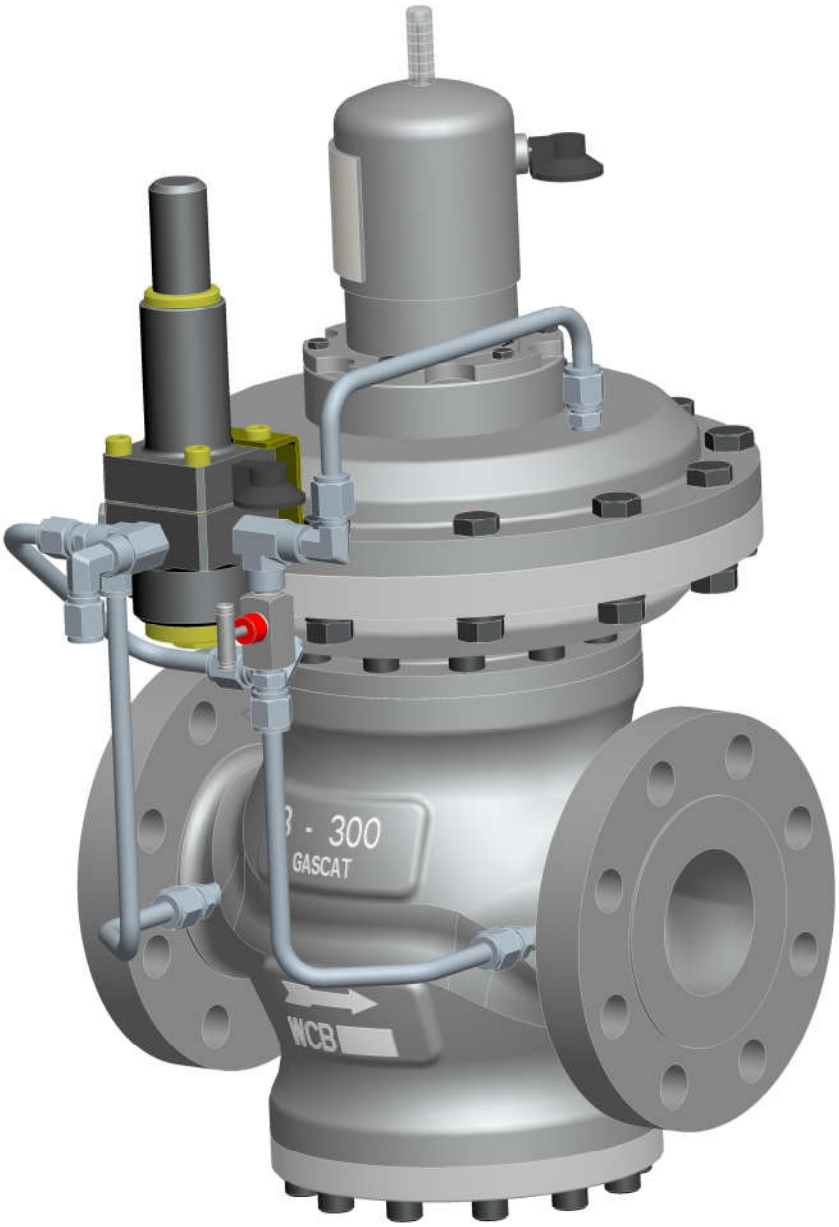
INSTALLATION & OPERATION MANUAL
PRESSURE REGULATOR VALVE
MODEL PI



GASCAT

INDEX

1 – INSTRUCTIONS PRIOR TO COMMISSIONING

It should be clearly understood that the information given under the Commissioning Instructions below do not intend to revoke or substitute instructions laid by any relevant entity and reference should be made to the relevant Standards and/or existent recommendations on this subject.

It is implied that before Commissioning the performance of the appropriate "Cleaning and Purification Procedures" will be observed and all the instructions contained in "Pressurization" and "Labor Safety and Health Standards" shall be strictly attended.

The recommendations of valves' suppliers, as for instance, "open slowly" or "open very slowly" should be strictly observed.

1.1 – SAFETY AND HEALTH

Regulators, valves, and other pressurized components that contain toxic or flammable gases, or other hazardous products, are potentially dangerous if not correctly operated and maintained. It is mandatory that all users of these equipments are properly instructed and warned on their potential danger, and certify yourself that the personnel responsible for installation, test, commissioning, operation, and maintenance of the plant are skilled enough to perform their duties. Instruction manuals are provided for orientation of the operators, but it is supposed that they have a basic knowledge level. If any doubts or ambiguities remain that could affect the proper procedures ask ***Gascat,*** which will be pleased to instruct, or to provide the suitable service or instruction. **NOT TO TAKE ANY RISK**. Our telephone, fax numbers, and e-mail are the following:

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The comments below, while not completely inclusive, provide guidance on possible sources of risk to safety and health.

1.1.1 – NOISE

Regulators, valves, and other pressure reducers can produce high noise levels, which can be harmful to persons exposed to them for long periods of time. Users should assure themselves that appropriate provisions will be taken, in order to foresee health safety of employees and/or third parties, according to valid standards and recommendations.

1.1.2 – INSTALLATION

All equipment, piping, and vessels are designed to support mechanical efforts, as, for instance, torque and bending momentum, in addition to internal pressure. However, careful shall be exercised during installation not to develop excessive efforts, which can cause cracks that may result in serious breakage when the regulator is put into operation. Excessive tensions can also be caused if the equipment is overburden by piping, which should be otherwise appropriately supported.

All regulators, shutoff valves, relief valves, etc., shall be installed taking into account the correct flow sense.

Impulse lines are important components of any control system and it is essential for them to be correctly installed according to instructions.

Impulse lines should be appropriately supported to reduce excessive vibration, which can provoke fatigue breaks. They should also be positioned so that they cannot serve as feet or hands supports. Impulse lines should be slightly sloping so that liquids and condensates drain towards the main piping.

Auxiliary systems should not be changed, or modified, without knowledge of the operation conditions and permission of the responsible in charge.

1.1.3 – OPERATION

Depending on the regulator type, its valve can be positioned fully open. Consequently, when a regulator is put into operation, the shutoff valves should be open slowly so that the regulator valve can assume its regulating position. If the valves are quickly opened the upstream pressure can pass downstream through the regulator and over-pressurize downstream the main line.

All regulators, etc., should operate with the regulating spring specified by the manufacturer. This provision is particularly important when operating relief or shutoff valves, since incorrect springs can hinder a relief valve to open and a shutoff valve to close at the proper time.

Provisions should be taken to avoid water input through breathing and ventilation openings.

1.1.4 – MAINTENANCE

Regulators and valves contain gases at pressures that sometimes are higher than the atmospheric pressure. Before trying to investigate any problem or to perform service maintenance of the equipment, they should be safely de-pressurized. Besides, as most gases can be flammable, poisonous, corrosive, or somehow, dangerous, it may be necessary to purge the installation with an inert gas, as nitrogen. Special precautions are necessary for operation with oxygen or hydrochloric gas and the user should be reassured that appropriate procedures are implemented.

Eventually, it is not enough to isolate the high-pressure device, since high pressures can be retained downstream of isolation valves. Do not try to remove covers, plugs, etc., before these parts are properly freed-up. Even so, it is advisable to consider if high-pressure gas can be present at the time of removal of covers and plugs.

Most regulators use spiral springs as the loading device. It is important to reduce the load of these springs relieving their loaders as much as possible. In some cases, some residual load may last, even though the spring is relaxed to the limits of its housing.

There is not a recommendation about the frequency to change the repair kit due several different variables in the process that changes installation by installation as, for example, process gas quality, service conditions etc. The repair kit should be changed when the regulator has problems during operation, as leakage, increase in set pressure and also others that become the quality and regulator performance different.

However, ***Gascat*** recommends that after all regulators opening during maintenance service the repair kit must be changed. It is also indicated to change a complete repair kit and not only specific part (example o'ring, obturator), to have the all spare parts with same life time.

Gascat already inform to avoid all non original and genuine parts.

2 – INTRODUCTION

2.1 – SCOPE OF MANUAL

This Instruction manual has as objective supply information about operation, installation and maintenance about PI pressure regulator manufactured by GASCAT.

2.2 – DESCRIPTION

PI Pressure Regulator was desgined by Gascat Engineering to assist all kind of application, allowing its operation with several different service conditions according to its configuration. PI Series belongs to pilot operated regulators and can be applied with all type of non-corrosive gases. For corrosive one it should previously consulted.

Due its "top entry" characteristic it is not necessary to remove the valve body from the pipe for maintenance. PI series also has a robust construction, high performance, with accuracy and high flow capacity.

It is designed for gas distribution where there is metering for custody transference as, for example, pressure regulating and metering skids, or any other application where it is necessary excellent accuracy.

2.3 – SPECIFICATIONS

2.3.1 – AVAILABLE CONFIGURATIONS

PI SC: Pilot operated pressure regulator spring to close (fail close).

PI SO: Pilot operated pressure regulator spring to open (fail open).

2.3.2 – AVAILABLE CONNECTIONS

ND	FLANGE ASME B16.5	FLANGE DIN 2633	THREAD
1”	150# / 300#	PN 16 / PN40	NPT-F
2”	150# / 300#	PN 16 / PN40	-
3”	150# / 300#	PN 16 / PN40	-
4”	150# / 300#	PN 16 / PN40	-

2.3.3 – TEMPERATURE LIMITS

Operating temperature: -20°C a 60°C

Ambient temperature: -20°C a 60°C

The temperature limits informed at this manual or in any applicable standard must not be exceeded under any circumstances, at risk of damage the equipment, safety of installation and safety of people involved in the operation.

2.3.4 – FLOW COEFICIENT

DN	KG
1”	440
2”	1950
3”	3800
4”	6850

2.3.5 – VALVE WEIGHT

DN	150# / PN16 / NPT-F	300# / PN40
1”	25 Kg	28 Kg
2”	34 Kg	35 Kg
3”	69 Kg	71 Kg
4”	85 Kg	89 Kg

2.3.6 – PRESSURE REGULATOR SPRING RANGE (SET-POINT)

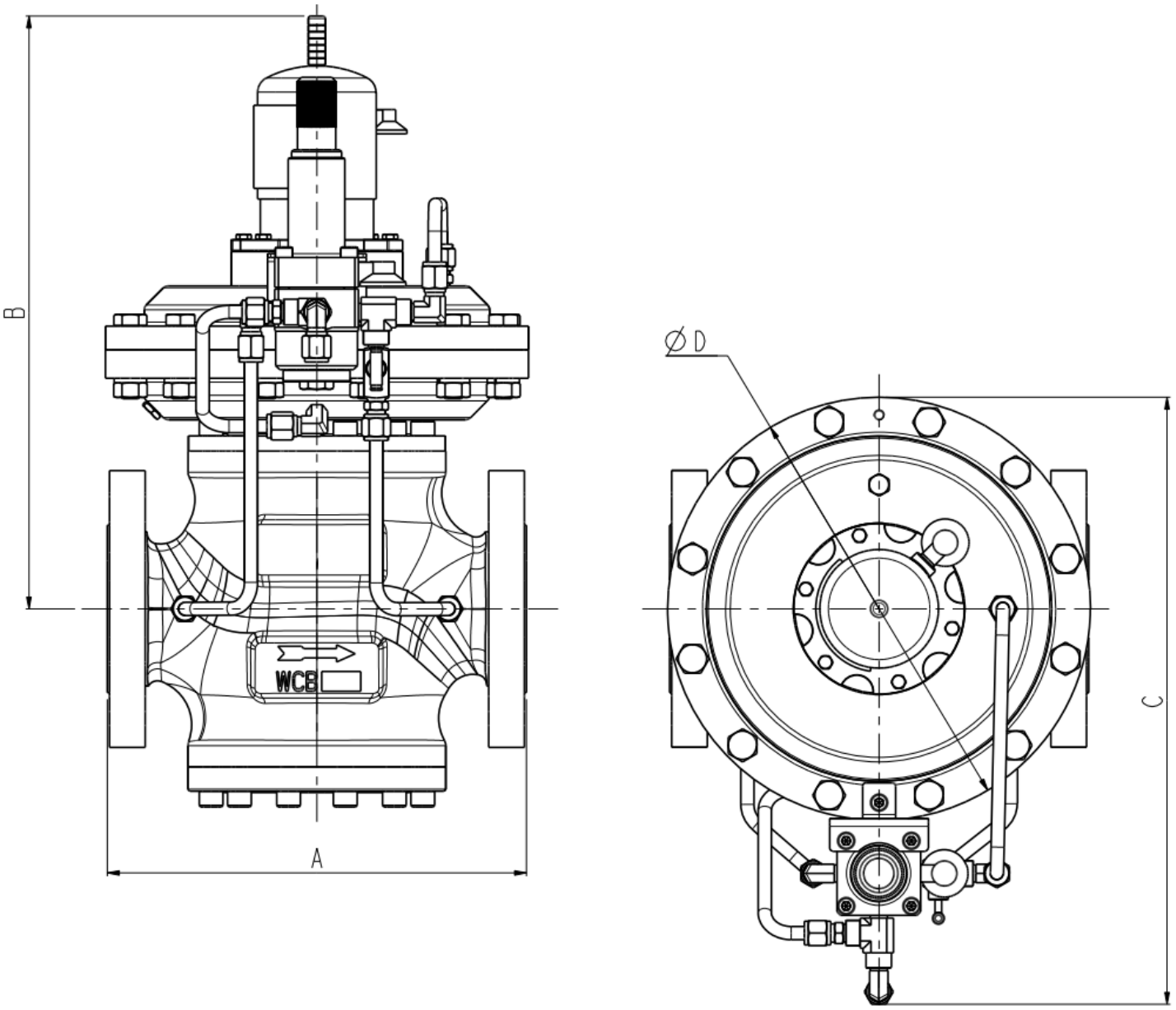
G-31 PILOT		
SPRING COLOR	**PART NUMBER**	**RANGE**
GREY	01.49.61	0.7 – 2.8 bar
GREEN	01.49.65	9.0 – 5.5 bar
RED	01.49.64	4.5– 14.0 bar
BROWN	01.49.33	7.0 – 18.3 bar
BLACK	01.49.59	14.0 – 32.0 bar
G-33 PILOT		
SPRING COLOR	**PART NUMBER**	**RANGE**
BROWN	01.49.33	14.0 – 36.6 bar

2.3.7 – ACCURACY AND LOCK UP

Pressure regulator: AC up to 2,5% / SG up to 5%

SSV: AG up to 5

2.3.8 – PRESSURE REGULATOR DIMENSIONS (STANDARD LAYOUT)



DIMENSIONS (mm)					
ND	A (RF)		B	C	D
	150#	300#			
1”	184	197	340	300	190
2”	254	267	340	300	190
3”	298	318	450	460	321
4”	352	368	460	460	321
General Tolerance = ± 2.0					

3 – OPERATING PRINCIPLE

3.1 – SPRING TO CLOSE

PI pressure regulato work by pilot loading pressure principle in main diaphragm upper chamber that, through differential pressure between loading pressure and inlet pressure (PE), it moves the diaphragm and, consequently, the main shaft and obturator that are connected each other, increasing or decreasing the valve passage (opening).

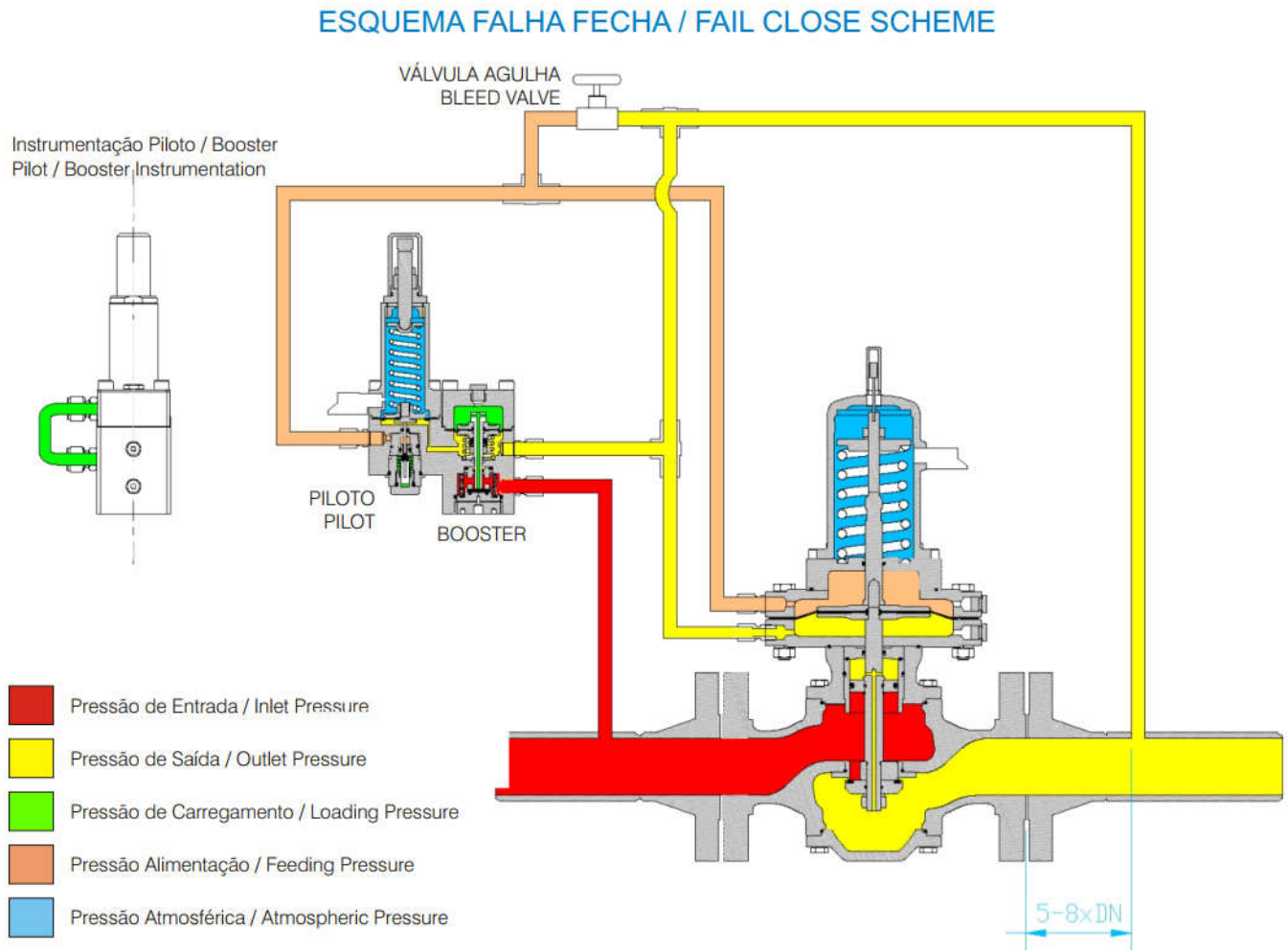
In case of absence process flow, the increase in outlet pressure transmitted by sensing line to the pilot diaphragm and main valve diaphragm, closing the same (pilot and valve), it will cause the shaft downward movement by main shaft. It will also cause the obturator moving against the seat closing the gas passage in main valve.

With gas consumption the opposite effect will happen. It will cause the pilot gas opening, increasing the loading pressure in diaphragm upper chamber that, added to the outlet drop pressure in the diaphragm lower chamber, will cause the main valve opening.

A graduated bleed valve assembled in downstream of loading pressure will allow the gas passage in the orifice; increasing or decreasing the response velocity of main regulator and, consequently, the opposite reaction of closing response, getting the equilibrium according to each installation and service conditions.

By this working principle it is possible to obtain a pressure regulator with response velicity extraordinary for gas consumption demand, beyond excellent accuracy and low lock-up.

Depending of regulator configuration PI Series can be supplied with pre-regulator or booster that limits and allows the pressure stabilization to the pilot sensor allowing better downstream pressure regulation. It is not applied for differential pressure lower than 4 bar. The utilization and model pre-regulator or booster to be applied must be defined by Gascat engineering.

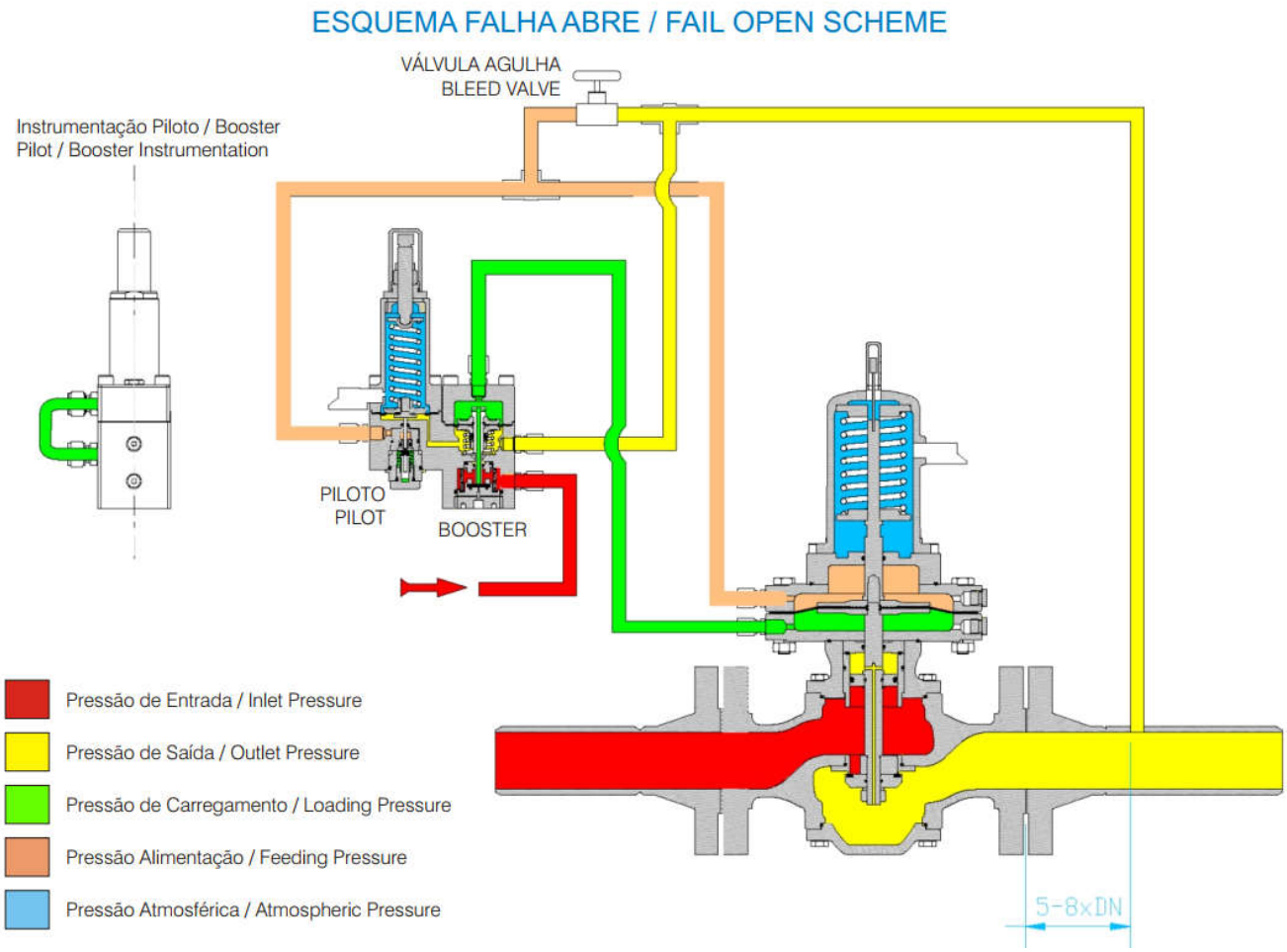


3.2 – SPRING TO OPEN

The Fail Open version of PI pressure regulator is applied in systems configured as active (fail open) / monitor (fail close).

Under normal service conditions the active regulator adjusts the outlet pressure. The spring of main valve forces the actuator set downward to keep the valve in open position, beyond the tubbings connections of Pilot / Booster are different between fail open and fail close versions. In case of flow absence the outlet pressure increases and the pilot start to close itself. Then, the pressure in the lower chamber decreases, because the bleed valve discharge the excess of pressure to downstream. With the closing of the pilot the booster feeds the upper chamber and this pressure is higher than spring force as well lower chamber pressure; in this case the main valve will close.

In case of diaphragm rupture of Pilot, Booster or main valve the main spring will keep the valve totally opened.

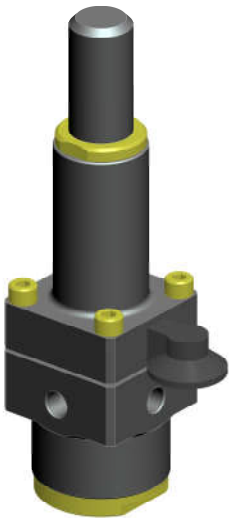


3.3 – PILOT

The pressure regulator model PI manufacture by GASCAT use pilot model G-31F or G-43M+31 depending of the differential work pressure. If the differential work pressure is greater than 10.0 bar, applies the G-43M+G31.

This pilot is responsible by the control of feed pressure of main regulator actuator and by consequence of the pressure regulator aperture.

G-43 BOOSTER + G-31 PILOT



G-31 PILOT

4 – INSTALLATION

4.1 – CHECKING SYSTEM INTEGRITY

Before installing the pressure regulator it's necessary to insure that:

1) The equipment are in perfect conditions or has evidences of damage during the transport, in case of perceptible damage in the equipment do not proceed with installations and get in contact with GASCAT.

2) The space provided for the acess and installation of equipment is appropriate, including future maintenance.

3) The installation was designed to support the load imposed by the equipment.

4) The inlet and outlet pipe connections are in the same level.

5) All connections for sense line and discharge line requested by the model of pressure regulator are arranged in the pipeline and respect the dimensions provided by manufacturer.

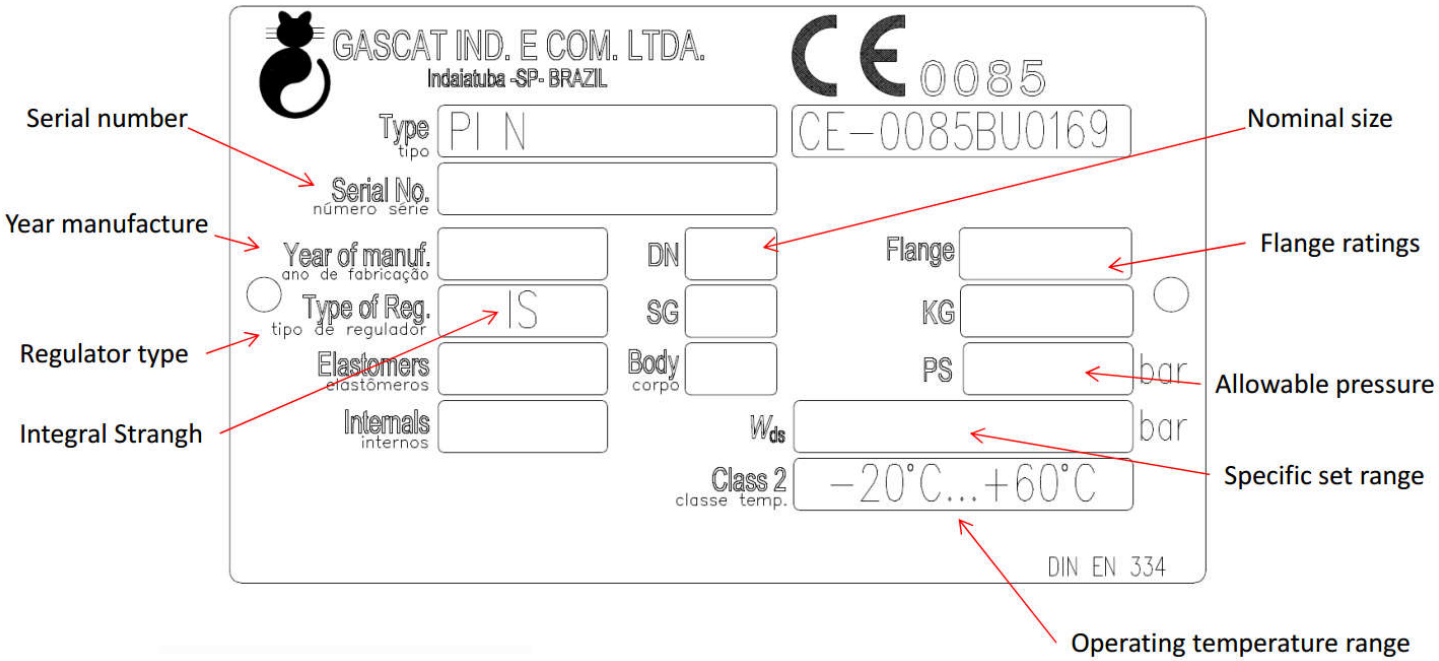
6) Was arranged pressure indicators at the inlet and outlet of the pressure regulator to insure the correct adjustment of set point during the commissioning.

7) Was arranged a vent line between the pressure regulator and the first block valve in the outlet of stream to help the operator during the start-up.

8) Check the flow direction in the valve body and pay attention in the installation to assure that the valve are in the correct position.

4.2 – PRESSURE REGULATOR NAMEPLATE

Before installation, checking is recommended to ascertain that the conditions of use are in conformity with the specifications of the equipment. These specifications are recalled with the symbols on the plate fitted on pressure regulator.



4.3 – FILTER

We recommended the installation of a basket type filter, with minimum 150 mesh, as close as possible to the regulator input, without being joined flange to flange, because, if the filter is installed immediately upstream of the regulator, it can produce turbulence that will cause disturbances in the pressure control of the regulator. Care with the filter installation is essential to the perfect operation of the apparatus, because, particles eventually found in the piping can lodge themselves the seat and the shutter, damaging them and producing direct flow.

4.4 – CLEANING

Check piping cleaning before the installation of the regulator. We recommended a complete purge of the line with nitrogen or compressed air.

4.5 – FLOW DIRECTION AND ASSEMBLY OPTIONS

Before starting the equipment installation, it is necessary to check if:

9) The equipment is in perfect conditions, or it has evidence of damage during transportation. If so, do not proceed with the installation and contact GASCAT.

10) The space provided for access and installation of the equipment is adequate for future maintenance.

11) The installation is designed to support the load applied by the equipment.

12) The inlet and outlet connections, where the pressure regulator shall be installed, are perfectly aligned.

13) All necessary pressure-sensing pick-ups, downstream of the equipment pipeline, were provided respecting the dimensions recommended by the manufacturer.

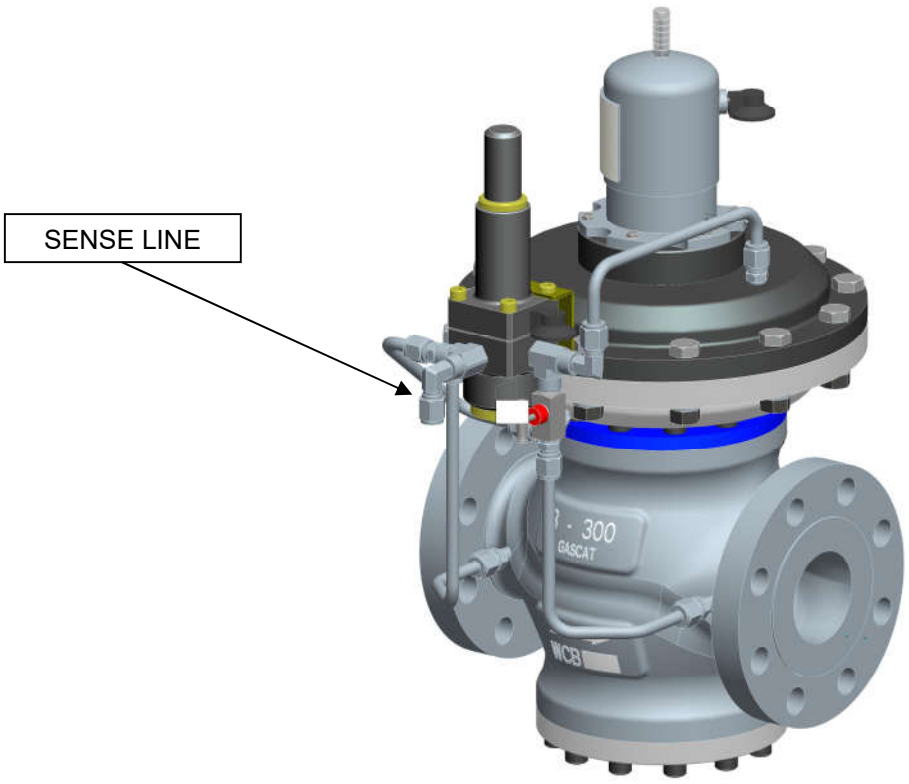
14) A pressure gauge, or any other pressure-measuring device, was foreseen for the upstream and downstream of the equipment to allow for the correct setting up at the operation start-up.

15) A vent line was planned between the regulator and the first outlet shut-off valve to assist the operator during start-up.

16) Check the flow direction marked on the body of the pressure-regulating valve and pay attention at the time of its installation so that it is properly positioned.

4.6 – SENSE LINE

After install the pressure regulator model PI in the stream, you must connect the sensing lines and discharge line as showed as follow:



The correct positioning of pressure regulators sense line in the pipeline is essential for the proper functioning of the pressure regulator, for this reason it's important to install the impulse take at a distance of 5 times the nominal pipe diameter from the outlet of pressure regulator at a pipe stretch free from obstruction, with a pipe diameter sized to a velocity not higher than 25 m/s (considering the minimum pressure and the maximum flow)

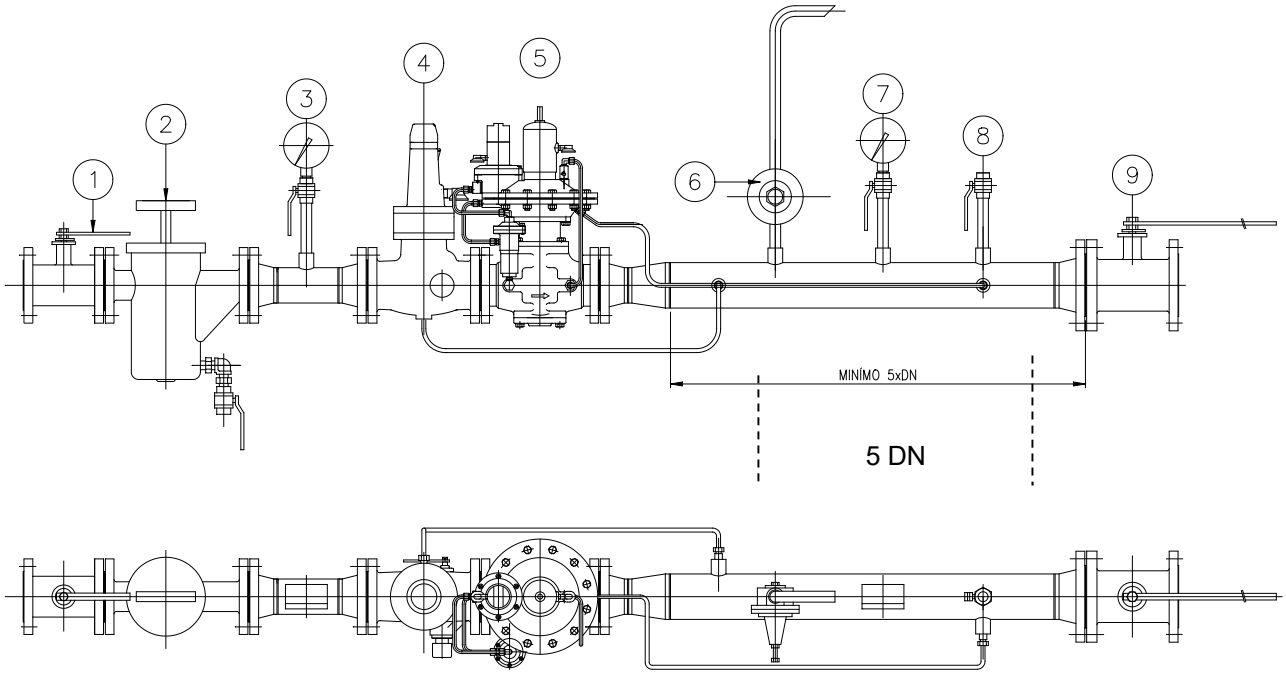
We do not recommend installations of any type of block valve in the sensing lines.

The connections of PI sense and discharge line are normally supplied for 10 mm OD pipe, however other connections could be arranged under consult.

We recommend to not use pulse pick-up downstream of regulator with orifices with nominal diameter less than 3/8".

Note: The distance and gas velocity recommended at this manual for the impulse take are generic, other values for distance and velocity could be used under GASCAT analysis of installation, for more information get in contact with GASCAT.

4.7 – RECOMMENDED INSTALLATION SCHEME



4.8 – OTHER IMPORTANT DEVICES FOR A SAFETY INSTALLATION

It is recommended for a safety installation:

1. Manual On-Off valve (sphere or similar)
2. Filter (with drain if possible)
3. Manometer (for inlet pressure)
4. Slam-shut Valve (model GIPS FC)
5. Pressure regulator (PI)
6. Manometer (for outlet pressure)
7. Purge valve ND ½''
8. Partial Pressure Relief Valve (CH Series)
9. Manual On-Off valve (sphere or similar)

5 – COMMISSIONING AND START UP

Always, before proceeding with the equipment commissioning it is important to:

1) Check if the equipment is properly installed according to the recommendations of item 4.7 of this manual.
2) Shut the blocking valves of the inlet, output and bypass (if applicable)
3) Open vent valve downstream of the last pressure regulator installed on the span.
4) Make sure that the station is depressurized.

ATTENTION:

* Under no circumstances proceed with pressurization of the span where the equipment is installed by the downstream valve of the equipment.

* Under no circumstances proceed with the depressurization of the span where the equipment is installed by the valve located upstream of the equipment, such as the filter drain.

5) Check if all connectors are properly secured in the station before starting pressurization of the span.
6) Check if the installed equipment has suitable operating conditions, using the information available on the nameplate attached to the equipment.
7) Make sure that the SSV is in the shut position.

ATTENTION:

GASCAT's SSV are sent to the field already calibrated, however, depending on transport conditions and the equipment handling the valve may have its set point changed.

Therefore, we recommend that you check the SSV set point with the help of an external air supply directly connected to the actuator, before proceeding with the pressurization of the span.

The model PI valves are not sent to the field with adjusted set points; this measure tends to preserve the life of the equipment internals. Therefore, after receiving a pressure regulator valve model PI, remember that you must perform the set point adjustment before putting the equipment into operation.

The pressure reducing station setting shall be in accordance with the DIN EN 12186 / NBR 12712 standards and all other regulations in force in the region where it will operate.

1) Close slowly the on-off manual valve upstream of regulator.
2) Close slowly the on-off manual valve downstream of regulator.
3) Certify that the springs of pre pilot and pilot are totally released.
4) Certify that bleed (discharge valve / needle valve) is open in 1/8 of turn.
5) Open the purge valve installed downstream of regulator 1/8 of turn.
6) Open slowly the on-off manual valve upstream of regulator verifying the gas pressure.

5.1– PRESSURE REGULATOR ADJUSTMENT (SINGLE REGULATOR)

1) Open the purge valve located downstream of the regulator to, approximately, 20% of the passage.
2) Adjust the regulator pressure with the regulating screw located in the pilot's upper part, under the protection cover, to the requested operation pressure.
3) Close the purge valve.
4) Check for regulator lockup with the pressure gauge located downstream of the same; an stable pressure indication for, approximately, 20 minutes after closing attends this requisite.
5) Close the purge valve, and then slowly open the gas output blocking valve.
6) Make fine pressure adjustments.

5.2– PRESSURE REGULATOR ADJUSTMENT (ACTIVE / MONITOR SYSTEM)

1) Open the purge valve located downstream of the regulator to, approximately, 20% of the passage.
2) Adjust the spring of the Active Regulator Pilot to the maximum value of pressure regulation.
3) Adjust the spring of the Monitor Regulator Pilot to the minimum of value pressure regulation (zero).
4) Completely purge the station pressure, if necessary.
5) Slowly open the Blocking Valve located upstream of the regulator. Open it completely when the pressure reaches the Monitor Regulator, which is the moment when it will close.
6) Slowly increase the adjustment of the outlet pressure with the spring of the Monitor Regulator Pilot until attaining the desired value.
7) With some flow flowing through the station, start the reduction of the adjustment by adjusting the spring of the Active Regulator Pilot, until the desired value for the output pressure is reached.
8) Check the Monitor Regulator operation; with flow flowing though the station, slowly increase the adjustment of Active Regulator Pressure. When the output pressure reaches the pressure adjusted at the Monitor Regulator this will assume the station operation control and the Active Regulator will open completely.
9) Reduce the pressure adjustment of the Active Regulator back to the required output pressure.

Notes:

1 – In stations with Monitor / Active Regulating Systems, the station shutting pressure, will always be the Monitor Regulator pressure.

2 – In these stations, the line adjustment pressure for blocking test of the shutoff valve shall be previously obtained through the Monitor Regulator, however, the pressure of the Active Regulator shall be increased until it opens completely and the Monitor takes over the system regulation.

5.3– BACK-UP LINE ADJUSTMENT (IF APPLICABLE)

1) Isolate the line main depressurizing the system.
2) Adjust the secondary line pressure as already described with a pressure at the Active Regulator 10% below the Active Regulator pressure of the main line I.

5.4 – RECOMMENDED TOOLS FOR START-UP

- ✓ Combination spanner size: 3/8” and 19 mm
- ✓ Adjustable spanner 1”

6 – TROUBLE SHOOTING

To maintain the pressure regulator in the correct conditions of operation, the pressure regulators model PI must be submitted to preventive maintenance, the periodicity depends of the flow, quantity/type of contaminants and the operation conditions.

Defect	Cause	Correction
Vibration	Problems in the installation	Verify if the pipe is correctly supported, if the vibration doesn't come from other devices or if it is inadequate sizing of some equipment.
	Damaged diaphragm or stem assembly of main valve damaged	Change the damaged pieces.
Outlet Pressure Variation	Low flow (less than 5% of maximum flow)	Verify the regulator sizing (check if is available a reduced orifice).
	Sensing line installed wrongly	Verify if the sensing line is too close of main valve of near of an equipment that my cause flow turbulence
	Bleed valve wrongly adjusted	Proced the adjustment of bleed valve with the regulator operating (working) to find the best position oo work.
Direct passage through the regulator or main valve totally opened	Main regulator stem locked	Verify the respective stem and change it if necessary.
	Sensing line damaged	Verify the sensing line and change it if necessary.
Outlet drop pressure / non-enough flow	Filter element dirty	Clean or change the filter element.
No Flow and No Outlet Pressure	Main diaphragm damaged	Change the main diaphragm.
Outlet pressure increase / Direct passage	Particles between obturator / seat or these parts damaged	Remove the inspection cover and obturator and clean the components (obturator e seat). Verify all other components and change if necessary.
	Particles between obturator / seat or these parts damaged	Remove the pilot balancin, clean it or change if necessary.

7 – WARRANTY

We warrant our products, for a 12 months period from the date of invoicing, if the products are in operation, extending the warrant up to 18 months, in case they are in stock. Such warranty only covers those cases for which the occurrence of production defects are evidenced, which remained unnoticed at the time the product delivery.

To present warranty is not valid if it is found that the defect or mishap was caused by accident, normal wear, inadequate installation, improper maneuvering or use, inadequate storage, assembly disregarding technical standards or if the buyer undertook repairs or changes in equipment by himself, without the manufacturer's previous authorization.

The information contained in this manual contains Gascat's supply conditions, independently of the verified performance.

The information herein contained shall not be interpreted or suggest performance warranty in relation to the final products, or the system usage purpose, nor should they serve as usage recommendation for any product or process mentioned in the specifications. This system should only be operated by qualified technician trained for this purpose; and no changes that may affects the system safety can be executed without our previous authorization.

GASCAT Ind and Com. Ltda. withhold the right to make changes without notice, introducing improvements in the described products drawings or specifications.

8 – STORAGE

The regulators should not suffer mechanical shock, not to risk internal components' damages.

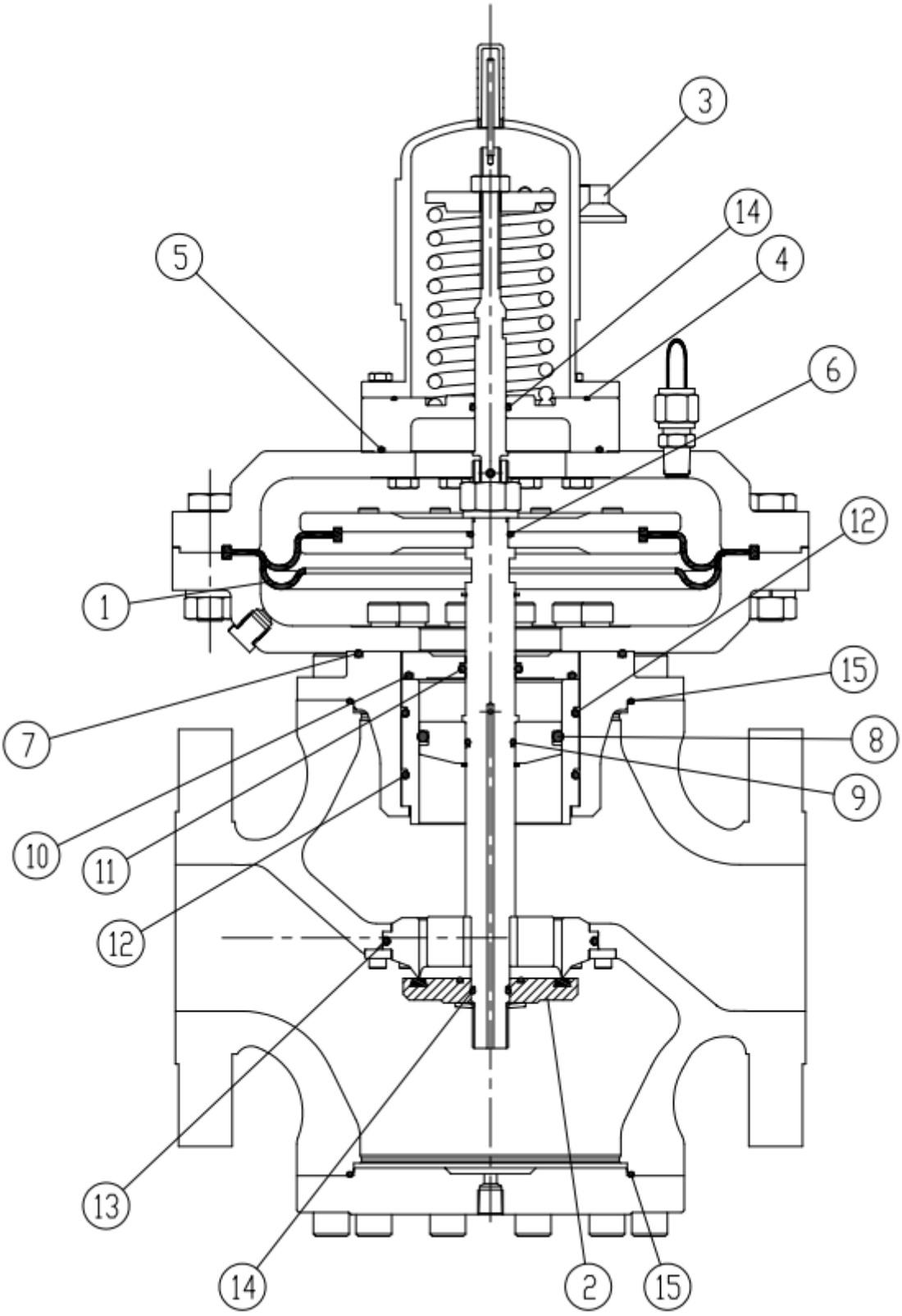
The regulators should be stored at a clean and dry place, protected from bad weather

9 – GENERAL RECOMMENDATION

1) We test our regulators and valves at the requested operation conditions.
2) Criteria and maintenance steps are contained in manuals, however, for any doubt on the use, operation, or maintenance, contact Gascat's technical department that will give you proper guidance.
3) ***Gascat*** supplies, on request, a complete replacement kit.

10 – COMPONENTS & SPARE PARTS

Find below the components positions and spare parts components of PI, G31F PILOT, and G43M+31 PILOT.


3
14
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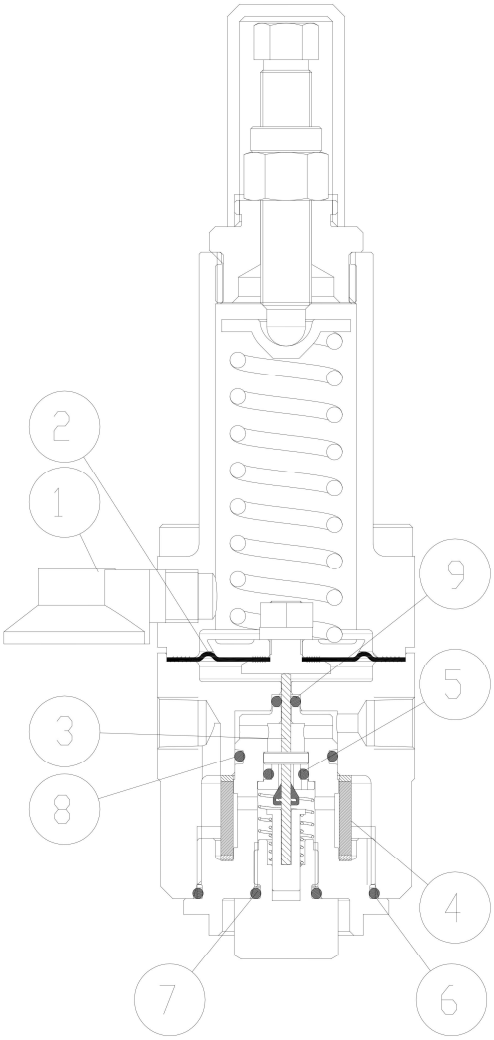
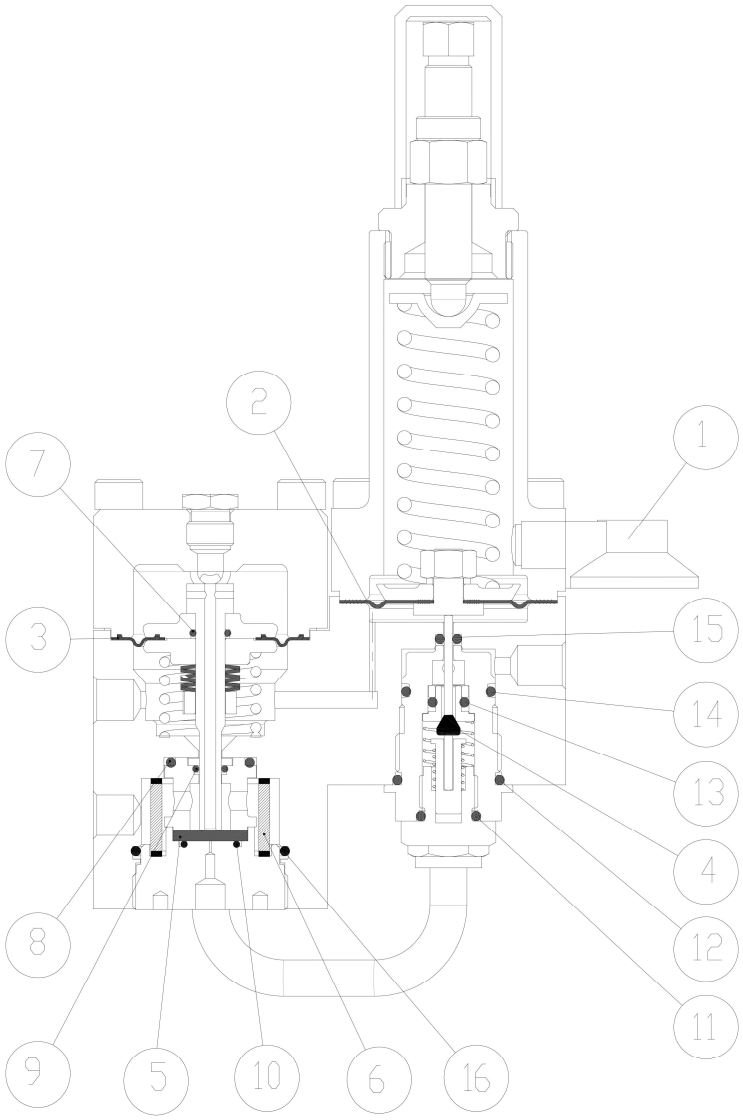
15

POS.	DESCRIPTION	QTY
1	DIAPHRAGM	1
2	SHUTTER	1
3	RELIEF	1
4	O'RING	1
5	O'RING	1
6	O'RING	1
7	O'RING	1
8	O'RING	1
9	O'RING	1
10	O'RING	1
11	O'RING	1
12	O'RING	2
13	O'RING	1
14	O'RING	2
15	O'RING	2



PRE PILOT G-31 → COCE: 28.20.41F		
POS.	**DESCRIPTION**	**QTY**
1	RELIEF	1
2	DIAPHRAGM	1
3	SHUTTER	1
4	FILTER ELEMENT	1
5	O'RING	1
6	O'RING	1
7	O'RING	1
8	O'RING	1
9	O'RING	1



PILOT G-43M+G31 → CODE: 28.21.10.FH65					
POS.	**DESCRIPTION**	**QTY**	**POS.**	**DESCRIPTION**	**QTY**
1	RELIEF	1	9	O'RING	1
2	DIAPHRAGM	1	10	O'RING	1
3	DIAPHRAGM	1	11	O'RING	1
4	SHUTTER	1	12	O'RING	1
5	LINING SHUTTER	1	13	O'RING	1
6	FILTER ELEMENT	1	14	O'RING	1
7	O'RING	1	15	O'RING	1
8	O'RING	1	16	O'RING	1