

Properties:	: non bleed suitable for air to open regulating systems

Materials:

Pressurised parts	: S355J2G3, 3.1 certified
Guides	: CuZn
Internal components	: Mainly X10CrNiS
Diaphragm	: NBR with nylon insert
O-rings	: FPM and NBR

1.7 Technical specifications acceleration pilot AP095-Xp

Setpoint range response pressure: see table 3.

Weight : approx. 5 kg

Dimensions:

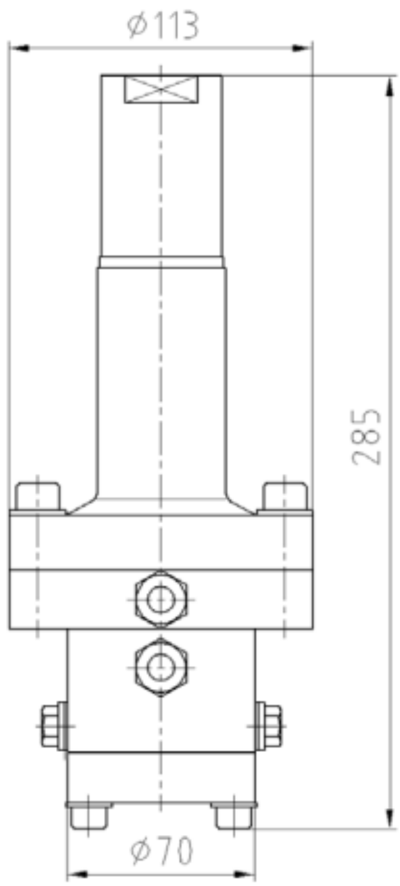


figure 3: dimensional drawing AP095-xP

Materials:

Pressurised parts	: S355J2G3, 3.1 certified
Guides	: CuZn
Internal components	: Mainly X10CrNiS
Diaphragm	: NBR with nylon insert
O-rings	: FPM and NBR

2. Principal of operating

2.1 General

The entire regulating system consists of an active regulator with pilot (R100S + P095), a monitor regulator with pilot (R100S-M + P095) and, if required, an acceleration pilot (AP095-xP).

As far as construction is concerned, the monitor regulator and active regulator are practically identical with the exception of the valve system which is balanced in the monitor regulator. The pilots belonging to the monitor regulator and active regulator are entirely identical.

Under normal circumstances the active regulator is in operation, the monitor is fully open and the acceleration pilot stand-by.

The acceleration pilot AP095-xP serves to accelerate the response of monitor regulation at the instant the main regulating system fails.

2.2 Principle of single stage pressure reduction system

See figure 4

At a constant outlet pressure Po valve (10) allows passage of a flow volume equal to the gas offtake. The forces over the main diaphragm (8) are in equilibrium. The equilibrium is determined by the control pressure (7) on the one hand and the outlet pressure Po plus spring (9) on the other hand. If more gas is taken off at the outlet side, the outlet pressure drops. Because of feedback of the outlet pressure to the active regulator, valve (10) will open further and allow more gas to pass. The diaphragm movement will increase the volume in the control chamber (7) and further pressed down return spring (9). A new equilibrium occurs at a lower regulated outlet pressure Po. Pressure control regulator P095 ensures that the outlet pressure is adjusted to the setpoint value, for a reduction of the outlet pressure Po also results in a lower position of the diaphragm (3). Because of this, supply valve (4) allows a larger gas flow to pass than the gas flow able to discharge to the outlet through the internal restriction. This results in a rise of the pressure in the control chamber (7) until the outlet pressure Po is practically equal to the required value set by means of the adjusting screw (1).

The system responds in reverse order at a drop of gas offtake.

The first control stage of the pilot, called the inlet pressure regulator or stabiliser (6), maintains a fixed difference between the regulated pressure and the feeding pressure for pilot valve (4), called the auxiliary pressure or stabiliser pressure (5).

When gas offtake discontinues entirely, the main valve (10) and the pilot valve (4) close, as well as the inlet pressure regulator (6). Via an internal run-off restriction in the pressure control regulator, the pressure in the control chamber (7) is exchanged with Po so that spring (9) can close valve (10).

Under normal operating conditions there is always a very small runoff from the control chamber (7) to the outlet (Po) so that very stable regulation is obtained.

Before the first control stage there is a fine filter, preventing soiling of the pressure control regulator.

The required outlet pressure can easily be set with spring (2) and adjusting screw (1).

The pilot is available in 2 basic executions: the P095-MPS and P095-HPS. The pilots are mutually different in the setpoint range of the regulated pressure. As far as construction is concerned, both pilots are identical with the exception of the second stage diaphragm package. The same series of springs (2) is available for both types of pilot. Each spring corresponds to a section of the total setpoint range (see also chapter 1 Technical specifications).

The P095-xPS is provided with a breather. It can also be supplied with a straight screw-in coupling for a breather pipe at connection 4.

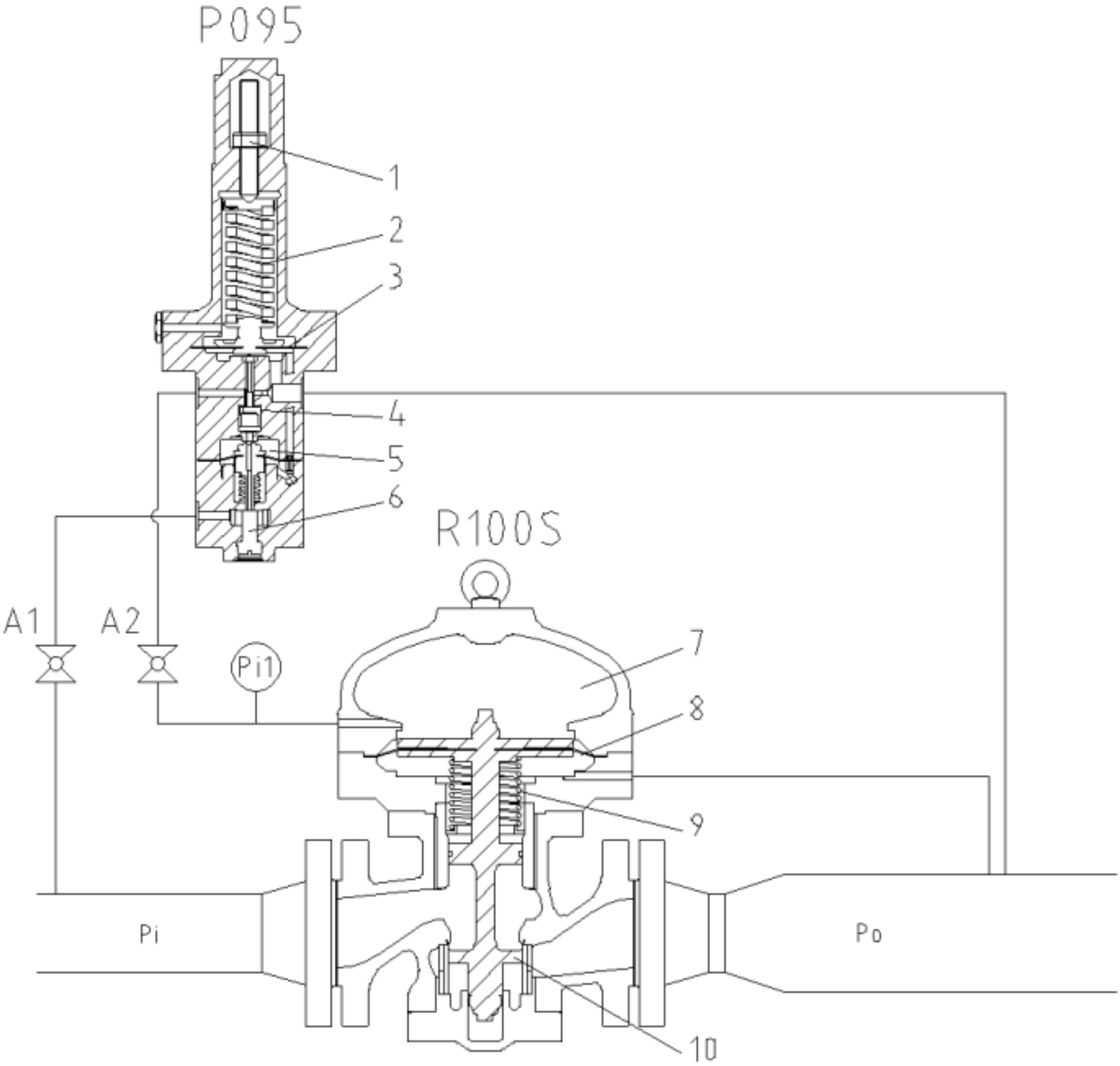


Figure 4 Schematic diagram single stage pressure reduction with BAAI-R100S + P095 xPS

A1+A2+Pi1 recommended

2.3 Principle of wide-open monitor regulating system

Normal operation

Wide-open monitor See figure 5

The working generally:

The working of the wide-open monitor regulating system is identical to that of the single stage pressure reduction system.

Monitor take-over:
If the active regulating system open fails, outlet pressure Po rises. When Po has risen up to the setpoint of the monitor pilot P095-xPS, pilot valve (11) will close, resulting in a decrease of the control chamber pressure (13). As the monitor valve (14) is fully open in normal operation (i.e. functioning active regulator) and is limited by a metal stop, it will take a while before it is actually going to close. In order to speed up this process, the acceleration pilot will start acting as soon as pressure Po rises above the setpoint set by means of the adjusting screw (15). By means of valve (16), this acceleration pilot creates an extra flow from the control chamber to the outlet, which makes the control chamber pressure drop faster and valve (14) close quicker. The valve will close up to the point when Po has gone down again to the set monitor setpoint. Valve (16) closes the instant that outlet pressure Po drops again until just below the setpoint of the acceleration pilot AP095-xP. Therefore, it is always closed when the monitor regulator is regulating normally and, accordingly, does not contribute to regulation. After the take-over, pressure Pt in the pipe-piece between monitor regulator and active regulator will be practically equal to the outlet pressure Po.

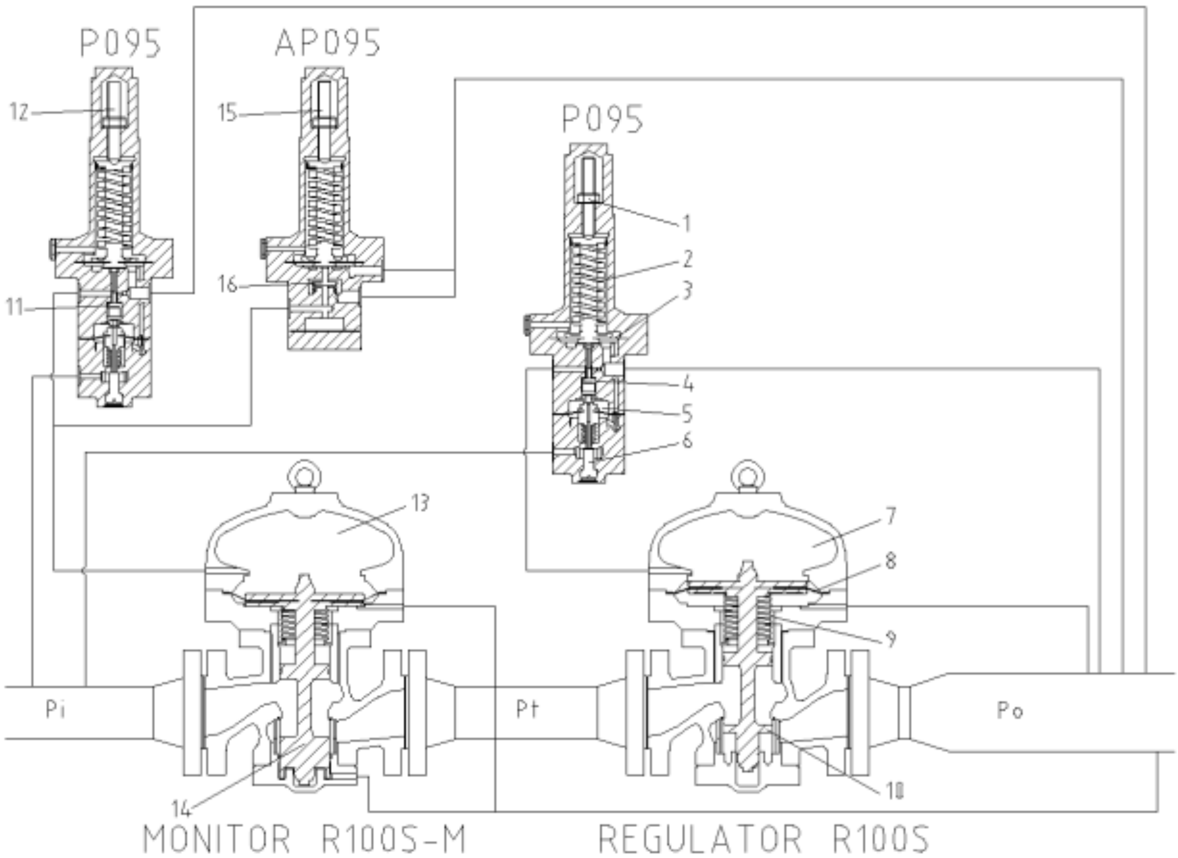


Figure 5 Schematic diagram wide-open monitor regulating system with: (BAAI-R100S+P095-xPS) +(R100SM+P095-xPS+AP095-xP)

For all other regulating systems please don't heasetate to contact our company.

3. INSTALLATION

3.1 Connection signal lines

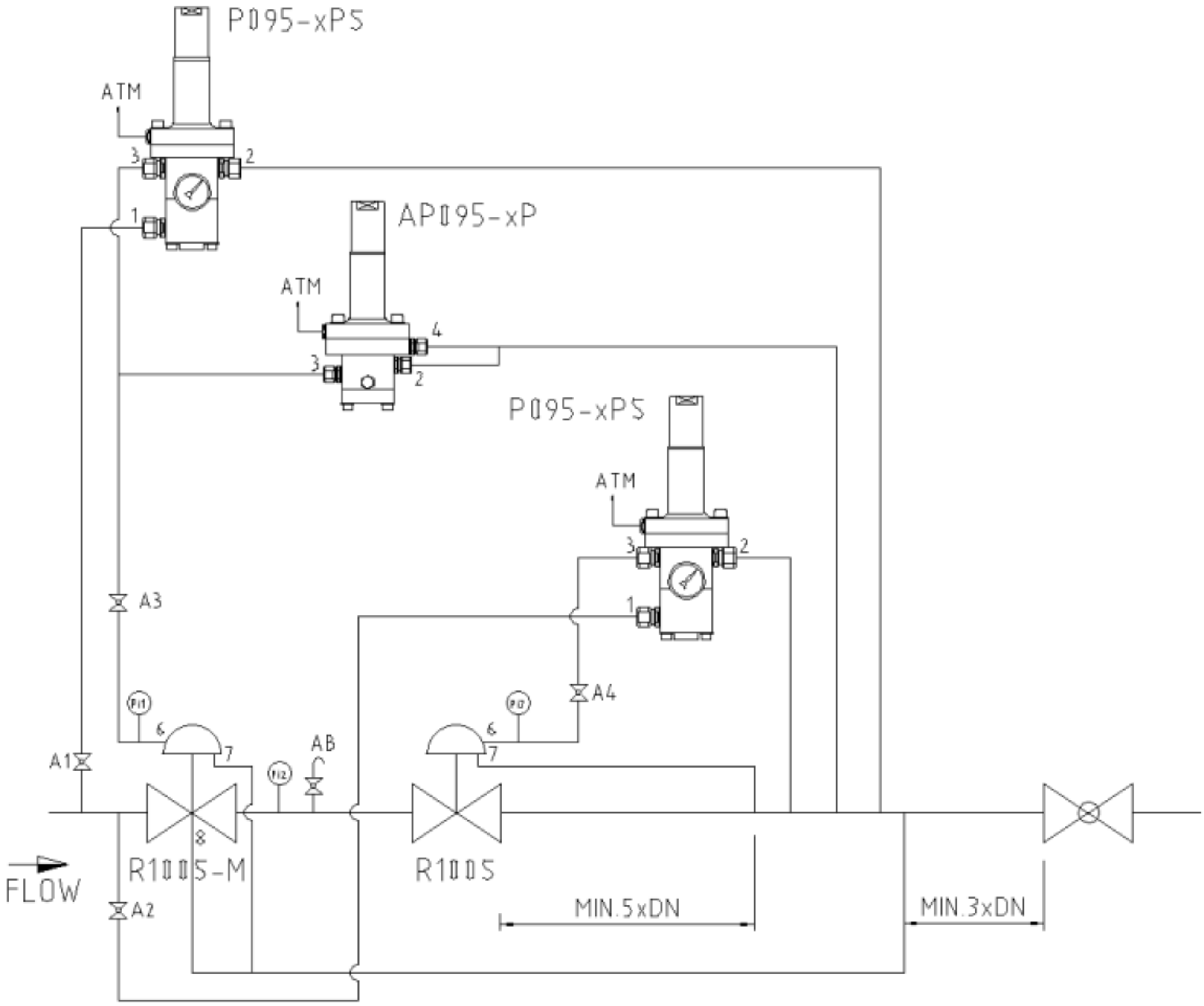


Figure 6 Connection diagram Baai gas pressure regulating system with monitor regulator
A1 - A4 recommended
Pi1 – Pi3 recommended

The connections of the instrumentation lines on the outlet pipe-piece must be situated at least 5 x the nominal diameter of the outlet pipe (DN) from the expansion pipe-piece behind the active regulator and at least 3 x the nominal pipe diameter before the next interference (e.g. the end valve).

The connections to the outlet pipe-piece between active regulator and end valve may be distributed around the periphery of the outlet pipe-piece with the exception of the bottom. Metering line 2 of both P095 and numbers 4 of the AP095 should not be combined.

For practical reasons it is recommended to fit a pressure gauge and manual blow-off on the pipe-piece between the monitor regulator and active regulator (Pi2 and AB, figure 6). This way it is easy to see whether the monitor regulator and/or the active regulator is in operation and to check the monitor valve for tightness.

Also for practical reasons it is recommended to mount a valve (A1 and A2) in the feeding line of the pilots in order to be able, in case of leakage, to easily determine which component is leaking.
If required, Gorter Controls B.V. can supply such valves. These valves meet high safety demands and are 'self (spring) opening', thus preventing any failure to open the valve when the regulating system is put back in operation. These valves are available under type indication ZV-O.

For ease of inspection and replacement of the valve seal, it is recommended:

A in applications with an outlet pressure < 10 bar, to mount a valve in the pipeline between connection 3 of the pilot and connection 6 of the active regulator/monitor regulator (A3 and A4).

B in applications with an outlet pressure >= 10 bar, to mount an extra valve which, in an unpressurised situation, can easily put a pressure of approximately 1 bar in the control chamber of the regulator/pilot.

Depending on the weight of the regulators, it is recommended to make provisions for hoisting facilities on location.

NB. In the remainder of this documentation it is taken for granted that above mentioned practical provisions have been made.

The size of the connections has been shown in tables 4 to 7.

Connection	Size	Pipe outside diameter	Function
0	1/4"BSP	10	pressure gauge connection stabiliser pressure
1	1/4"BSP	10	feeding inlet pressure Pi
2	1/4"BSP	10	measuring outlet pressure Po
3	1/4"BSP	10	feeding control chamber

Table 4: Connections pilot P095-xPS

Connection	Size	Pipe outside diameter	Function
2	1/4"BSP	12	blowoff from control chamber to outlet pressure Po
3	1/4"BSP	10	connection control chamber
4	1/4"BSP	10	measuring outlet pressure Po

Table 5: Connections acceleration pilot AP095-xP

Connection	Size	Pipe outside diameter	Function
6	3/8"BSP)*	10	connection control chamber
7	1/2"BSP	Minimum 16	measuring outlet pressure Po

Table 6: Connections gas pressure regulator R100S

Connection	Size	Pipe outside diameter	Function
6	3/8" BSP)*	10	connection control chamber
7	1/2" BSP	minimum 16	measuring outlet pressure Po
8	1/4" BSP	10	outlet pressure Po to balance valve

Table 7: Connections monitor regulator R100S-M

)* Size will be changed into 1/4"BSP

3.2 Some remarks

- In applications where the ambient temperature may drop far below 0 degrees Celcius, the indicated precision may only be achieved when the pilots are heated. In this case we can think of outside installations.

- Depending on the gas composition, gas temperature in combination with the process pressure drop, it may be necessary to provide the pilots' feeding with a preheater. This to prevent possible freezing.

- For all 10 mm instrumentation pipe, 12 mm may also be used.

As the active regulator and monitor regulator are very similar, type indication is not only stamped into the nameplate, but also in large letters on the housing of the regulators. To highlight this indication, and thus prevent any mistakes in practice, it is strongly advised to mark this indication with a different, eye-catching colour. (only if the unit is purchased as a system).

- If the P095 is used as a pressure control regulator in combination with a gas pressure regulator other than type BAAI-R100S, the nominal diameter of the instrumentation pipe for bottom coupling of the regulator (connection 7) should be 16 mm minimum. The capacity of the P095 may be adapted on request.

- The distance between the regulator (incl. reducing pipe) and the connection of the bottom-coupling of the regulator (7) and the pilot (2) should be at least 5 x the nominal diameter of the outlet pipe-piece.

- If allowed, when using the P095 in combination with the BAAI R100S and regulated pressures < 10 bar, it is useful to mount a valve in the control line (connection 3 of the P095 and connection 6 of the regulator). By closing this valve, before unpressurising the regulating line, the valve of the regulator remains open. In this way it is easy to inspect or replace the valve rubber. In addition, the valve may be used in the event of a failure analysis.

- For regulated outlet pressures = >10 bar, it is possible to make special provisions to fill the control chamber with gas after the regulating line has been unpressurised. A pressure of 1 bar is more than enough to fully open the valve (maximum 9 bar).

- In addition, it is also useful to mount a valve in the feeding line of the pilot (connection 1). In this way it is very easy to find out whether the pilot or the regulator is untight in case of leakage (see chapter 6 on failure).

4. Operation regulating system

4.1 Commissioning notes (Single stage pressure reduction system)

Warning

Never pressurize a reducing run by first opening the outlet block valve. This may provoke overload of the valve internals and diaphragms.

Pressurizing and depressurizing needs time, don't push it !

Before getting started:

The reducing run between the slam shut or inlet block valve and the outlet block valve should be completely depressurized (check if the outlet block valve is closed).

To depressurize the run:

- Isolate the gas run and slightly open the purge valve
- Do not relax the setpoint adjusting screw of the pilot until after the run is depressurized.

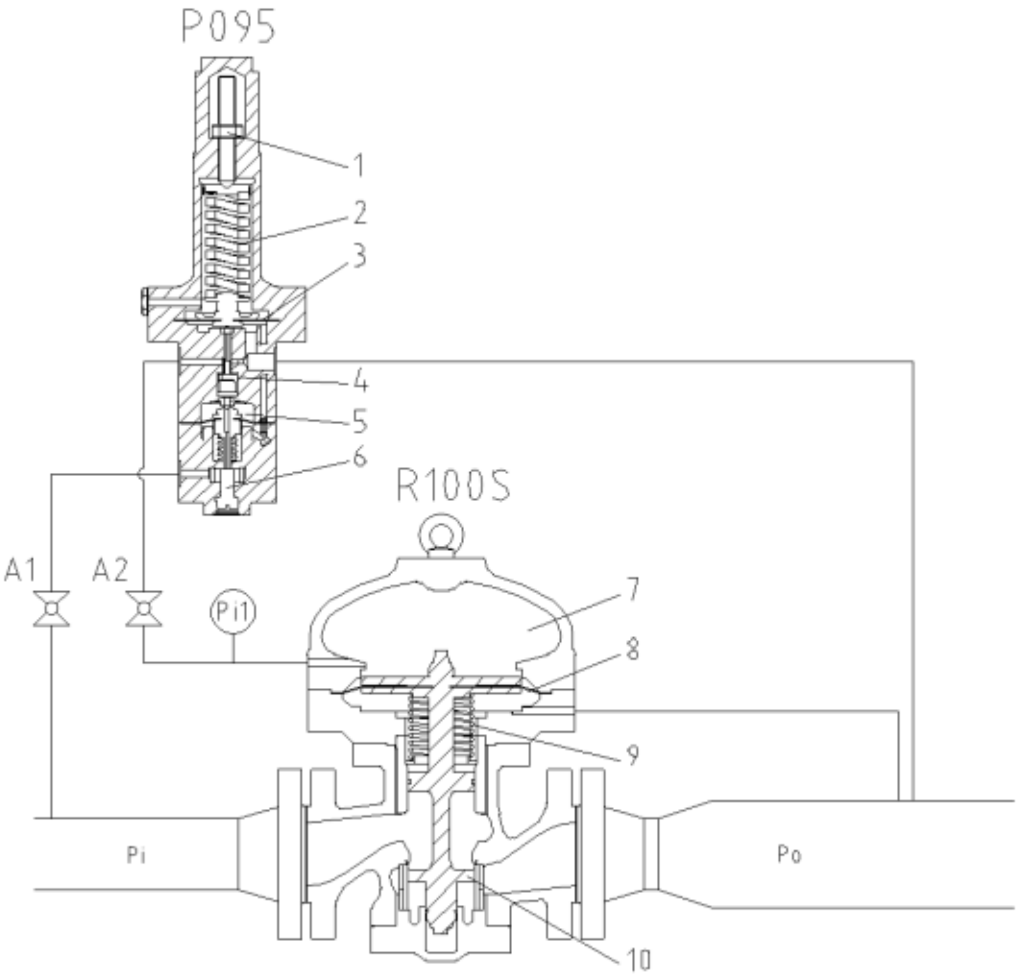


Figure 7 Schematic diagram BAAI-R100S + P095-xPS

A1 + A2 +Pi1 recommended

Recommendations:

Prior to commissioning and start-up consider the following :

- Any water residue left from hydrostatic testing will cause trouble to the operation of both main line valves and pilots; therefore purge and dry the upstream pipe line thoroughly and increase the outlet temperature temporarily.

- Any particles left from welding, grinding, tapping or any solid contamination resulting from corrosion in the piping between filter and regulator (also the heat exchanger) will damage the valve disc and/or it's guide cylinder, therefore clean this part thoroughly.

Should contamination be found then act as follows to minimize damage:
- Remove bottom cover (incl. silencer and cage) of main line valve.
- Remove valve plug and stem guide spacer.
- Purge the run thoroughly via the open regulator.
- Assemble the regulator without silencer and cage.
- Refit the silencer and cage only if contamination can be excluded.

Check all instrument lines for proper arrangement and all fittings for proper connection
Provide 'emergency' spares

Sequence of Commissioning

1. Remove closure nut, then fully unscrew the adjusting screw (1) on top of the pilot

2. Preset the auxiliary pressure of the pilot:
- Fully turn the adjusting screw (located at bottom of the pilot) inward (CW)* carefully until it just stops on to the seat inside
- Then screw the adjusting screw out again (turning CCW)** one (1) complete turn

3. Slowly pressurize the regulator and pilot by either cracking the upstream block valve or opening the bypass over the slam shut valve(s).

4. Adjust the auxiliary pressure:

The minimum setting for the auxiliary pressure differential on P095 pilots should be as follows :

Note: "Differential" refers to the difference between the setpoint of the auxilliary pressure and the setpoint pressure of the pilot.

- 2..6 bar normal range for general purpose
- 2 bar lower end of range, used to slow-down pilot response (small regulators)
- 6 bar higher end of range, used to speed-up pilot response (large regulators)

Adjustment notes:
- adjust pilots for active regulators to approx. 3 bar pressure differential
- adjust pilots for monitor regulators to approx. 4 bar pressure differential
- make adjustments to the auxilliary pressure adjusting screw only when the pilot is operating (supplying condition)
- adjust the set screw carefully, checking after each adjustment for lock-up

Check if fine-tuning is required after commisioning the equipment
- adjust auxiliary pressure differential to slow-down or speed-up the pilot response
- if the aux. setting has been adjusted, then correct the setpoint

So without the need for adjustment the auxiliary pressure differential should range between 3 and 4 bar above outlet pressure

)* CW=ClockWise
)** CCW=Counter ClockWise

5. Check the regulator for lock-up.
- First unload or relax the set spring of the pilot.
- Slowly apply full inlet pressure to the upstream side of the regulator by either cracking the block valve or opening the bypass of the slam shut valve.
- Check the downstream pressure for leakage of the MLV* and the pilot

6. If necessary ***slowly*** turn adjusting screw of pilot (1) CW to increase the outlet pressure above the UPSO** setting of the slam shut valve(s).

7. Open the slam shut valve.

8. Check or set the slam shut valve.
- Increase the outlet pressure to the OPSO*** setting by slowly turning the adjusting screw (1) of the pilot CW.
- For adjustment itself consult the manual of the relevant slam shut.
- Repeat this action to test the safety relief valve (to be blocked while testing the SSV).

9. Check and test the regulator.
- Slightly open the purge valve and decrease the outlet pressure by slowly turn the adjusting screw (1) of pilot CCW.
- Close the purge valve to check the regulator and pilot for lock-up (tightness).

10. Check operation by opening the outlet block valve
Normally the regulator will be set slightly lower than the network pressure. The pilot setting can be increased and fine-adjusted to it's setpoint after fully opening the outlet block valve

11. After completing commissioning lock the adjust screw with the closure nut

12. To take the run out of operation and depressurize it, act as follows :
- Close the inlet block valve
- Allow the pressure upstream of the regulator to drop to outlet pressure
- Close the block valve in the supply to the pilot (if provided)
- Close the outlet block valve
- Slightly open the downstream purge valve to depressurize the run

)* MLV=Main Line Valve
)**UPSO= Under Pressure Set Operation
)***OPSO= Over Pressure Set Operation

4.2 Commissioning notes (Wide-open monitor regulating system)

Warning

Never pressurize a reducing run by first opening the outlet block valve. This may provoke overload of the valve internals and diaphragms.

Pressurizing and depressurizing needs time, don't push it !

Before getting started:

The reducing run between the slam shut or inlet block valve and the outlet block valve should be completely depressurized (check if the outlet block valve is closed).

To depressurize the run:
- Isolate the gas run and slightly open the purge valve
- Do not relax the setpoint adjusting screw of the pilot until after the run is depressurized.

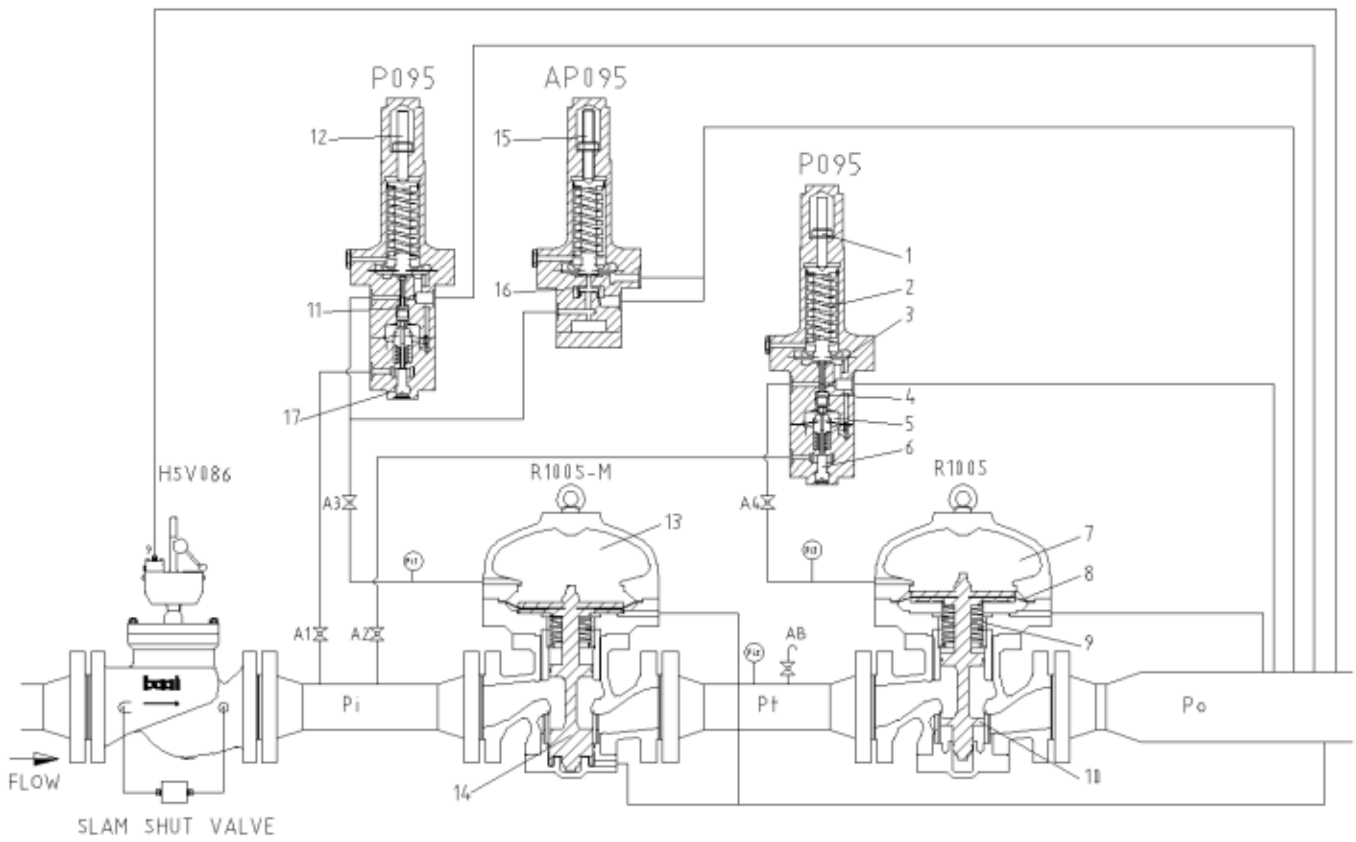


Figure 8 Schematic diagram wide-open monitor regulating system with:
BAAI-R100S(+P095-xPS) +R100SM(+P095-xPS+AP095-xP)
A1 – A4 + Pi1-P12 recommended

Recommendations:

Prior to commissioning and start-up consider the following :

- Any water residue left from hydrostatic testing will cause trouble to the operation of both main line valves and pilots; therefore purge and dry the upstream pipe line thoroughly and increase the outlet temperature temporarily.

- Any particles left from welding, grinding, tapping or any solid contamination resulting from corrosion in the piping between filter and regulator (also the heat exchanger) will damage the valve disc and/or it's guide cylinder, therefore clean this part thoroughly.

Should contamination be found then act as follows to minimize damage:

- Remove bottom cover (incl. silencer and cage) of the monitor main line valve.
- Remove piston, valve plug and stem guiding.
- Purge the run thoroughly via the open monitor.
- Assemble the monitor without silencer and cage.
- Refit the silencer and cage only if contamination can be excluded.
- Repeat this action for the regulator.

Check all instrument lines for proper arrangement and all fittings for proper connection
Provide 'emergency' spares

Sequence of Commissioning

1. Remove closure nut, then fully unscrew the adjusting screw (1) on top of the pilot from both the regulator and monitor

2. Turn adjusting screw (15) of the accelerator fully inwards (CW)

3. Preset the auxiliary pressure of the pilot:
   - Fully turn the adjusting screw (located at bottom of the pilot) inward (CW) carefully until it just stops on to the seat inside
   - Then screw the adjusting screw out again (CCW) one (1) complete turn

4. Slowly pressurize upstream of the monitor by either cracking the upstream block valve or opening the bypass over the slam shut valve(s)

5. Adjust the auxiliary pressure:

The minimum setting for the auxiliary pressure differential on P095 pilots should be as follows :

Note: "Differential" refers to the difference between the setpoint of the auxilliary pressure and the setpoint pressure of the pilot.

- 2..6 bar above the regulator setpoint is the normal range for general purpose
- 2 bar lower end of range, used to slow-down pilot response (small regulators)
- 6 bar higher end of range, used to speed-up pilot response (large regulators)

Adjustment notes:

- adjust pilots for active regulators to approx. 3 bar pressure differential
- adjust pilots for monitor regulators to approx. 4 bar pressure differential
- make adjustments to the auxilliary pressure adjusting screw only when the pilot is operating (supplying condition)
- adjust the set screw carefully, checking after each adjustment for lock-up

Check if fine-tuning is required after commisioning the equipment

- adjust auxiliary pressure differential to slow-down or speed-up the pilot response
- if the aux. setting has been adjusted, then correct the setpoint

So without the need for adjustment the auxiliary pressure differential should range between 3 and 4 bar above outlet pressure

6. Check the monitor for lock-up.

- Completely unwind the adjustment screws of both the active and the monitor pilots
- Slowly apply full inlet pressure to upstream of the monitor by either cracking the upstream block valve or opening the bypass of the slam shut valve.
- Check the intermediate pressure for leakage of the MLV
- Check the downstream pressure for leakage of both pilots
- Take note that test valves A1 and A2 enable differentation between the pilots.

7. Check the regulator MLV for lock-up.

- Put full inlet pressure upstream of the regulator by tensioning the set spring of the monitor pilot temporarily until it opens.
- Completely unwind the adjustment screws of both the active and the monitor pilots
- Use the bypass valve of the slam shut valve if nessessarry to repressurise upstream of the monitor.
- check the outlet pressure for leakage of the MLV

Note that the regulator pilot has been checked already

8. Fail the regulator wide-open

- By advancing the adjusting screw (1) fully inward. Open the purge valve slightly to depressurize the outlet and vent the pilot bleed of the regulator

9. If necessary *slowly* turn adjusting screw of pilot (12) CW to increase the outlet pressure above the UPSO setting of the slam shut valve(s).

10. Open the slam shut valve.

11. Check or set the slam shut valve.
- Increase the outlet pressure to the OPSO setting by slowly advancing the adjust screw (12) of the monitor pilot.
- For adjustment itself consult the manual of the relevant slam shut valve.
- Repeat this action to test the safety relief valve (to be blocked while testing the SSV)

12. Check or set the accelerator.
- Decrease the outlet pressure to the accelerator setting by slowly backing out the adjust screw (12) of the monitor pilot
- Now open the purge valve enough to open the monitor MLV
- Back out the adjust screw (15) of the accelerator until it interferes with the pressure control.
- A slight drop in the outlet pressure indicates activation of the accelerator pilot

13. Set and check the monitor.
- Decrease the outlet pressure by slowly backing out the adjusting screw of the monitor pilot (12) CCW.
- Open and close the purge valve to check the monitor for response
- Be aware of the pilot bleed from the active regulator which is searching for a higher setpoint at this time.

14. Set and check the regulator.
- Decrease the outlet pressure by slowly backing out the adjusting screw of the regulator pilot (1) CCW.
- Take note that the regulator does not have an accelerator pilot to speed-up take over.
- Open the purge valve enough to vent the pilot bleed of the monitor.
- A rise of the intermediate pressure indicates take-over
- Open and close the purge valve to check the regulator for response.
- Be aware of the pilot bleed from the monitor regulator which is searching for a higher setpoint at this time.

15. Check the system for lock-up.
- Close the purge valve.
- Check the outlet pressure for leakage.
- The outlet pressure will first rise to regulator lock-up, then rise to monitor lock-up.
- A further rise will occur as the pressure from the monitor motorization is equalized with the outlet pressure.
- You may vent temporarily a little to reduce this outlet pressure to monitor lock-up

16. Check operation.
- Slowly open the outlet block valve. Normally the regulator will first be set a slightly lower than the network pressure. The pilot setting can be increased and adjusted to it's final setpoint after fully opening the outlet block valve.

17. After completing commissioning
- Lock the adjust screws with the closure nuts provided for this purpose.

18. To take the run out of operation and depressurize it, act as follows :
- Close the inlet block valve.
- Allow the pressure upstream of the regulators to drop to outlet pressure.
- Close the block valve in the supply to the pilots (if provided).
- Close the outlet block valve.
- Slightly open the downstream purge valve to depressurize the run.

4.3 Recommendations choice of setpoints

Setpoint pilot for regulator P095: x bar
Regulator:

The setpoint of the regulator should be choosen low enough to enable trouble-free relatching of the slam shut. (the minimum relatching differential)

Setpoint pilot for monitor P095: (x+1) bar
Monitor:

The setpoint of the monitor regulator should be chosen high enough to avoid interference during dynamic response of the regulator.

Setpoint acceleration pilot for monitor:

The following setpoint is advised:

setpoint AP095-MP/HP : (x+2) bar

4.4 Taking out of operation for servicing purposes

During or before unpressurising the regulating system it is **not allowed** to screw back the adjusting screw of the P095, otherwise the stabiliser part will be unnecessarily loaded.

1. Close the safety shut-off valve. Wait until the pressure in the pipe-piece before the monitor regulator is equal to the mains pressure. Then close the end valve.

If gas supply has to continue, the active regulator of any second line will take over regulating.

2. Unpressurise the installation by opening a manual blow-off at the (inlet and) outlet side of the line.

Warning	
CAREFUL:	Some pressure may temporarily remain in the control chamber of both the active regulator and monitor regulator (connections 6, figure 6).
	Therefore always watch pressure gauges Pi1 and Pi3.
	If any gas pressure remains, these spaces can be unpressurised by opening the bleed screws on the pressure gauge cocks.

4.5 Commissioning pre-set regulating line

This procedure can be followed when the setpoint of the active regulator and monitor regulator have been pre-set and re-setting or adjusting is not necessary.

Starting situation: system or regulating line is completely unpressurised.

1. ***Slowly*** bring the part before the monitor regulator up to pressure by means of the bypass of the safety shut-off valve.

2. The outlet pressure will now slowly rise. When it is equal to the setpoint of the active regulator, the safety shut-off valve(s) can first be opened and then *slowly* the end valve.

4.6 Putting stand-by (seasonal demand)

If you opt for putting a station stand-by due to seasonal demand, it is recommended to lower the setpoint of the active regulator(s). However, it should always be taken into account that the monitor pilot always runs off a little to the outlet side, as the monitor valve generally remains open. (N.B. the system is non-bleed in a fully closed situation).

4.7 Adjusting stabiliser pressure \ auxiliary pressure

The auxiliary pressure is the output of the first control stage of the P095 and is adjustable between approx. 2 and 6 bar above the outlet pressure. The 1st stage of the pilot determines the accuracy of the regulator and can be changed by adjusting it's setting with screws (6) and (17).

- High settings (turn CCW) result in higher amplification which equals improved accuracy and faster response of the pilot control loop. However settings that are too high may provoke instability.
- Low settings (turn CW) result in lower amplification which equals more stability and slower response of the pilot control loop. Settings that are too low may disable a valve to open (partly or fully).

Always check if the setting of the auxiliary pressure differential meets the installed operating conditions during set-up and testing. See also 'commissioning notes'

The amount of care to be taken while adjusting the auxiliary pressure must be accentuated as this may cause many problems during commissioning and start-up.

Mind that, by adjusting the stabiliser pressure, the setpoint of the relevant pilot also changes and in case of the monitor pilot, the setpoint of the acceleration pilot also changes. Adjustment of these setpoints after the stabiliser pressure has been changed is therefore essential.

4.8 Exchanging setpoint spring P095

A situation may occur when it is required to exchange the setpoint spring of the P095 because, for instance, to realise another regulated outlet pressure or influence the pilot action.

For this exchange, it is easy to unscrew the adjusting screw (1, 12 or 15 of fig.5 page15) and then the screw swivel in the spring housing. It is not necessary to unpressurise the installation! However, the regulating line must be taken out of operation.

When exchanging the setpoint spring of the acceleration pilot AP095 and the P095 belonging to the monitor regulator, the installation must be re-tested.

4.9 Periodic function test

Testing active regulator and monitor regulator for tightness

Characteristic of the regulating system with monitor regulator is that the closing pressure of the system corresponds to the closing pressure of the monitor regulator. The monitor regulator and active regulator, as a combination, can easily be tested for tightness by slowly closing the end valve of the line.

Tightness active regulator and pilots:
The outlet pressure may no longer run up after the pressure on the pressure gauge on the monitor regulator is equal to the outlet pressure (takes some minutes, depending on the size of the monitor regulator). Is this the case after all, and pressure gauge Pi2 on the pipe-piece between monitor regulator and active regulator indicates that the pressure is dropping, then there is leakage over the active regulator. Otherwise there is leakage over one of the pilots (apart from leakages over the bypasses, that is).

Tightness monitor regulator:
Open the valve (blow-off) on the pipe-piece between monitor regulator and active regulator and let the pressure in the pipe-piece drop until almost equal to the outlet pressure. Close this valve and wait for some minutes. If the pressure in this pipe-piece (Pt) increases, the monitor valve is untight.

In case of leakage you are referred to chapter 6 on failure.

4.10 Increase of the outlet pressure at zero offtake

See also figures 6 and 7.

It should be taken into account that under normal conditions and at zero offtake the pilot of the monitor regulator always runs off a little until the monitor valve has fully closed itself. ***The closing pressure of the regulating system is therefore always the closing pressure of the monitor regulator.***

If at zero offtake the outlet pressure still increases after a few minutes, then there is leakage in one of the components of the regulating system. Assuming that the bypasses are not leaking.

First of all, find out which component is untight.

1. AP095
Fully screw in adjusting screw 16 of the acceleration pilot AP095-xP. If the outlet pressure still increases, this acceleration pilot can be ruled out. If not, the internal sealing of the acceleration pilot has to be inspected.

2. P095
A
If there are valves in the feeding lines of the pilots P095-xPS (connection 1, valves A1 and A2) this simplifies the analysis. Close these valves and slightly screw in the adusting screw of both pilots in order to exchange the pressure in the stabiliser space with the outlet pressure. If the outlet pressure still increases after some time, the main regulator is bound to be leaking.

If this is not the case, open the valve in the feeding line of the regulator-pilot A2. If the outlet pressure increases, the pilot of the active regulator is leaking. If not, the pilot of the monitor regulator is leaking.

B
If there are no valves in the feeding line of the pilots (connection 1, figure 7), the line must be taken out of operation and unpressurised. Next, fully unscrew the adjusting screws of both the monitor and the regulator pilots. Unscrew the coupling on connection 2 of both pilots. Put some pressure before the monitor regulator. Check at both pilots whether there is a flow at the pilot side of connection 2. If so, then the pilot has a leak.

3. active regulator R100S
If neither of the pilots has a leakage, then check the pressure gauge on the pipe-piece between active regulator and monitor regulator. Should it indicate a decreasing pressure while the pressure before the monitor regulator remains constant, then the active regulator is leaking.

5. Maintenance

5.1 General

5.1.1 Life and types of maintenance work

Under normal operating conditions, when the medium is clean and dry and does not contain any constituents which are harmful to the materials applied, life without any maintenance is 4 years minimum.

Generally, seals and diaphragms (the so-called soft parts) are to be replaced during maintenance work.

Gorter Controls B.V. has composed special spare-part sets for its equipment which already contains all the necessary parts for standard maintenance.

5.1.2 Maintenance requirements

Gorter Controls B.V.'s equipment has been designed in such a way that no special tools are required for maintenance. Valves and pistons are provided with tapped holes to which simple pulling tools may be connected.

Lubricants:

Molykote BR2 plus
Molykote copper paste CU-7439-plus
Multigrease White Applied 8255

Oil:

Shell Madrela GS 68 or Tellus 15

Adhesive:

Loctite 243

5.1.3 General maintenance regulations

Unless otherwise indicated, all screw and bolt connections <M10 are to be greased with a graphite-containing high-pressure grease. We would advise Molykote BR2 plus.

Screw and bolt connections >M10 are to be greased with copper-containing grease. We would advise Molykote copper paste.

For both assembly and preservation purposes, all O-rings are to be greased with a suitable product. We would advise Molykote BR2 plus.

All guiding surfaces are to be treated with a suitable grease. We usually advise Molykote BR2 plus. *Normally, the guiding surfaces must be greased very thinly.*

5.2 Disassembly and assembly

5.2.1 General

Place all loose internal components on a clean cloth during assembly, prevent sand or other dirt from soiling these components or from damaging them. Clean all disassembled components well and then grease them as per the directions.

5.2.2 Disassembly and assembly pilot

There is no need to unpressurise the entire installation in order to replace the set spring for any process adaptation. The lock nut can simply be removed and a new set spring fitted. For details you are referred to Appendix A (page 31).

5.2.3 Disassembly and assembly regulator and monitor *

To simplify assembly and disassembly of the regulator, built into the regulating installation, the construction has been opted for where all components can be removed upwards (with the exception of the bottom cover).

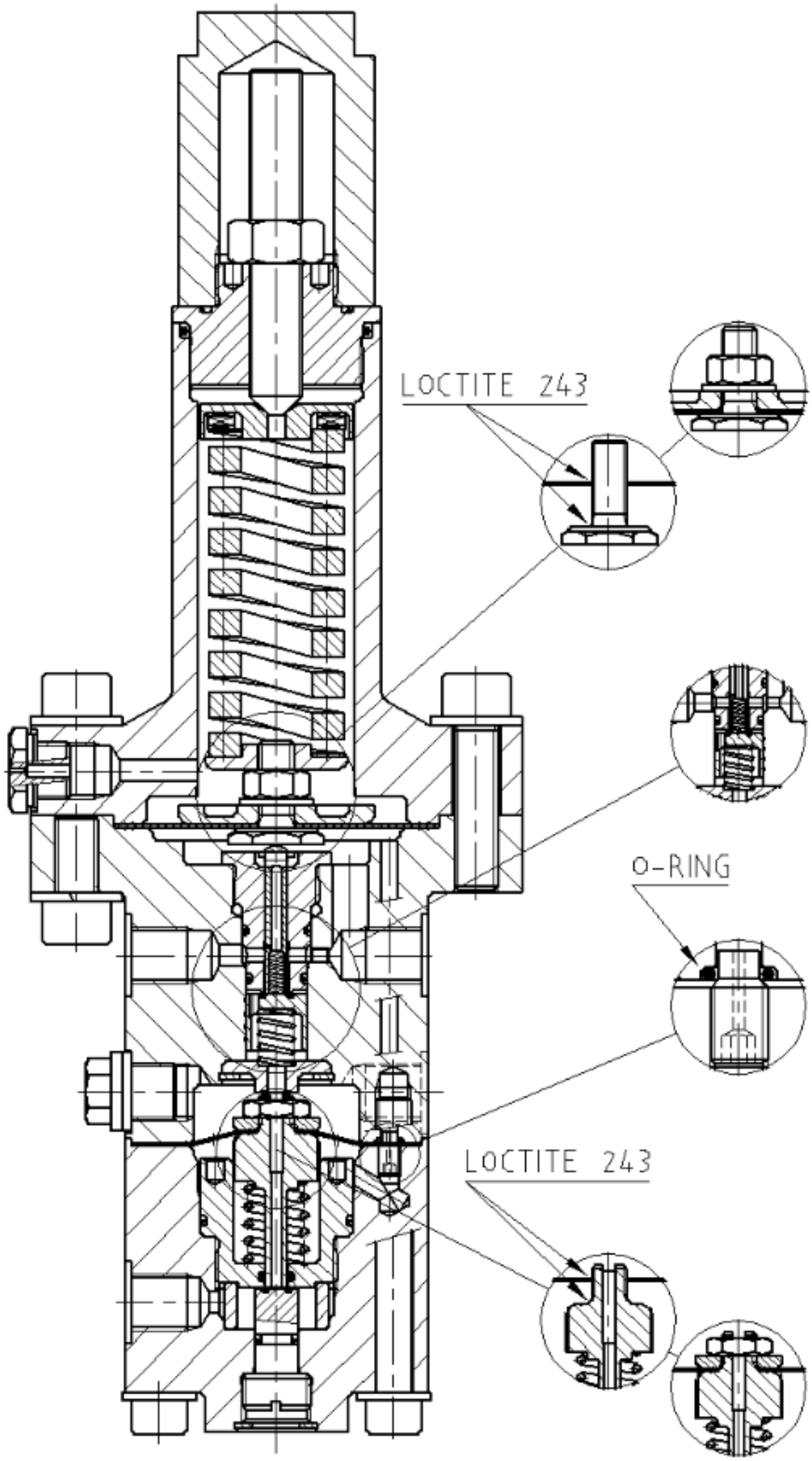
For instance, after unscrewing the nuts below the top flange of the valve body, the diaphragm housing can be removed upwards, complete with all internal parts.
Mounting this unit is to be done with care to prevent damage to the "O"-ring around the guide bush.
It is also possible to remove the components one by one.

The compensation piston of the regulator is lubricated with oil (Shell Madrela GS 68).
When the regulator has been completely disassembled, this oil has been lost and after fitting the compensation piston the space above this piston has to be refilled. For details you are referred to Appendix B (page 32).

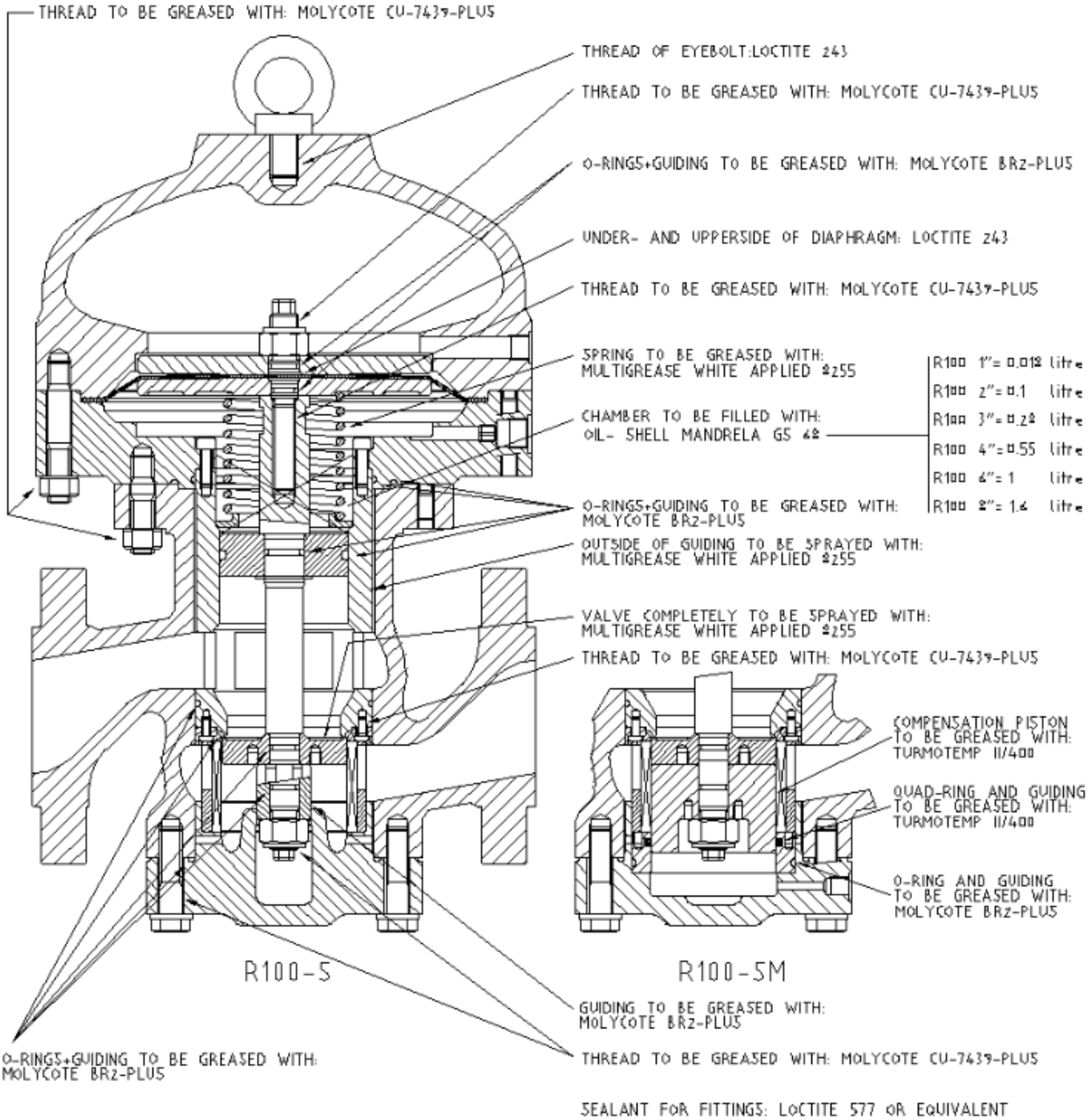
After completion of maintenance and after a tightness test, the regulating system can be re-tested and taken into operation.

* Only to be done by certified engineers

Appendix A



Appendix B


THREAD TO BE GREASED WITH: MOLYCOTE CU-7439-PLUS
THREAD OF EYEBOLT:LOCTITE 243
THREAD TO BE GREASED WITH: MOLYCOTE CU-7439-PLUS
O-RINGS+GUIDING TO BE GREASED WITH: MOLYCOTE BR2-PLUS
UNDER- AND UPPERSIDE OF DIAPHRAGM: LOCTITE 243
THREAD TO BE GREASED WITH: MOLYCOTE CU-7439-PLUS
SPRING TO BE GREASED WITH: MULTIGREASE WHITE APPLIED 8255
CHAMBER TO BE FILLED WITH: OIL- SHELL MANDRELA G5 68
R100 1"= 0.018 litre
R100 2"= 0.1 litre
R100 3"= 0.28 litre
R100 4"= 0.55 litre
R100 6"= 1 litre
R100 8"= 1.6 litre
O-RINGS+GUIDING TO BE GREASED WITH: MOLYCOTE BR2-PLUS
OUTSIDE OF GUIDING TO BE SPRAYED WITH: MULTIGREASE WHITE APPLIED 8255
VALVE COMPLETELY TO BE SPRAYED WITH: MULTIGREASE WHITE APPLIED 8255
THREAD TO BE GREASED WITH: MOLYCOTE CU-7439-PLUS
COMPENSATION PISTON TO BE GREASED WITH: TURMOTEMP II/400
QUAD-RING AND GUIDING TO BE GREASED WITH: TURMOTEMP II/400
O-RING AND GUIDING TO BE GREASED WITH: MOLYCOTE BR2-PLUS
R100-5
R100-5M
GUIDING TO BE GREASED WITH: MOLYCOTE BR2-PLUS
THREAD TO BE GREASED WITH: MOLYCOTE CU-7439-PLUS
O-RINGS+GUIDING TO BE GREASED WITH: MOLYCOTE BR2-PLUS
SEALANT FOR FITTINGS: LOCTITE 577 OR EQUIVALENT

5.3 Off-line tightness test pilot

The off-line tightness test is optional.

If a feeding line (instruments air or the medium itself) is available, an off-line tightness test can be done. This feeding line can then be connected to connection 1 of the pilot (see figure A2 for pilot connections). Unscrew the closure nut and ensure that the adjusting screw is completely unscrewed (1).

The pilot pressure gauge should now indicate the stabiliser pressure (auxiliary pressure). This should be in the set range from 2 to 6 bar. If there is no pressure in this space, it is possible that stabiliser valve 37 remains stuck. The stabiliser pressure depends somewhat on the inlet pressure which makes small deviations from the above range possible.

The stabiliser pressure should not increase, otherwise the stabiliser seal is leaking.

Also check whether there is flow from connections 2 and 3. The seal of the second regulating stage is leaking (valve 29 and guide 15) if this is the case.
Now slightly screw in the set screw so that the pilot is going to supply and completely unscrew it again. Re-check for leakage.

The off-line tightness test is always followed by the in-line tightness test.

5.4 In-line tightness test pilot

Internal tightness:

Put the pilot back into the installation, with completely unscrewed adjusting screw (1). Ensure that the regulator has inlet pressure. The outlet pressure should not increase. If so, then there is leakage across the pilot or the regulator.

If there is a valve in the feeding line of the pilot (connection 1), it is easy to find out which component is leaking. Close it and slightly screw in the adjusting screw of the pilot to exchange the pressure in the stabiliser chamber with the outlet pressure. Next, unpressurise the outlet side again and wait for a few minutes. If the outlet pressure has risen again, the regulator is leaking. In this case you should consult the chapter on maintenance in this manual. Otherwise the pilot is leaking.

If there is no valve in the feeding line of the pilot, you can remove the pipe on connection 2 of the pilot and feel whether there is flow from connection 2. If so, there is a good chance that the pilot seal of the second stage is leaking. If not, the regulator is most probably leaking.

In the event of leakage across the pilot, it will have to be removed again for inspection.

Check the pressure gauge of the pilot. The stabiliser pressure has to be within the range from 2 to 6 bar and should not increase, otherwise there is a leak across the stabiliser seal.

Following this, the whole regulating system may be tested for internal tightness at the required setpoint by means of the normal testing procedure as described in the user manual of the regulating system.

Having established leakage it is, in the case of a valve in the feeding line of the pilot, again rather easy to find out which component is leaking. Close this valve and open the manual blow-off until the pressure has dropped below the setpoint. Wait for a few minutes. If the outlet pressure has increased again, the regulator is leaking. In this case you should consult the chapter on maintenance in this manual. Otherwise the pilot is leaking.
If there is no valve in the feeding line, it will not be possible in this situation to find out which component is leaking.

External tightness:
For an external tightness test, all partitions between the different pressurised parts of the pilot should be soaped down or sprayed with a leak-detection spray. Also do this for all couplings, bolt holes, breather opening and the stabiliser set screw (pos. 39, fig. A1).

5.5 Spare-part sets

5.5.1 General

For standard maintenance, Gorter Controls B.V. has put together spare-part sets. The spare parts can be ordered under the numbers mentioned.

When ordering the parts, the following particulars must be supplied:

- Type of regulator, stating connection diameter and pressure stage.
- Manufacturing number and year of construction.
- If no complete set is ordered, the position number and the drawing to which this number relates and the required number of items.

5.5.2 Spare-part set P095

The spare-part set can be ordered under the following numbers:

Type	Number
P095 HPS/MPS	939401S115080

The contents of these sets are specified in the parts list in paragraph 5.6

5.5.3 Spare-part set AP095

The spare-part set can be ordered under the following numbers:

Type	Number
AP095 HP/MP	939401S134270

The contents of these sets are specified in the parts list in paragraph 5.7

5.5.4 Spare-part sets R100S(M)

The spare-part sets can be ordered under the following numbers:

Type	Number	Type	Number
R100S 1"	939402S141830	R100SM 1"	939402S141840
R100S 2"	939402S116920	R100SM 2"	939402S127880
R100S 3"	939402S116930	R100SM 3"	939402S127890
R100S 4"	939402S116940	R100SM 4"	939402S115200
R100S 6"	939402S116950	R100SM 6"	939402S127480
R100S 8"	939402S116960	R100SM 8"	939402S127910

The contents of these sets are specified in the parts list in paragraph 5.8 and 5.9

5.6 P095 MPS/ HPS

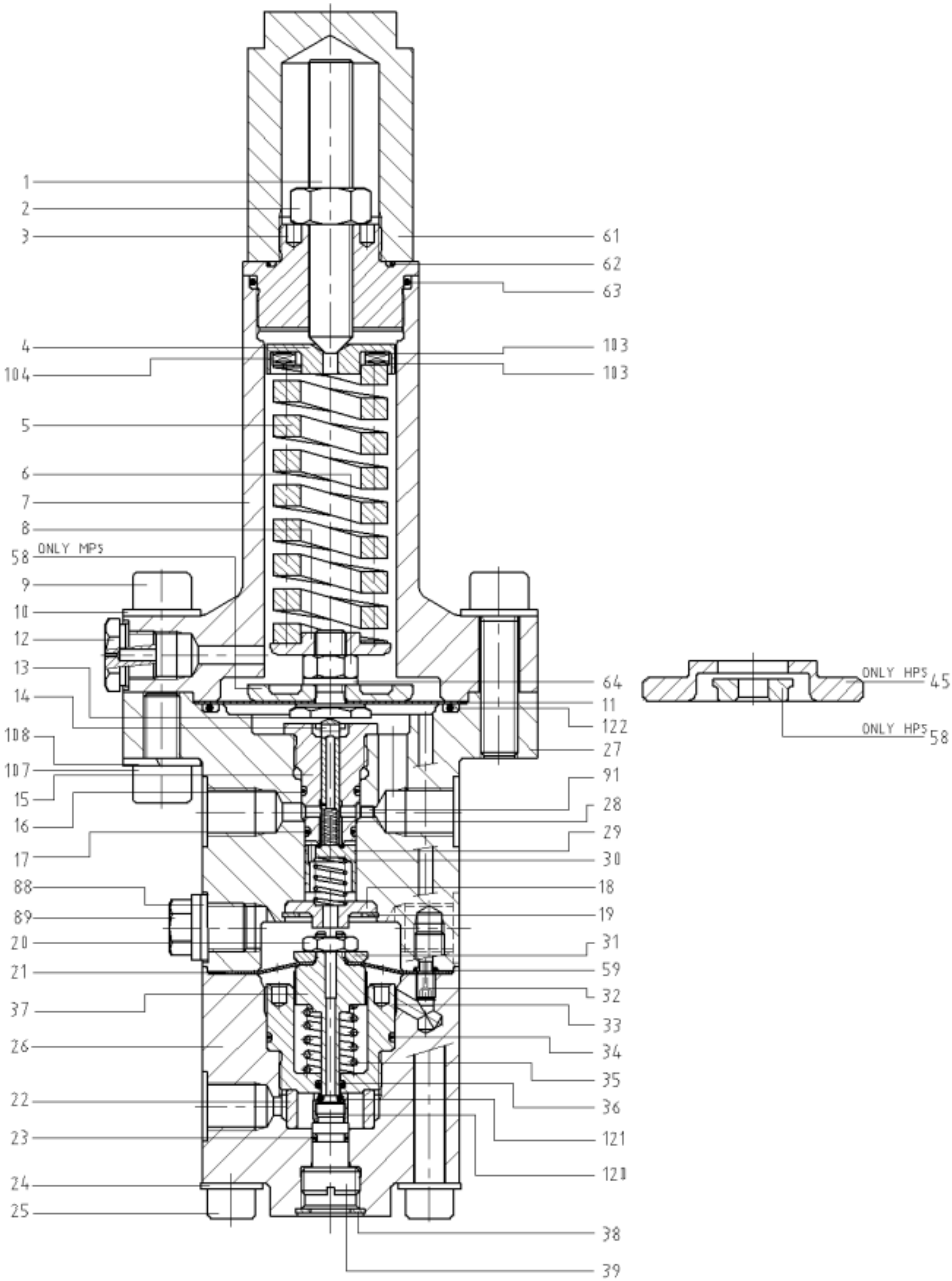


Figure A1: Position numbers P095

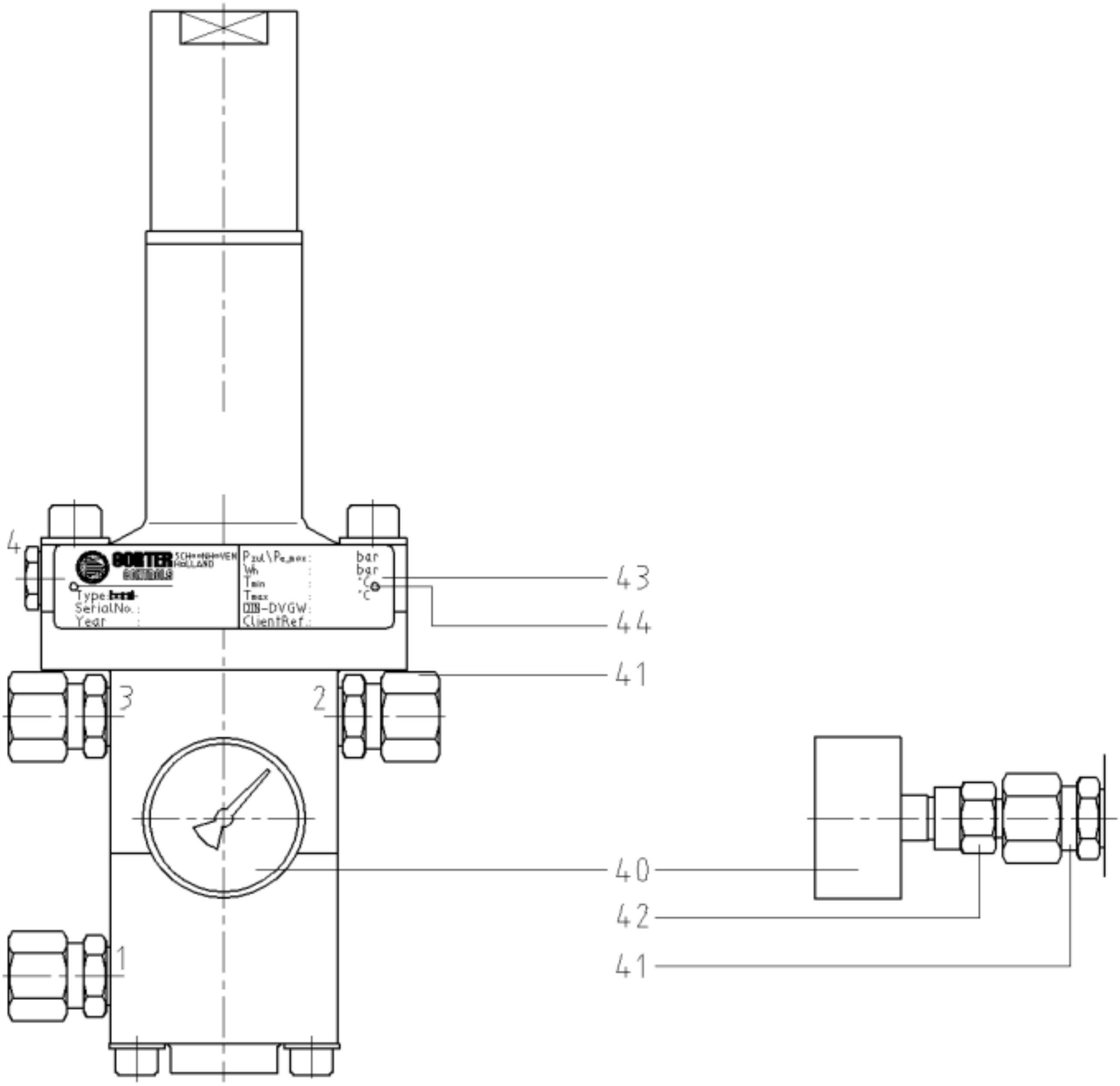


Figure A2: position numbers P095 continued

5.6.1 Partslist P095 MPS/ HPS

Pos	Name	Code no	Spare
01	Set screw	83.03.01.0000031	
02	Hexagon nut	82.01.34.0120125	
03	Lock nut	81.03.00.4114690	
04	Spring seat	81.03.00.4135980	
05	Compression spring	see user manual	
06	Hexagon nut	82.51.08.0080001	
07	Spring housing	81.03.20.3111820	
08	Spring seat	81.03.00.4114670	
09	Socket screw	82.07.16.0100040	
10	Washer	82.38.13.0100001	
11	Diaphragm	93.03.00.4112450	x
12	Plug	81.03.00.4112330	
13	Bolt	81.03.00.4111840	
14	Valve stem	81.03.00.4111860	
15	Guide	81.03.00.4111850	
16	O-ring	84.01.01.2401014	x
17	O-ring	84.01.01.0801013	x
18	Retaining plate	81.03.00.4111880	
19	Circlip	82.36.05.0025001	
20	Low hexagon nut	82.51.09.0080001	
21	Diaphragm	93.03.00.4151780	x
22	Filter	81.03.00.4112130	x
23	O-ring	84.01.00.6801000	x
24	Washer	82.38.13.0080001	
25	Socket screw	82.07.16.0080070	
26	Housing stabiliser	81.03.20.2111890	
27	Housing second pressure stage	81.03.20.2111870	
28	Compression spring	85.01.21.0109700	
29	Valve	93.03.50.4139250	x
30	Compression spring	85.01.22.0215600	
31	Spring seat	81.03.00.4112110	
32	Restriction	93.03.00.4114650	
33	Guide	81.03.00.4111900	
34	O-ring	84.01.03.1501026	x
35	Spring	85.01.21.0128900	
36	O-ring	84.01.00.4501008	x
37	Valve	81.03.00.4133530	x
38	Retainer ring	82.36.05.0018001	
39	Seating stabiliser	81.03.00.4142690	x
40	Pressure gauge	11.01.05.1211322	
41	Coupling	customer dependent	
42	Pressure gauge screwed coupling	customer dependent	
43	Type plate	81.01.00.4146630	
45	Reducing ring	81.03.00.4114660 (P095-HPS only)	
58	Diaphragm disc	81.03.00.4116530 (P095-MPS only)	
59	O-ring	84.01.00.3701007	x
61	Sealing nut	81.03.00.4114700	
62	O-ring	84.01.03.1501026	x
63	O-ring	84.01.03.9402129	x
64	Washer	82.51.93.0080001	
88	Plug	82.07.67.0063001	
89	Ring	82.50.30.2130018	
91	Adjusting screw	82.07.85.0030004	
103	Thrust washer	83.02.01.0000006	
104	Trust bearing	83.02.01.0000004	
107	Socket screw	82.07.16.0100020	
108	Spring washer	82.37.02.0100001	
120	Nut	81.03.00.4142700	x
121	O-ring	84.05.00.3701007	x
122	O-ring	84.01.05.9903229	x

5.7 AP095 MP/ HP

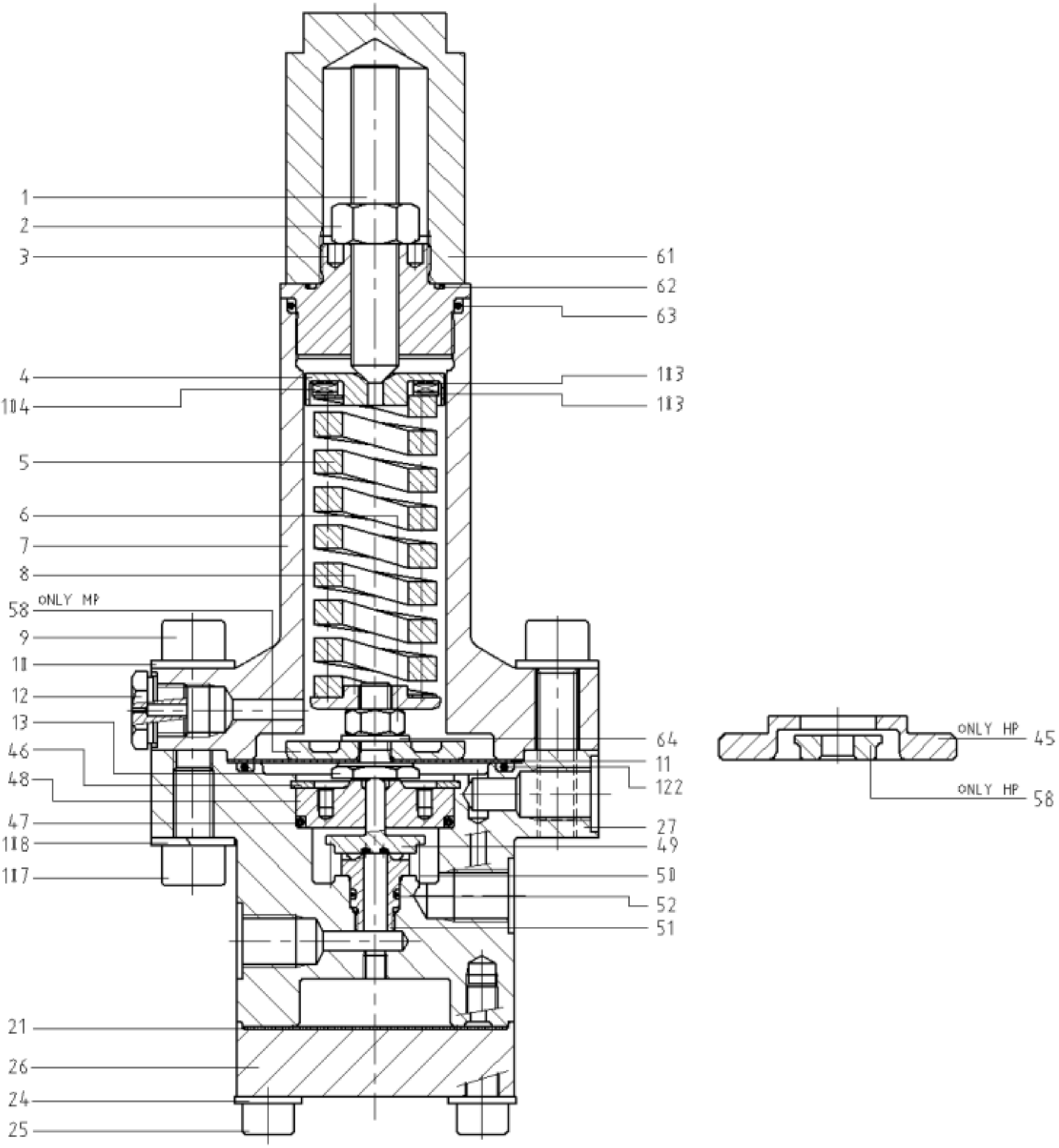


Figure B1: Position numbers AP095

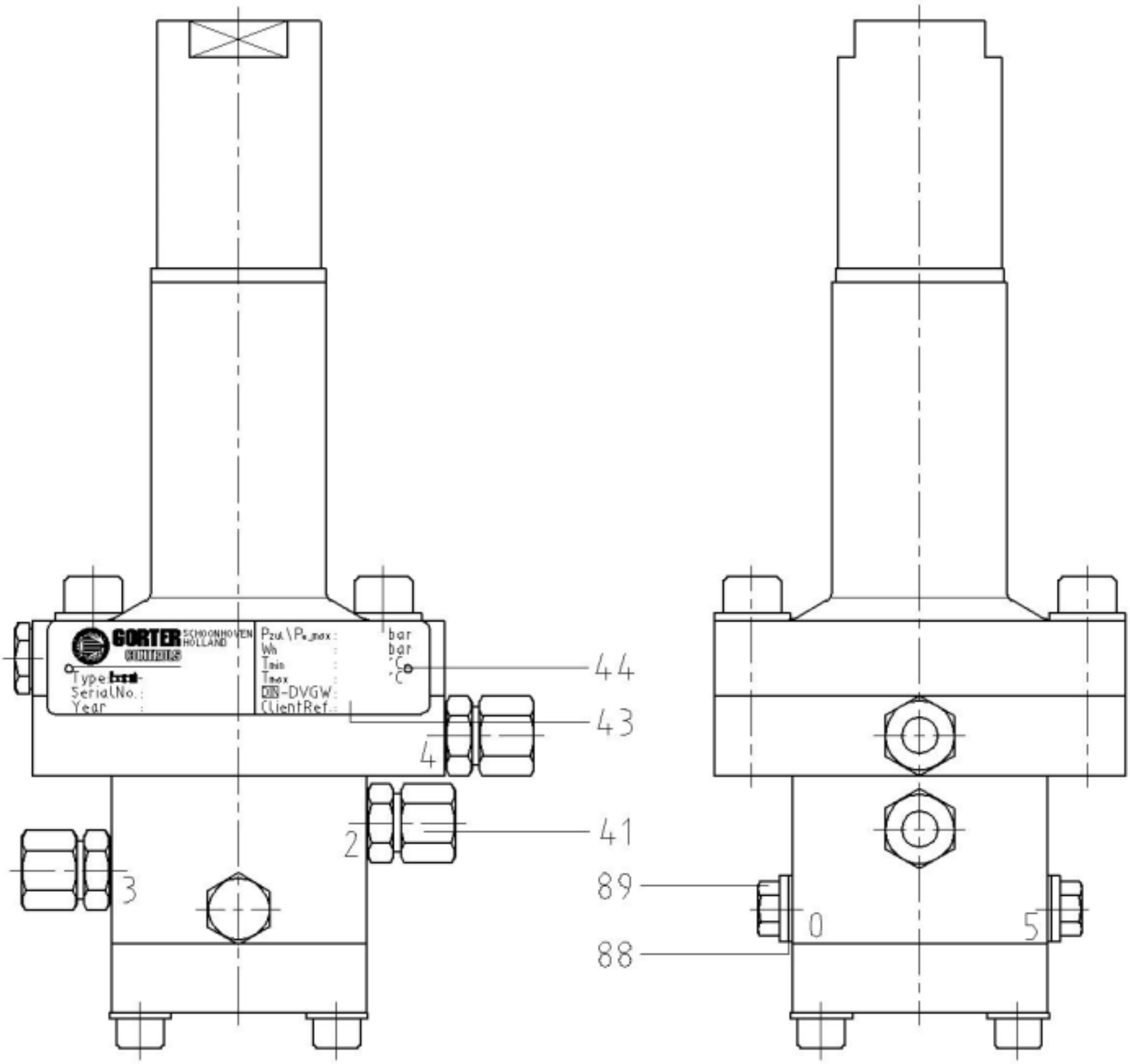


Figure B2: position numbers AP095 continued

5.7.1 Partslist AP095 MP/ HP

Pos	Name	Code no	Spare
01	Set screw	83.03.01.0000031	
02	Hexagon nut	82.01.34.0120125	
03	Lock nut	81.03.00.4114690	
04	Spring seat	81.03.00.4135980	
05	Compression spring	see user manual	
06	Hexagon nut	82.51.08.0080001	
07	Spring housing	81.03.20.3111820	
08	Spring seat	81.03.00.4114670	
09	Socket screw	82.07.16.0100040	
10	Washer	82.38.13.0100001	
11	Diaphragm	93.03.00.4112450	x
12	Plug	81.03.00.4112330	
13	Bolt	81.03.00.4111840	
21	Diaphragm	93.03.00.4113470	x
24	Washer	82.38.13.0080001	
25	Socket screw	82.07.16.0080030	
26	Cover	81.03.20.4113420	
27	Housing	81.03.20.2113370	
43	Type plate	81.01.00.4146630	
45	Reducing ring	81.03.00.4114660 (P095-HP only)	
46	Circlip	82.36.05.0040001	
47	O-ring	84.01.03.4503220	x
48	Guide	81.03.00.4113340	
49	Valve	93.03.50.4113530	x
50	Spring	85.01.11.4114640	
51	Nozzle	81.03.00.4113360	
52	O-ring	84.01.00.9301012	x
58	Diaphragm disc	81.03.00.4116530 (P095-MP only) 81.03.00.4114680 (P095-HP only)	
61	Sealing nut	81.03.00.4114700	
62	O-ring	84.01.03.1501026	x
63	O-ring	84.01.03.9402129	x
64	Washer	82.51.93.0080001	
88	Plug	82.07.67.0063001	
89	Ring	82.50.30.2130018	
103	Thrust washer	83.02.01.0000006	
104	Trust bearing	83.02.01.0000004	
107	Socket screw	82.07.16.0100020	
108	Spring washer	82.37.02.0100001	
122	O-ring	84.01.05.9903229	x

5.8 R100S(M) 1"

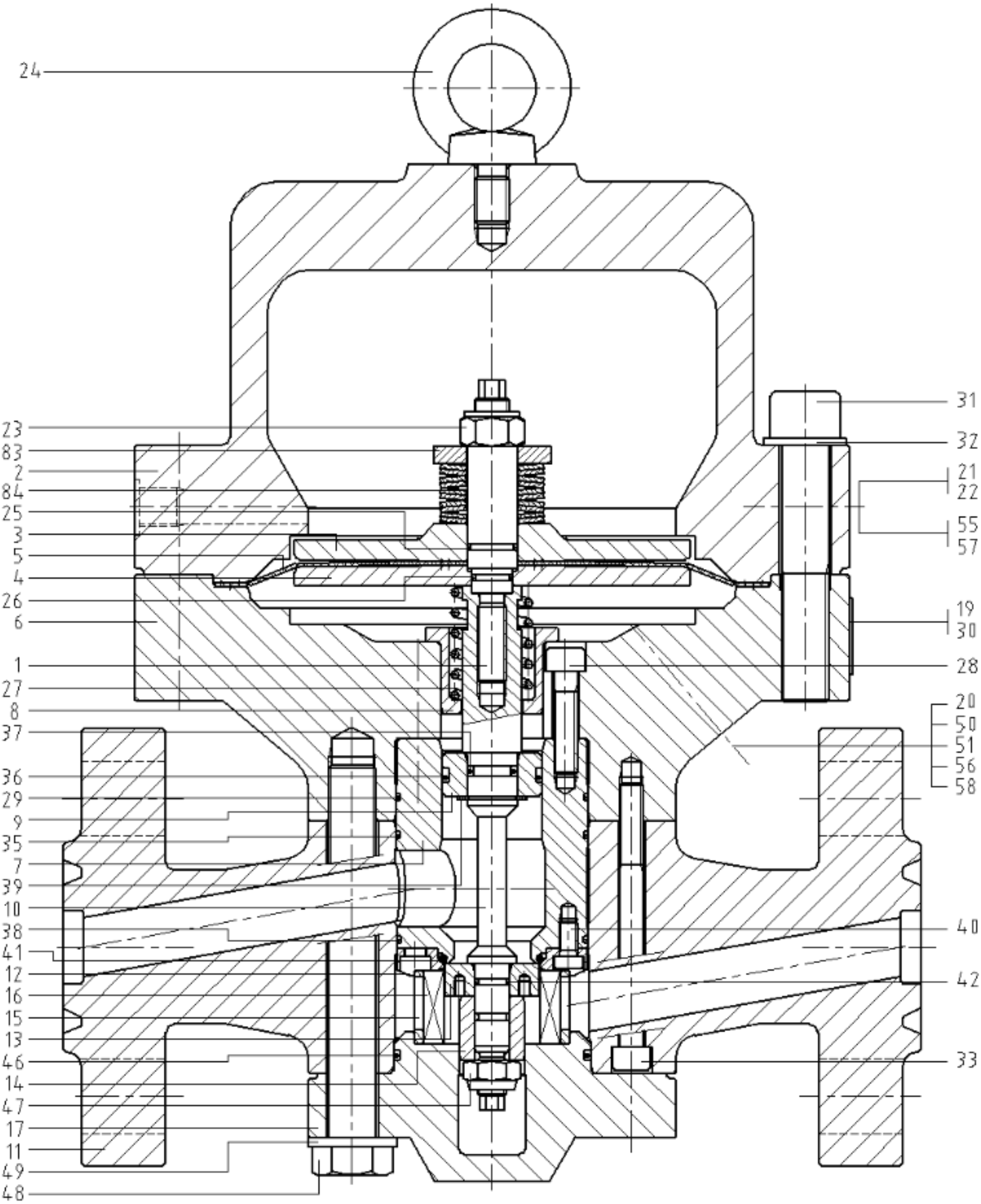


Figure 9: Component drawing R100S-1"

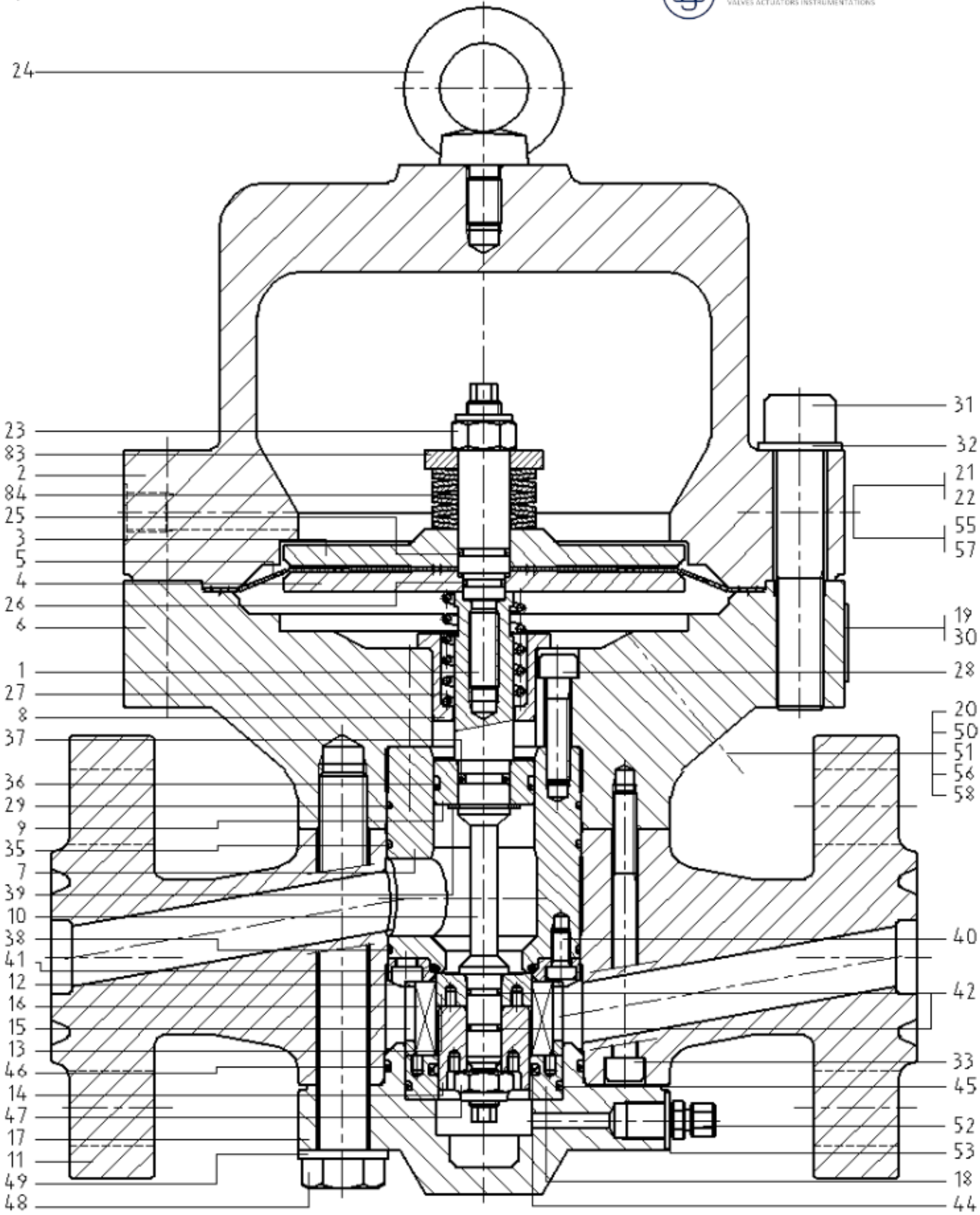


Figure 10: Component drawing R100SM-1"

5.8.1 Parts list R100S(M) 1”

See figures 9 and 10 for component drawing.

PARTS LIST R100S(M) 1”					
	R100S			R100SM	
Pos	Name	Spare	Pos	Name	Spare
01	Diaphragm fastening rod		01	Diaphragm fastening rod	
02	Bell		02	Bell	
03	Top diaphragm disc		03	Top diaphragm disc	
04	Bottom diaphragm disc		04	Bottom diaphragm disc	
05	Diaphragm	x	05	Diaphragm	x
06	Diaphragm housing Diaphragm		06	Diaphragm housing Diaphragm	
07	Guide bush		07	Guide bush	
08	Spring seat		08	Spring seat	
09	Compensation piston Diaphragm		09	Compensation piston Diaphragm	
10	Valve stem		10	Valve stem	
11	Valve body		11	Valve body	
12	Valve rubber holder		12	Valve rubber holder	
13	Valve		13	Valve	
14	Valve stem guide bush		14	Bottom compensation piston er	
15	Support cage		15	Support cage	
16	Metal-foam cylinder		16	Metal-foam cylinder	
17	Bottom cover		17	Bottom cover	
18	--		18	Valve guiding	
19	Name plate		19	Name plate	
20	Restriction		20	Restriction	
21	Elbow coupling		21	Elbow coupling	
22	Ring		22	Ring	
23	Locking nut		23	Locking nut	
24	Eye bolt		24	Eye bolt	
25	O-ring	x	25	O-ring	x
26	O-ring	x	26	O-ring	x
27	Spring		27	Spring	
28	Socket head screw		28	Socket head screw	
29	O-ring	x	29	O-ring	x
30	Drive screw		30	Drive screw	
31	Socket head screw		31	Socket head screw	
32	Washer		32	Washer	
33	Socket head screw		33	Socket head screw	
35	O-ring	x	35	O-ring	x
36	O-ring	x	36	O-ring	x
37	O-ring	x	37	O-ring	x
38	O-ring	x	38	O-ring	x
39	Circlip		39	Circlip	
40	Socket "low"head screw	x	40	Socket "low"head screw	x
41	O-ring	x	41	O-ring	x
42	O-ring	x	42	O-ring	x
44	--		44	Quad-ring	x
45	--		45	O-ring	x
46	O-ring	x	46	O-ring	x
47	Locking nut		47	Locking nut	
48	Hexacon bolt		48	Hexacon bolt	
49	Washer		49	Washer	
50	Straight coupling		50	Straight coupling	
51	Ring		51	Ring	
52	--		52	Straight coupling	
53	--		53	Ring	
55	Plug		55	Plug	
56	Plug		56	Plug	
57	Ring		57	Ring	
58	Ring		58	Ring	
79	Cap		79	Cap	
83	Spring seat		83	Spring seat	
84	Disc spring		84	Spring seat	

5.9 R100S(M) 2" t/m 8"

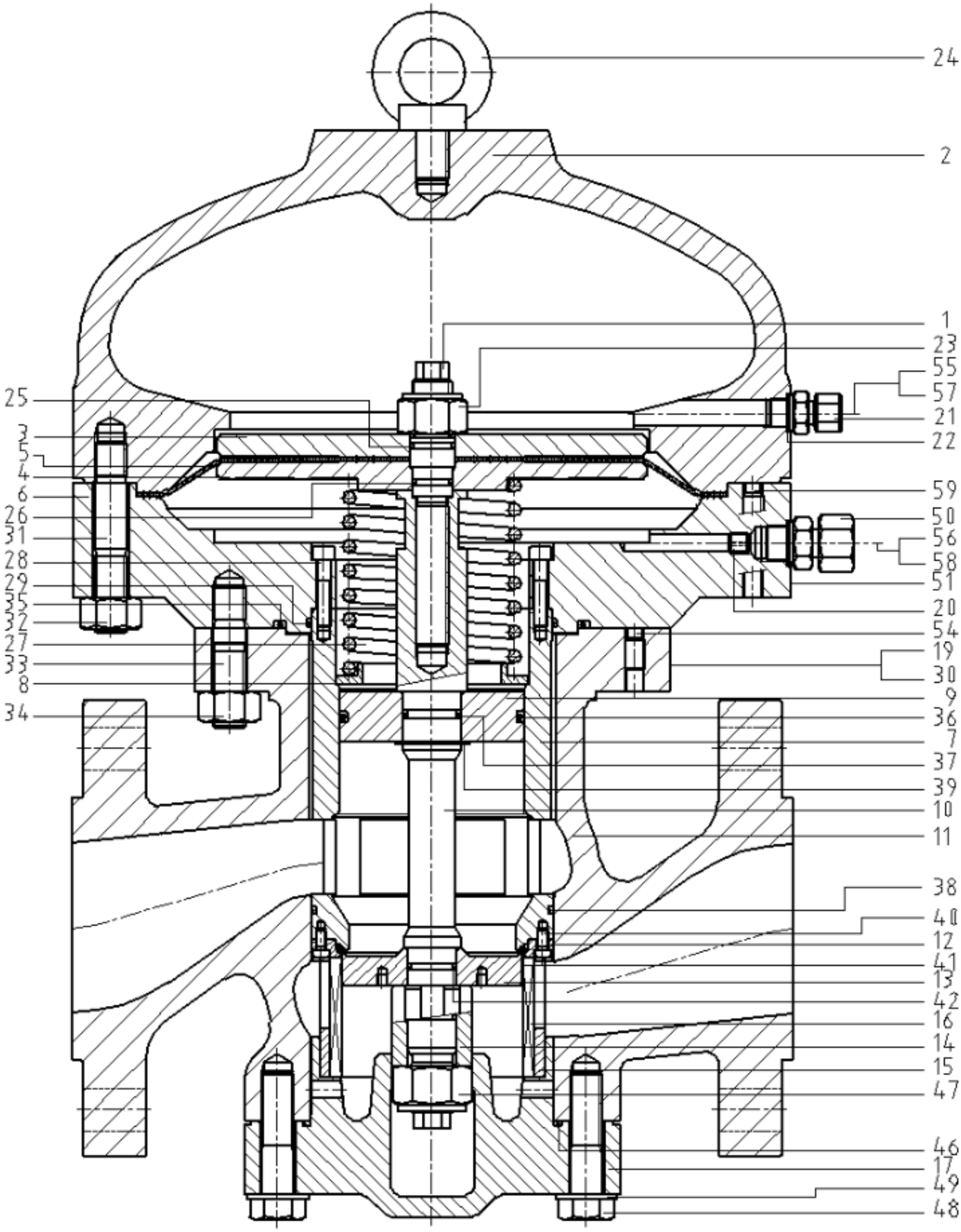


Figure 11: Component drawing R100S-2" to 8"

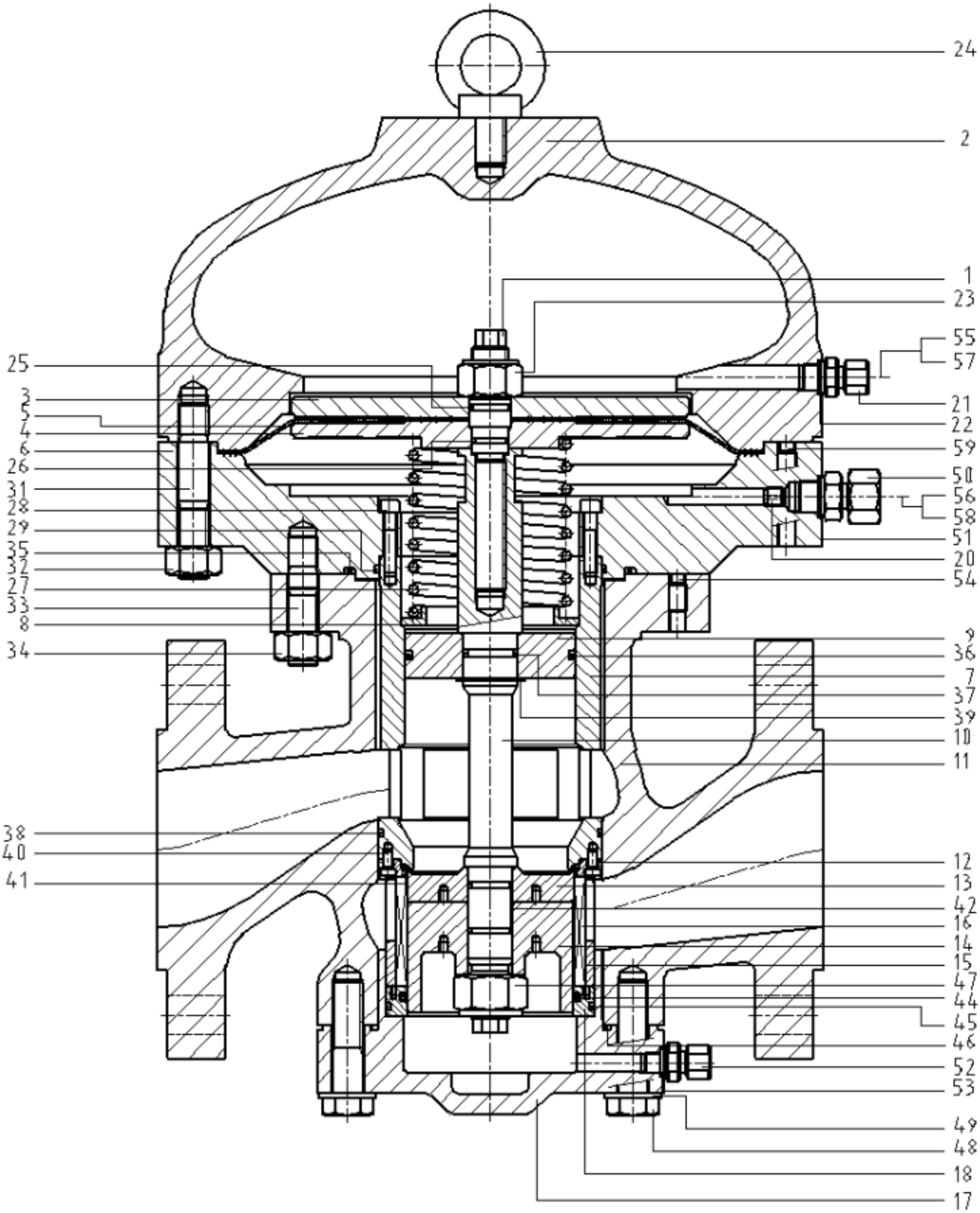


Figure 12: Component drawing R100SM- 2" to 8"

5.9.1 Partslist R100S (M) 2” t/m 8”

See figures 11 and 12 for component drawing.

PARTS LIST R100S (M) 2” T/M 8”					
	R100 (S)			R100M	
Pos	**Name**	**Spare**	**Pos**	**Name**	**Spare**
01	Diaphragm fastening rod		01	Diaphragm fastening rod	
02	Bell		02	Bell	
03	Top diaphragm disc		03	Top diaphragm disc	
04	Bottom diaphragm disc		04	Bottom diaphragm disc	
05	Diaphragm	x	05	Diaphragm	x
06	Diaphragm housing		06	Diaphragm housing	
07	Guide bush		07	Guide bush	
08	Spring seat		08	--	
09	Compensation piston		09	Top compensation piston	
10	Valve stem		10	Valve stem	
11	Valve body		11	Valve body	
12	Valve rubber holder		12	Valve rubber holder	
13	Valve		13	Valve	
14	Valve stem guide bush		14	Bottom compensation piston	
15	Support cage		15	Support cage	
16	Metal-foam cylinder		16	Metal-foam cylinder	
17	Bottom cover		17	Bottom cover	
18	--		18	Valve guiding	
19	Name plate		19	Name plate	
20	Restriction		20	Restriction	
21	Straight coupling		21	Straight coupling	
22	Ring		22	Ring	
23	Locking nut		23	Locking nut	
24	Eye bolt		24	Eye bolt	
25	O-ring	x	25	O-ring	x
26	O-ring	x	26	O-ring	x
27	Spring		27	Spring	
28	Socket head screw		28	Socket head screw	
29	O-ring	x	29	O-ring	x
30	Drive screw		30	Drive screw	
31	Stud bolt		31	Stud bolt	
32	Hexagon nut		32	Hexagon nut	
33	Stud bolt		33	Stud bolt	
34	Hexagon nut		34	Hexagon nut	
35	O-ring	x	35	O-ring	x
36	O-ring	x	36	O-ring	x
37	O-ring	x	37	O-ring	x
38	O-ring	x	38	O-ring	x
39	Circlip		39	Circlip	
40	Socket "low"head screw	x	40	Socket "low"head screw	x
41	O-ring	x	41	O-ring	x
42	O-ring	x	42	O-ring	x
44	--		44	Quad-ring	x
45	--		45	O-ring	x
46	O-ring	x	46	O-ring	x
47	Locking nut		47	Locking nut	
48	Hexagon bolt		48	Hexagon bolt	
49	Washer		49	Washer	
50	Straight coupling		50	Straight coupling	
51	Ring		51	Ring	
52	--		52	Straight coupling	
53	--		53	Ring	
54	Set screw hex.socket		54	Set screw hex.socket	
55	Plug		55	Plug	
56	Plug		56	Plug	
57	Ring		57	Ring	
58	Ring		58	Ring	
59	Set screw hex.socket		59	Set screw hex.socket	

6. Failures

Failure	Cause	Solution
Regulated pressure too high	The pilot of the active regulator is set too high.	Slightly turn the adjusting screw of the pilot spring back until the required pressure has been reached.
	The active regulator has failed and the monitor regulator is in operation.	Investigate failing action of the active regulator.
	Only in the event of very low ambient / operating temperatures. The pilot heating has failed.	Repair heating function.
Regulated pressure too low	The pilot of the active regulator is set too low.	Slightly turn the adjusting screw of the pilot in until the required pressure has been reached.
	The pressure drop across the regulating body is less than 0.5 bar.	If possible, increase the inlet pressure.
	The valve of the regulating body is all the way open. The system cannot supply enough pressure.	Heavy soiling of the low-noise cage.
	The setpoint of the acceleration pilot is too close to the setpoint of the monitor regulator.	Set the setpoint of the acceleration pilot higher.
	No inlet pressure.	See if safety shut-off valve has failed or if the monitor regulator is closed or trace its cause.
	Insufficient stabiliser pressure.	Check the stabiliser filter for soil.
	Only in the event of very low ambient / operating temperatures. The pilot heating has failed.	Repair heating function.
Monitor regulator active during normal operation.	Pressure equation between monitor regulator and active regulator has been chosen too tight.	Screw the adjusting screw of the monitor pilot a little further in or the adjusting screw of the regulator pilot a little further out.
	The setpoint of the acceleration pilot is too close to the setpoint of the monitor regulator.	Set the setpoint of the acceleration pilot higher.
Safety shut-off valve responds before the monitor regulator has taken action.	The setpoint of the acceleration pilot and/or monitor pilot is too high or too close to the setpoint of the safety shut-off valve.	Set the setpoint of the acceleration pilot and/or monitor pilot lower or set the setpoint of the safety shut-off valve higher.
Increasing outlet pressure at zero offtake.	A component is untight.	See paragraph 4.10

Failure	Signs	Cause	Solution
High-frequent variations at regulated pressure.	Reciprocating outlet pressure < 0.2 sec.	If reciprocating does not disappear when regulating gas loaded, the cause is in the interaction between process and regulator.	Fit a restriction in the bottom coupling of the regulator, start with a 3mm restriction. Instead of restrictions, a needle valve can also be fitted.
High-frequent variations stabiliser pressure	This is often audible by a humming sound from the regulating pilot. On the pressure gauge of the regulating pilot, which indicates the stabiliser pressure, this vibration will also be visible.	Stabiliser is too active.	Fit a smaller restriction in the stabiliser. Standard, the pilot is provided with a 0.7mm restriction. Seal the thread with Loctite 577. Restrictions are available on request.

Failure	**Signs**	**Cause**
Low-frequent variations regulated pressure.	Reciprocating of the outlet pressure > 0.2 sec.	Tracing the cause is not easy. It is therefore better to first aim at counteracting the phenomenon step-by-step.
Solution 1	**Solution 2**	**Solution 3**
Lower the stabiliser pressure by further screwing in set screw 6. This reduces the effect of the stabiliser pressure on the 2nd control stage of the pilot. This will often solve the problem. If not, continue with solution 2.	Let the regulator regulate gas loaded. If reciprocating does not disappear, you have to do with the natural resonance of the regulator. If it does disappear, it definitely has to do with the combination pilot-regulator-process. The solution lies in fitting a restriction plate in connection 3 of the regulator. Start with a 1mm restriction.	If 2 has no effect at all, you can try replacing the pilot spring by a spring with a greater stiffness (higher adjustable outlet pressure).
Solution 4	**Solution 5.**	
Try a combination of 1, 2, 3.	Another possible cause of reciprocating is increased friction of the movable parts of the regulating system. In this connection you can think of ageing of the dynamic sealings and soil accumulation at the guides. However, this can only be established by carrying out maintenance. Soil accumulation in or badly running of guides is in some cases audible in the form of noise.	