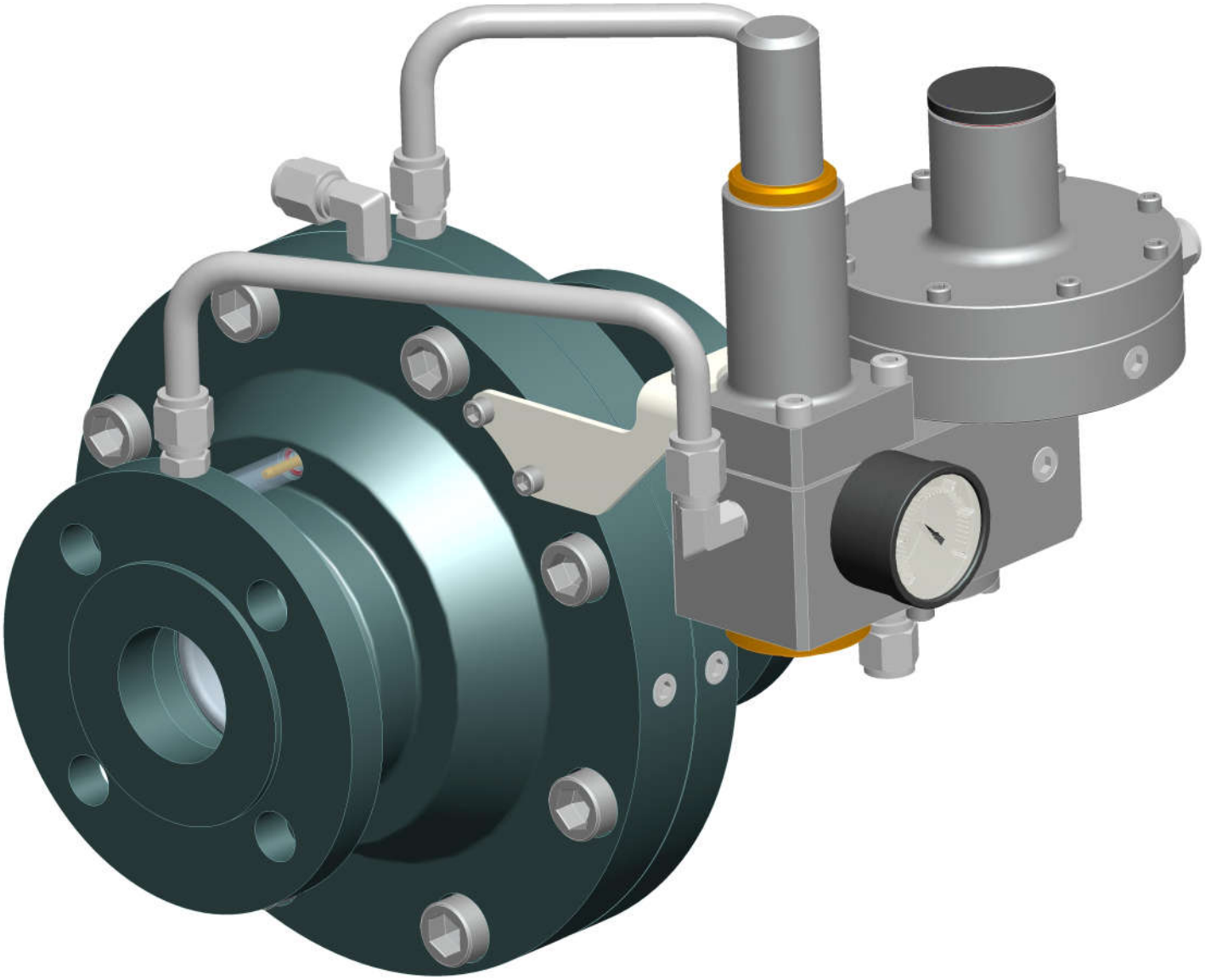
GASCAT

# Installation Manual, Maintenance and Operation
# Pressure Regulating Valve
# Model HORUS



GASCAT

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## 1.0 - GENERAL WARNINGS

### 1.1 – INSTRUCTIONS FOR PRE COMMISSIONING

It should be clearly understood that with the information presented in Commissioning Instructions that follow, it is not intended to repeal or replace the instructions determined by any other competent body and should be reference to the relevant standards and / or existing recommendations on this subject.

Before any commissioning, is implied the performance of the appropriate "Cleaning and Purification Procedures" that must be observed and all the instructions on "Pressurization" and "Work Standards for Health and Safety", must be strictly met.

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

### 1.2 – HEALTH AND SAFETY

Regulators, valves, and other pressurized components that contain toxic gases, flammable or other hazardous products, are potentially dangerous if not operated and maintained properly. It is imperative that all users of this equipment are adequately educated and guided to the potential hazards and make sure that staff responsible for the installation, testing, commissioning, operation and plant maintenance are competent to do this. Instruction manuals are provided for the guidance of operators, but it is assumed that they have a basic level of knowledge. If any doubts or ambiguities that affect the proper procedures ask Gascat Ind e Com. Ltda. who will be happy to advise or provide the relevant service or instruction. NO RISK. Our phone number, fax number and e-mail are described below:

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The comments that follow, while not exhaustive, provide guidance possible sources of danger to health and safety.

#### 1.2.1 – NOISE

Regulators, valves and pressure reducers can produce high noise levels, which may be harmful to persons exposed to them for long periods of time. Users should ensure that adequate precautions are taken in order to provide security to the health of employees and / or third parties as the standards and recommendations in force.

#### 1.2.2 – INSTALLATION

All equipment, piping and vessels are designed to withstand mechanical stress, for example, torque and moments of "bending" in addition to internal pressure. However, care must be taken during installation to not impose excessive strain, which may cause cracks that may result in a more serious break when the regulator is put into operation. Excessive stress can also be caused due to not supporting the length of the pipe, which must be adequately supported.

All regulators, valves shut off, relief valves, etc., should be installed with the correct flow.

Impulse lines are important components of any control system and it is essential that they are properly installed and without isolation valves.

Impulse lines should be adequately supported to reduce excessive vibration which may cause disruption due to fatigue. They should also be positioned so that they cannot serve as a footrest or hands. Impulse lines should be slightly inclined so that condensed liquids and to flow into the main pipe.

When necessary (in underground facilities or indoor area) should be installed a pipe ventilation from Ø threaded ¼ "NPT, positioned in the bell or diaphragm housing, which should be extended and positioned in a safe place and ventilated, with the departure of protected vent to prevent water entering the rain and insects that may cause obstruction of ventilation.

Auxiliary systems should not be altered or modified without the knowledge of operating conditions and permission of the people responsible.

### 1.2.3 – OPERATION

Depending on the type of regulator, the valve may even be positioned fully open. Consequently, when a regulator put in operation, the shutoff valves should be opened 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 spring adjustment specified by the manufacturer. This is especially important when operating relief valve or shutoff valves, since incorrect springs may prevent the relief valve to open and close the shutoff valve.

Precautions should be taken to prevent water from entering through the openings for breathing and ventilation.

### 1.2.4 – MAINTENANCE

Regulators and valves contain gases at pressures that are sometimes greater than atmospheric pressure. Before trying to investigate any problem or perform maintenance work on equipment, they must be safely depressurised. Furthermore, as most gases may be flammable, toxic, corrosive, or hazardous, it may be necessary to purge the system with an inert gas such as nitrogen. Special precautions are necessary for operation with gases such as oxygen or hydrochloric gas and the user must be sure that the appropriate procedures are in place.

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 this device is properly released. Still, it is wise to consider that the high pressure gas may be present when removing covers and plugs.

Most regulators use spiral springs as a charging device. It is important to reduce the burden these springs away your presser as possible. In some cases, there may be some cargo residue, even when the spring is relaxed within the limits of their house.

## 2.0 – INTRODUCTION

### 2.1 SCOPE OF MANUAL

This manual aims to provide operational information, installation and maintenance of the pressure regulators model HORUS manufactured by GASCAT.

### 2.2 DESCRIPTION

The pressure regulator model HORUS was designed to meet varied applications and to work with several process service conditions. It has outstanding applications with high differential pressure combined with high process flow and high pressure. It are typical installations with these characteristics the natural gas transportation and delivery points where occurs custody transference. It is also common to utilize with distributor stations of natural gas and other gases non-corrosive.

The pressure regulator HORUS is pilot operated and has axial flow what result in low noise level as well high flow capacity. Beyond this, the double diaphragm pilots supplied with the valve allow accuracy in set pressure up to 1%.

It's construction design meets the active (fail open) monitor (fail close) configuration.

The set of piston and seat was designed to proportionate high flow rangeability to the pressure regulator, can operate with a maximum inlet pressure of 150 kgf/cm² and outlet pressures from 1.0 to 80.0 kgf/cm².

## 2.3 SPECIFICATIONS

### 2.3.1 AVAILABLE SETTINGS

HORUS SC: Pilot operated pressure regulator fail close position

HORUS pressure regulators are classified as SC in accordance with standard DIN EN 334 directives, for fail condition.

### 2.3.2 AVAILABLE CONNECTIONS

| DN | FLANGE ASME B16.5 | FLANGE DIN 2634 / 2635 |
|---|---|---|
| 2” | 150#RF / 300#RF / 600#RF ou RTJ | PN16 / PN 40 |
| 3” | 150#RF / 300#RF / 600#RF ou RTJ | PN16 / PN 40 |
| 4” | 150#RF / 300#RF / 600#RF ou RTJ | PN16 / PN 40 |
| 6” | 150#RF / 300#RF / 600#RF ou RTJ | PN16 / PN 40 |
| 8” | 150#RF / 300#RF / 600#RF ou RTJ | PN16 / PN 40 |

### 2.3.3 TEMPERATURE LIMITS

Operating temperature: -20°C a 60°C

Ambient temperature: -20°C a 60°C

Temperature limits reported in this manual or any standard should not be exceeded under any circumstances, at the risk of damage to the equipment, installation and security of the people involved in the operation.

### 2.3.4 COEFFICIENTS FLOW

| DN | CV | KG |
|---|---|---|
| 2” | 80 | 2481 |
| 3” | 161 | 5024 |
| 4” | 320 | 9924 |
| 6” | 610 | 18920 |
| 8” | 1119 | 34735 |

Note:
1) We suggest that is considered a 20% safety factor on the calculated value.
2) When assembled in an active-monitor system consider 25% restriction on the CV / KG of both valves.

## 2.3.5 APPROXIMATE WEIGHT

| DN | 150# / PN16 | 300# / PN40 | 600# |
|---|---|---|---|
| 2” | 40 | 65.5 | 67.5 |
| 3” | 93 | 97 | 99 |
| 4” | 147 | 150 | 157 |
| 6” | 280 | 300 | 340 |
| 8” | 580 | 610 | 650 |
| 10” | 812 | 854 | 905 |

Note:
1) Weights reported in kilograms (Kg)
2) Considered body in carbon steel ASTM A516 GR70
3) For the exact weights contact the GASCAT for verification of the model.

## 2.3.6 MAXIMUM WORKING PRESSURE

| 150# | 300# | 600# | PN 16 | PN 40 |
|---|---|---|---|---|
| 19 bar | 51 bar | 100 bar | 16 bar | 40 bar |

Pressure limits reported in this manual or any standard should not be exceeded under any circumstances, at the risk of damage to the equipment, installation and security of the people involved in the operation.

## 2.3.7 SETTING PRESSURES SET-POINT

Pressure regulators, model HORUS use two models of pilots for pressure control called G-80 and G-42, here are the adjustment ranges available for each model:

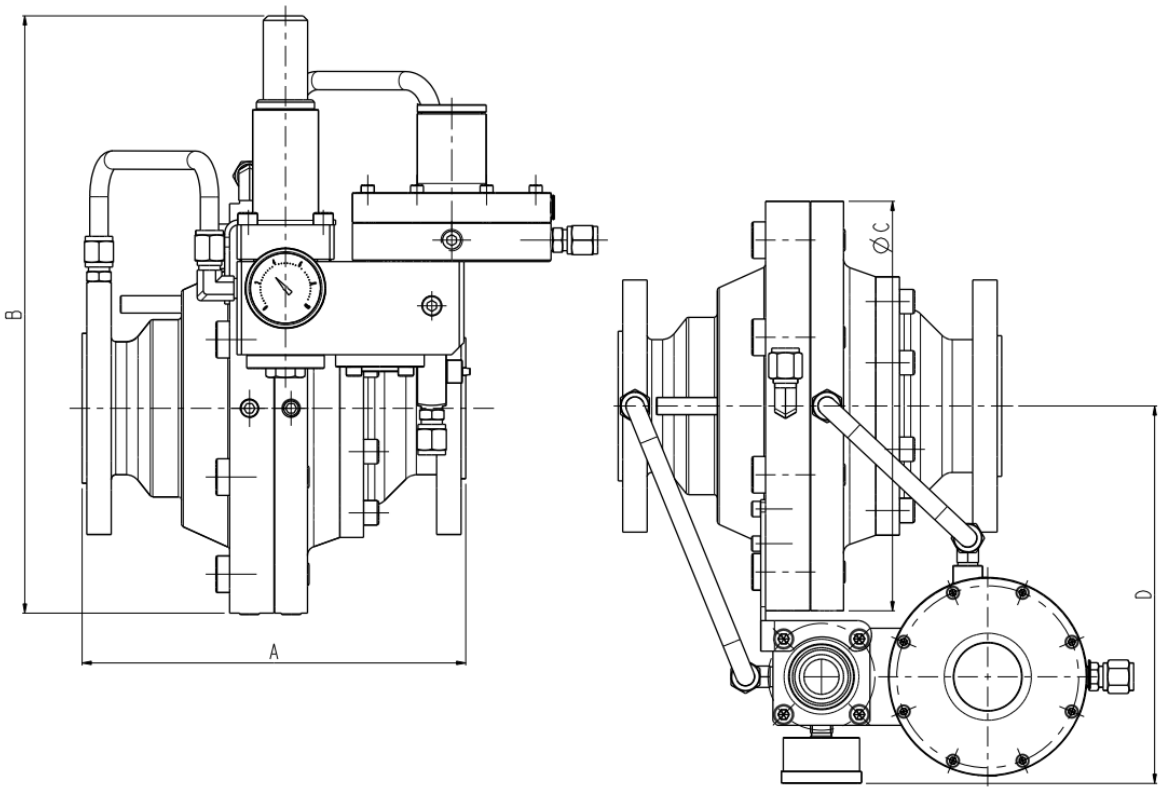
| G-80 PILOT | | |
|---|---|---|
| SPRING COLOR | PART NUMBER | RANGE |
| YELLOW / GREY | 01.50.09P | 20 – 50 mbar |
| BLUE | 01.53.35 | 40 – 130 mbar |
| WHITE / GREY | 01.50.21A | 90 – 250 mbar |
| SILVER | 01.50.21P | 230– 400 mbar |
| GREY | 01.50.24 | 350 – 1100 mbar |

| PILOT G-42 | | |
|---|---|---|
| SPRING COLOR | CODE | ADJUSTMENT RANGE |
| GREEN | 01.49.65 | 1,0 – 4,5 bar |
| GRAY | 01.49.64 | 4,5 – 12,0 bar |
| BLUE | 01.49.33 | 11,0 – 17,0 bar |
| RED | 01.51.94A | 16,0 – 30,0 bar |
| YELLOW | 01.51.94 | 27,0 – 55,0 bar |
| **PILOT G-40** | | |
| SPRING COLOR | CODE | ADJUSTMENT RANGE |
| YELLOW | 01.51.94 | 47,0 – 80,0 bar |

## 2.3.8 ACCURACY AND LOCK UP

Accuracy; Closing: AC up to 1%; SG up to 5%

## 2.3.9 PRESSURE REGULATOR DIMENSIONS (STANDARD LAYOUT)



| DIMENSIONS (mm) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | A (RF) | | | B | | C | | D | |
| ND | 150# / PN16 | 300# / PN40 | 600# | 150# / PN16 | 300# /PN40 / 600# | 150# / PN16 | 300# /PN40 / 600# | 150# / PN16 | 300# /PN40 / 600# |
| 1” | 184 | 197 | 210 | 334 | 334 | 198 | 198 | 310 | 310 |
| 2” | 254 | 267 | 286 | 390 | 416 | 268 | 280 | 247 | 392 |
| 3” | 298 | 317 | 337 | 465 | 476 | 329 | 340 | 441 | 452 |
| 4” | 352 | 368 | 394 | 536 | 536 | 400 | 400 | 512 | 512 |
| 6” | 451 | 473 | 508 | 668 | 668 | 532 | 532 | 644 | 644 |
| 8” | 543 | 568 | 610 | 846 | 846 | 710 | 710 | 822 | 822 |
| General Tolerance = ± 2.0 | | | | | | | | | |

## 3.0 – PRINCIPLE OF OPERATION

### 3.1 REGULATOR

During pressure absence, shutter (A) is kept in closed position by the shutting spring (B), which keeps it pressed against the gasket (C). It stands out that even when subject to pressure, upstream pressure variations have no influence on the shutter position, due to the balancing of the forces acting on the same, as well as on the actuator shaft (D) that is also balanced.

When the inlet piping is pressurized, gas reaches the booster (F), which reduces the pressure to a convenient value near to the outlet pressure and delivers the same to pilot (G). The pilot compares the gas feeding pressure with the outlet pressure, sensed by the pilot diaphragm (H), and controls the flow to be injected under the main regulator diaphragm (L).

If a decrease in downstream pressure occurs (due to an increased consumption or a drop of the upstream pressure) an imbalance between the spring (I) force on the pilot (H) diaphragm and the force generated by the outlet pressure under this same diaphragm, drives the pilot (K) shutter to a larger aperture, therefore, causing a pressure increase under the main regulator (L) diaphragm, which combined with downstream pressure drop, which actuates on the main regulator diaphragm and in the opposite side of the pilot pressure thereon, will determines the displacement of the shutter (A) upwards, thereby increasing the passage and restoring the set point.

When the pre-regulated pressure begins to increase, it makes the pilot (K) shutter to reduce the aperture. The increased pressure, which actuated under the regulator (L) diaphragm, flows through the Bleed (M) restriction (adjustable) that discharges the same downstream. The strength of the closing spring of the main regulator (B) plus the decrease of the pilot pressure cause a downward displacement of the main shutter (A), making the pressure to return to the preset value.

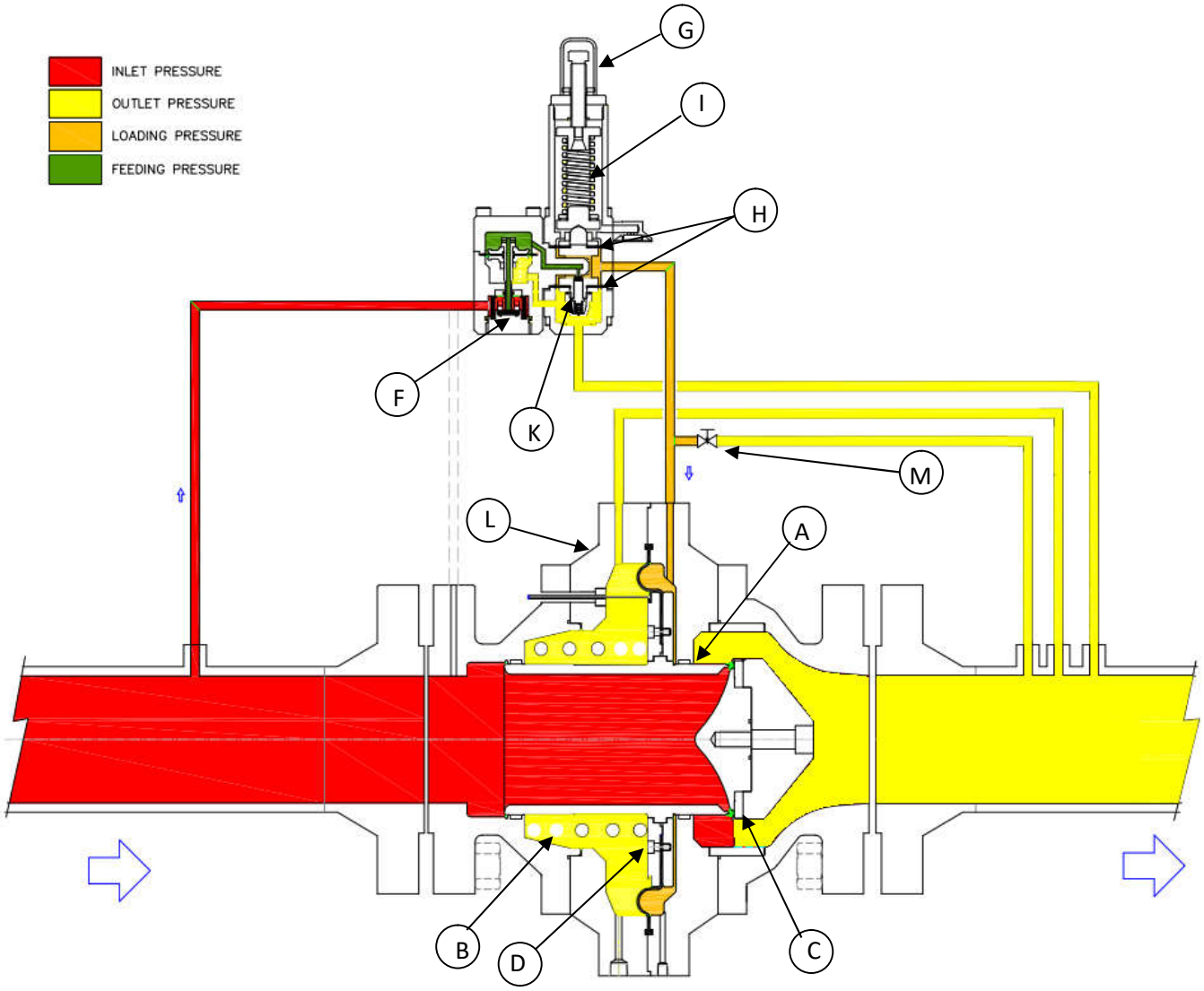


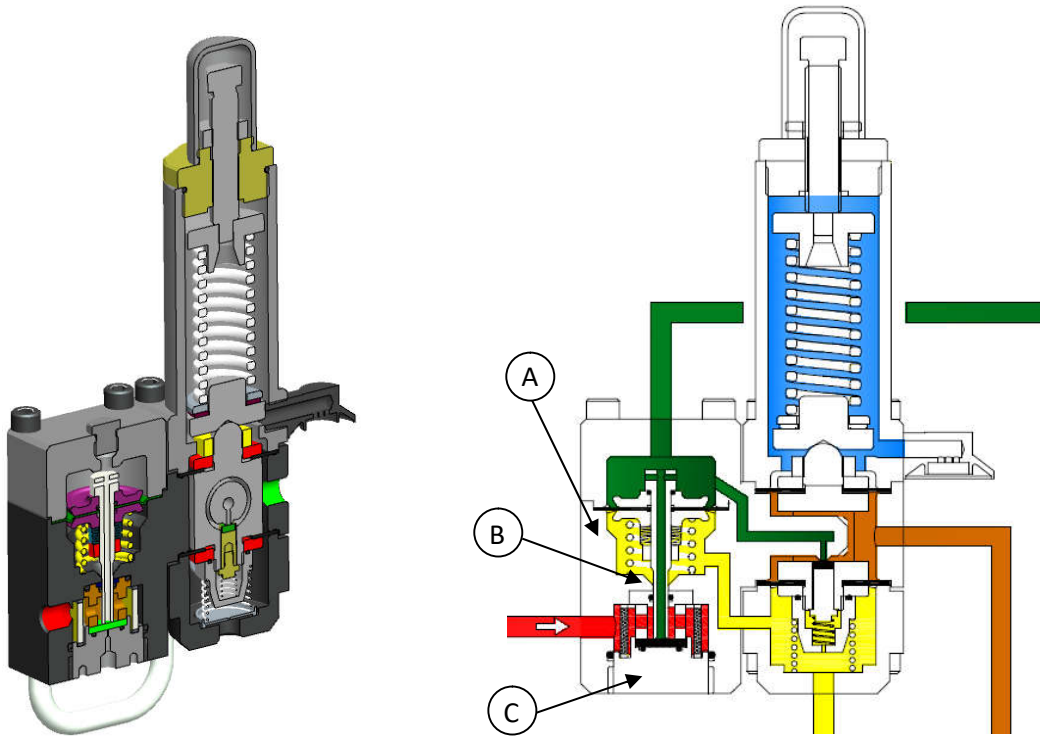

**FIGURE 1 - HORUS FAIL CLOSED**

## 3.2 BOOSTER (G-43)

The Booster is nothing more than a pre-regulator that automatically adjusts the process conditions as a function of the input pressure and output pressure with the purpose of reducing the pilot inlet pressure, allowing the pilot to operate in a milder condition, thus eliminating any chance of interference on the regulator piloting by the input pressure variation.

The use of a pre-regulator, or booster, is recommended only for applications where the pressure differential exceeds 10.0 bar.

Booster model G-43 and is designed to keep the pilot input pressure set 1 to 2 bar above the desired set point, e.g.: if we are adjusting the pressure regulator to 20 bar, the booster will be applying to the pilot a pressure of 21 to 22 bar.



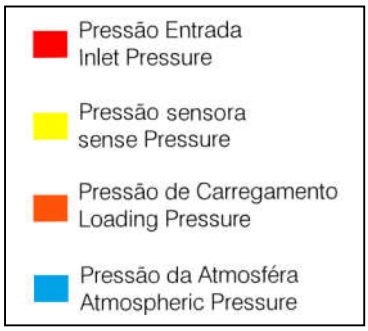

Typically, the booster G-43 have three connections to the process. These are represented by the red line in the figure above, from the regulator inlet and loaded with the inlet pressure; the yellow line is the output pressure of the main regulator, also called sensor pick-up, and is responsible for actuating on the booster diaphragm (A), moving the shaft (B) away from the gasket (C), thus allowing the passage of gas from the regulator input at a pressure 1 to 2 Kgf/cm² above the set point pressure of the main regulator, which by its turn is represented by the green color and is the pick-up that will follow to the Pilot.

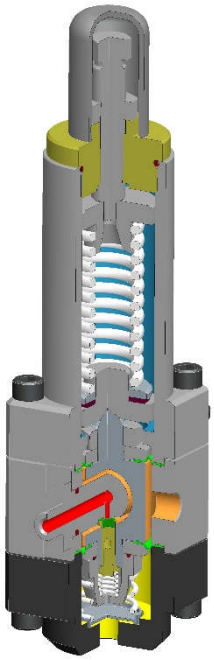
Attention: In some assemblies, the booster can be integrated into the pilot; this change is merely ergonomic to reduce space, component count and ease of operation. However, it is important to note that the operating principle is exactly the same as given above.

## 3.3 PILOTS (G-40 & G-42)

The pilots series G-40 and G-42 are composed by dual diaphragm pilot that can achieve much higher accuracy than other pilots due to their constructional characteristics.

Pilots are responsible for sending the exact loading pressure for pressure regulating valves open or close under normal process conditions by the balance between the force of the regulating spring and the outlet pressure received by the sensor outlet.



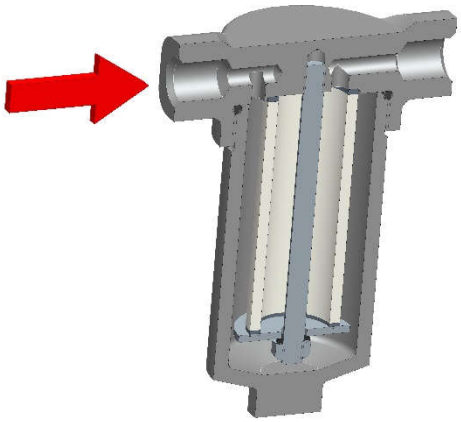
## 3.4 FILTERS

The GASCAT called pilot blocks consisting of pilot and booster has always a mechanical barrier against solid impurities, this barrier is composed by a filter element in polypropylene with filtration degree of 10 microns.

This barrier aims to prevent solid contaminants in the pipe can clog or damage the internal pre regulator and the pilot, **but it is important to note that this filter does not replace the filtration system that should be provided in the previous steps to pressure regulating so as to leave the clean fluid and correct operating conditions**, the filter is designed to serve as a last barrier to the solid contaminants.

### 3.4.1 F-10 FILTER

The HORUS pressure regulators are available with F-10 filter, mounted separate from the pilot block or compact version with the filter element already attached to the pre regulator.



## 4.0 – INSTALLATION

### 4.1 FILTER

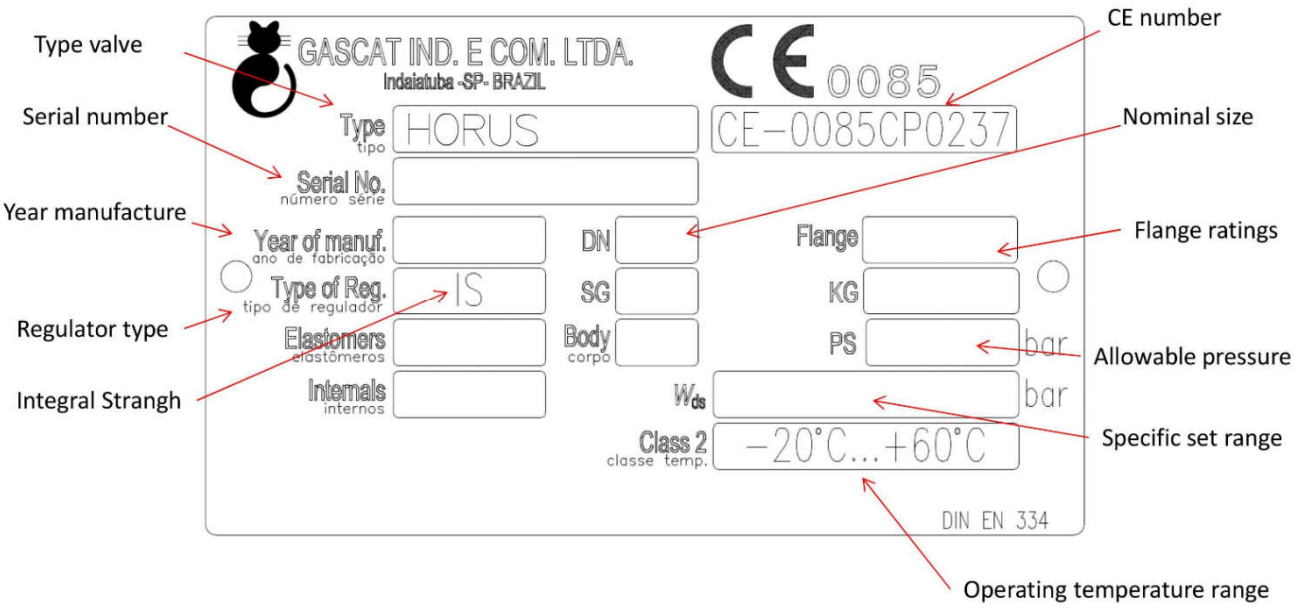
We recommend installing a filter type "cartridge", with grade 5 Micra filtration, as close to the regulator inlet, without being united flange to flange, therefore, the filter installed immediately upstream of the regulator may cause turbulence causing disturbance in the regulator pressure control. Care for the filter installation is essential to the smooth operation of the instrument as any existing particles in the pipe can become lodged between the seat and the shutter, damaging them and causing feedthrough.

### 4.2 CLEANING

Check the pipe cleaning before valve installation. We recommend a complete purge of the line with nitrogen or compressed air.

### 4.3 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.



## 4.4 DIRECTION OF FLOW AND SYSTEM INTEGRITY

Before proceeding with the installation of the equipment you must ensure that:

1) The equipment is in perfect condition or has function in damaged evidence in the handling during transport, if you have a fault not proceed with the installation and contact the GASCAT.

2) The area in which access and installation of the equipment is suitable, including for future maintenance.

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

4) The input and output connections where the pressure regulator is installed are perfectly aligned.

5) All outlets of necessary pressure in the pipeline downstream equipment for sensing, were provided and are respecting the dimensions recommended by the manufacturer.

6) It was predicted gauge or any other equipment upstream pressure indicator and downstream equipment to allow the correct fit for the start-up.

7) was provided a line of vent between the regulator and the first output block valve to assist the operator during start-up.

8) Check the direction of flow of the body marked throttle valve and pay attention to the time of installation so that it is properly positioned.

## 4.5 SENSE

The correct positioning of making impulse in the pipeline is essential for the proper functioning of the throttle valve, therefore install the pilot impulse outlet regulator downstream at a minimum distance of 5 times the nominal pipe diameter and stretch obstruction-free pipe with a pipe diameter where the gas flow rate does not exceed the maximum speed of 25 m / s (considering the lower output pressure and the maximum flow).

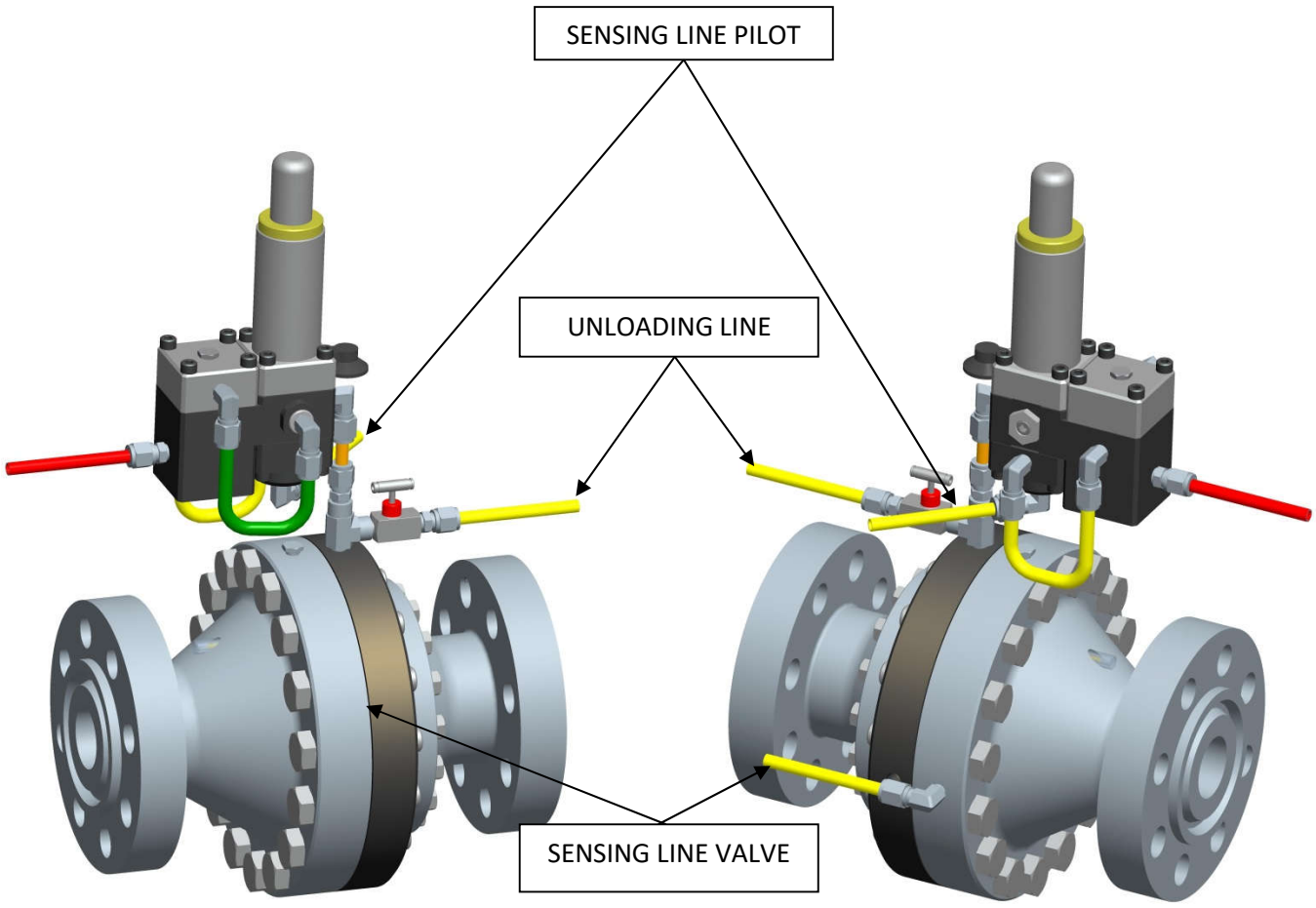
To obtain a better pneumatic signal, use ½ OF tubbings "stainless steel AISI 316 to connect the regulator to the process.

In order to avoid the accumulation of impurities and condensate in the impulse taken recommend that they be installed with a slope of 5% to 10% towards the connector on the pipe.

Pay attention to the connections welded pipe for it to be totally clear, without any welding residue that could interfere with pneumatic signal.

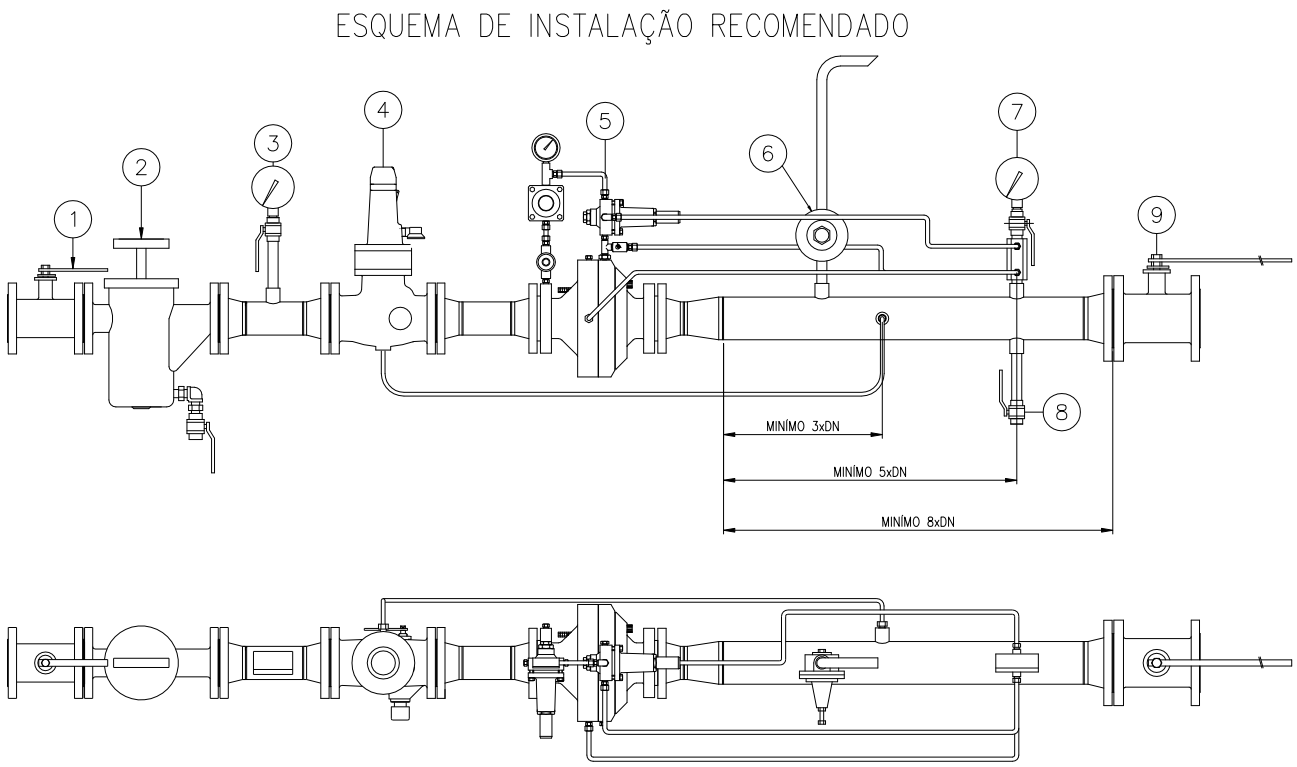
They should be installed block valves of any kind into the pressure regulators pulse taken.

Each throttle model HORUS SC (FF) needs three process connections: one directly to the actuator on the diaphragm, one that will be connected directly below the pilot and a third for the purpose of discharging the actuator under the diaphragm.



## 4.6 SCHEME RECOMMENDED INSTALLATION

### 4.6.1 SINGLE REGULATOR




1 – Inlet shut-off valve

2 – Filter cartridge type degree of filtration 5 micra

3 – Entry gauge + manifold 2 way

4 – Automatic shut-off valve for over pressure (SSV)

5 – Pressure regulator valve model HORUS GASCAT

6 – Partial relief valve

7 – Output pressure gauge + manifold 2 way

8 – Valve vent

9- Output block valve

Note: The position indicated for the sensor outlet may be less than 5D from the installation project to be reviewed and approved by engineering GASCAT.

Another recommended installation option is the use of a lung to connect the sensor taken near the equipment, among the advantages of adopting this configuration include:

1) Greater convenience during maintenance.

2) Pneumatic signal of better quality (stable).

3) Reduction of damage to tubbings during maintenance and transport.

Note: The position indicated for lung outlet may be less than 5D from the installation project to be reviewed and approved by engineering GASCAT.

## 4.7 START-UP

### 4.7.1 GENERAL RECOMMENDATIONS

Before proceeding with the commissioning of the equipment is important to always:

1) Check that the equipment is properly installed according to the recommendations set out in item 4.3 of this manual.

2) Close the input block valves, output and bypass (if applicable) of the leg.

3) Open the vent valve downstream of the last pressure regulator installed on leg.

4) Make sure that the depressurized this station.

**ATTENTION:**

* Under no circumstances do with the line pressurization where the equipment is installed by the posterior valve equipment.

* Under any circumstances perform depressurization line where equipment is installed by the valve located at the entrance of the equipment, such as filters drain.

5) Make sure all connectors are properly secured the station before proceeding with the pressurization of the line.

6) Check that the installed equipment is suitable operating conditions through the information available on the nameplate attached to the equipment.

7) Make sure the SSV is in the closed position.

**ATTENTION:**

The SSV GASCAT are sent to the already calibrated field, however due to the conditions of carriage and operation of any equipment the valve may have its set-point change.

Therefore we recommend that you checked the set-point of the SSV with the help of a connected external air supply directly to the actuator, before proceeding with the pressurization of the line.

The model HORUS valves are not sent to field set on their set-point, this measure tends to preserve the life of the product's internal therefore to receive a control valve HORUS model pressure, keep in mind that you need to perform the adjustment set-point before putting the equipment into operation.

**The setting of the pressure reducing station should be in accordance with DIN EN 12186 / NBR 12712 and all other applicable regulations in the region where it will operate.**

## 4.7.2 COMMISSIONING (SINGLE REGULATOR LINE)

Using as reference the assembly scheme presented in section 4.5.1 we will proceed with the description indicated for HORUS model regulator commissioning a simple adjustment line, considering that the recommendations made in section 4.6.1 of this manual have been properly observed.

The procedure in question considers the use of GIPS-FC GASCAT model valves as a safety device.

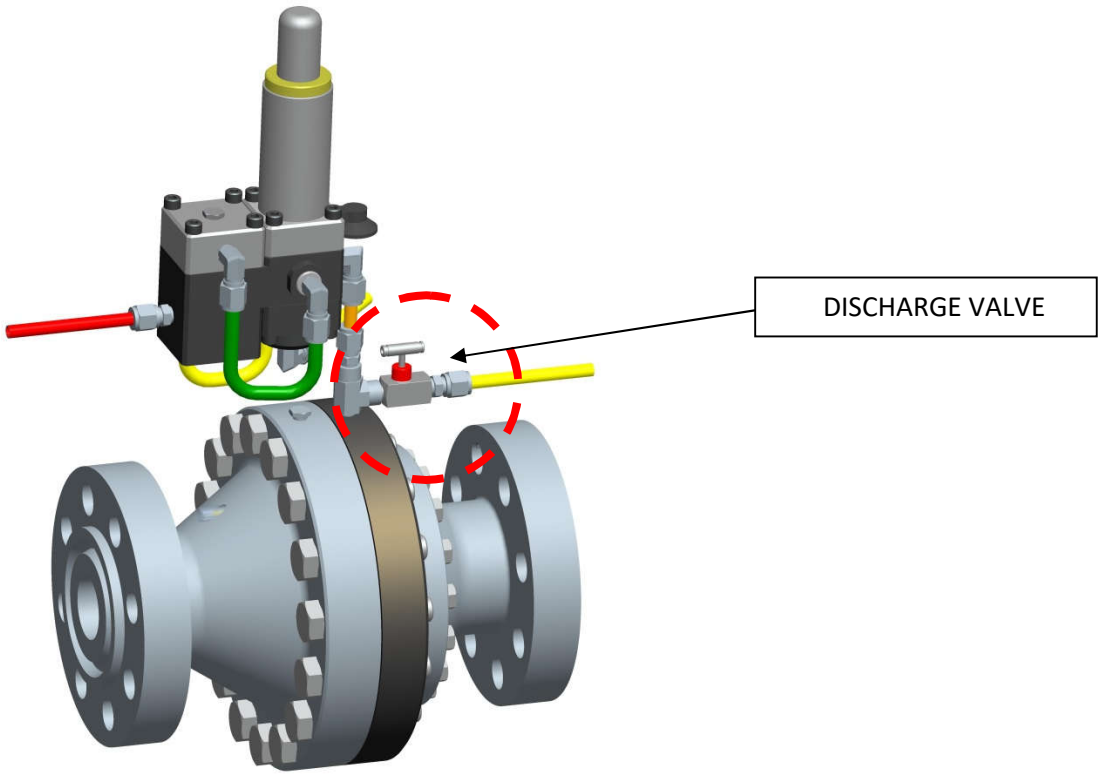
1) Fec Close the vent valve.

   As the line shut-off valves are closed we will use the vent valve to simulate a small flow and do so with the regulator adjustment before aligning the line.

2) Check that the pilot of the regulating spring is properly relieved (discharged).

   Relieving regulating spring we are ensuring that the valve will remain in the closed position when pressurized.

3) Make sure the unloading valve (needle valve) is open in 1/8 turn.




4) **SLOWLY AND GRADUALLY** open the shut-off valve, or when the station is provided with a by-pass valve block uses the same to carry out pressurization.

5) Since there is no regulator downstream pressure shut-off valve GIPS-FC model will be in the closed position, so keep the bypass valve located on the side of the SSV pressed to pressurize the space between it and the regulator pressure.

6) While still holding the valve bypass the SSV, proceed with placing a light load on the pilot's regulating spring in order to admit a small downstream pressure control valve, use a pressure gauge to monitor the increase of this pressure and let the pressure adjusted to a value at least 20% above the set-point of low pressure SSV.

7) Once the actuator SSV is already pressurized, release the by-pass valve and proceed with the disengagement of the actuator of the SSV.

8) Reset the shutter GIPS-FC block valve, through the reset lever.

9) Open the vent valve at 20%, make sure the pressure will continue in pre-set value.

10) Using a combination wrench 7/8 "turn the adjustment screw clockwise to increase the output pressure to the value of set-point desired.

11) If the pressure is oscillating perform a fine adjustment by opening or closing the discharge valve.

12) If the pressure is oscillating perform the fine adjustment by opening or closing the discharge valve.

13) Being set pressure according to the desired value, close the vent valve and check valve lock up.

14) Check for leakage in connectors and other throttle connections to the line.

15) Open **SLOWLY AND GRADUALLY** the output shut-off valve to put the line into operation.

16) If necessary to perform fine-tune the set pressure through the pilot regulating spring.

### 4.7.3 ADJUSTING THE LINE BOOKING

When the regulator is installed in a reserve line recommend that you performed the same procedure reported in 4.6.2, but the set-point pressure regulator should be adjusted for a 15% pressure - 20% less than the valve set-point that is in operation.

Made it open **SLOWLY AND GRADUALLY** downstream so that the pressure outlet shut-off valve to the regulator leg reserves equalize with the pressure that is already in operation, the regulator reserves remain closed.

To make the regulator that the reservation leg assume the setting, press the regulating spring towards slowly clockwise until the set-point of this regulator reaches a value greater than the set-point of the line is in operation, this the way regulatory reserve will open slowly and take the operation.

It is important that the two regulators remain with a difference of set-point at least 5% - 10%, so there is not a set-point of overlap causing a competition between the two lines, ie a minute regulator opens in governor opens another booking, promoting an inaccuracy in regulating.

**TABLE SET POINTS RECOMMENDED**

| SET POINT MAIN REGULATOR (PS) | SET POINT REGULATOR RESERVE | SET POINT PSV | SET POINT SSV |
|---|---|---|---|
| 2,5 – 5,0 bar | PS x 1,150 | PS x 1,400 | PS x 1,500 |
| 5,0 – 12,0 bar | PS x 1,050 | PS x 1,200 | PS x 1,300 |
| 12,0 – 20,0 bar | PS x 1,025 | PS x 1,200 | PS x 1,300 |
| 20,0 – 80,0 bar | PS x 1,025 | PS x 1,150 | PS x 1,250 |

Note: The values in this table are recommendations based on best practices, but it is not prohibited the use of set-points in different groups of informed upon review and approval of GASCAT.

### 4.7.4 LIST OF RECOMMENDED TOOLS

To perform the adjustment set-point commissioning and start-up of regulatory HORUS GASCAT the model is required only the use of a combination wrench 7/8 "to adjust the regulation of pilots springs.

1


2

The valves are HORUS model fornecdias with connectors for tubbing DN ½ "in the sensor plugs, so we still recommend the use of combination wrenches 19 mm and 13/16" for fixing the sensor taken the process line.

| ND | 1 | 2 |
|---|---|---|
| 1",2",3",4",6", 8" and 10" | 19 mm, 7/8" e 13/16" | 1" |

## 5.0 TROUBLE SHOOTING

This section of the manual aims to show potential field problems and their causes.

The problems listed in this section may be from different situations, but most of them is related to the gas conditions (impurities), natural wear and failures during operation of the equipment.

It is important to keep in mind that the operation and maintenance of GASCAT equipment must be only carried out by highly qualified and trained personnel, preferably by staff trained by GASCAT instructors.

For training and qualification of operators and technicians contact the GASCAT through the contacts below to check availability.

E-mail: sales@gascat.com.br

| HORUS | | |
|---|---|---|
| **PROBLEM** | **PROBABLE CAUSE** | **CORRECTIVE ACTION** |
| Malfunction, outlet pressure oscillation | Low flow (less than 5% of the maximum flow). | Check the operating conditions and restore the flow conditions for the standards to which the equipment has been designed. |
| | Making poorly localized impulse. | Adjust the position of the pulse taken as reported in this manual, or contact the GASCAT for analysis of engineering. |
| | Response speed of the regulator incompatible with the system. | Adjust the unloading valve (needle). |

| | | |
|---|---|---|
| Feedthrough or regulator locked in the open position | Shutter of the locked main regulator | Adjust the unloading valve (needle) .Check state shutter and anti-friction rings proceeding replacement or cleaning if necessary (minimum of grease should be applied to assembly of these items, preferably using bi-molybdenum sulfide). |
| | Broken or damaged impulse line | Check status of impulse line and proceed to replace it if necessary. |
| | Headquarters damaged or particulate matter between the shutter and the seat. | Make cleaning and check state headquarters, if it has no apparent marks of damage proceed to the assembly and check the lock up, replace if damaged. |
| Output pressure decrease and or insufficient flow | Dirt on the filter | Provide filter cleaning or replacing the filter element. |
| | Power Outage | 1) Check the locking of the booster shutter (G-43). Make sure the pilot's seat is blocked. |
| | Passage in the main diaphragm | Replace the main diaphragm |
| Exhaust gas by the pilot cover the breather. | Breaking the diaphragm | Replace the diaphragm. |
| Gas leak at door trim booster | Booster trim disruption (G43) | Replace the gasket. |

## 6.0 MAINTENANCE

Perform preventive maintenance of pressure regulators model HORUS is essential for proper operation of the equipment over time and is directly related to the reliability of the pressure control system, preventing the user operating problems.

The frequency of maintenance varies considerably according to the installation, operating conditions and the quality of the fluid in question, for example if the machine is subject to a large presence of contaminants such as black powder, yellow powder, oil, condensate, etc. certainly the service interval should be lower.

The GASCAT own standards repair kits for each throttle component HORUS model composed of the most likely items to wear with time, this list of components that discriminated in this manual for the guidance of users.

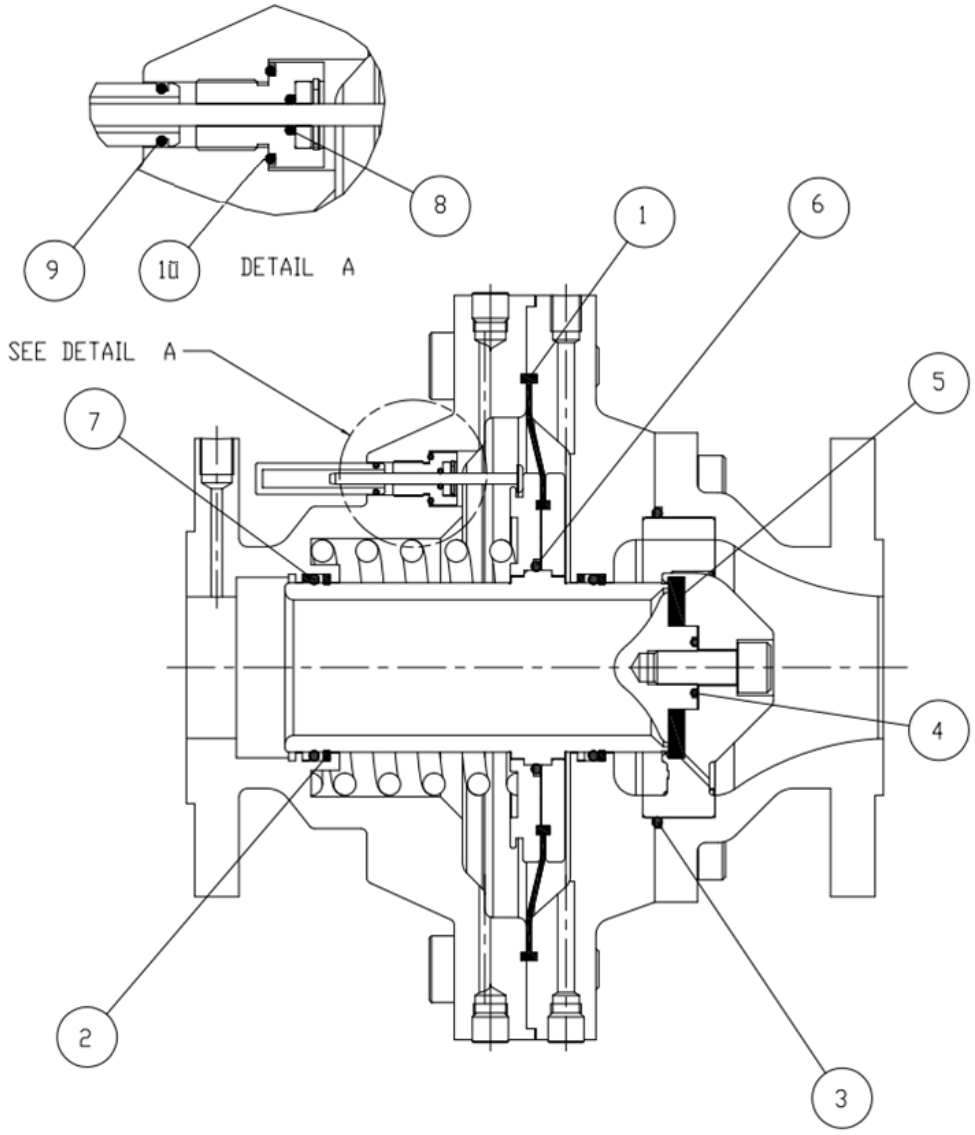
**ATTENTION:**

The components of the control valves GASCAT pressure are developed, manufactured and tested with GASCAT exclusivity in order to provide the greatest efficiency and safety operation, not using original components makes unsafe operation and compromises the process efficiency.

The GASCAT not responsible for the operation of equipment that do not operate with original components.

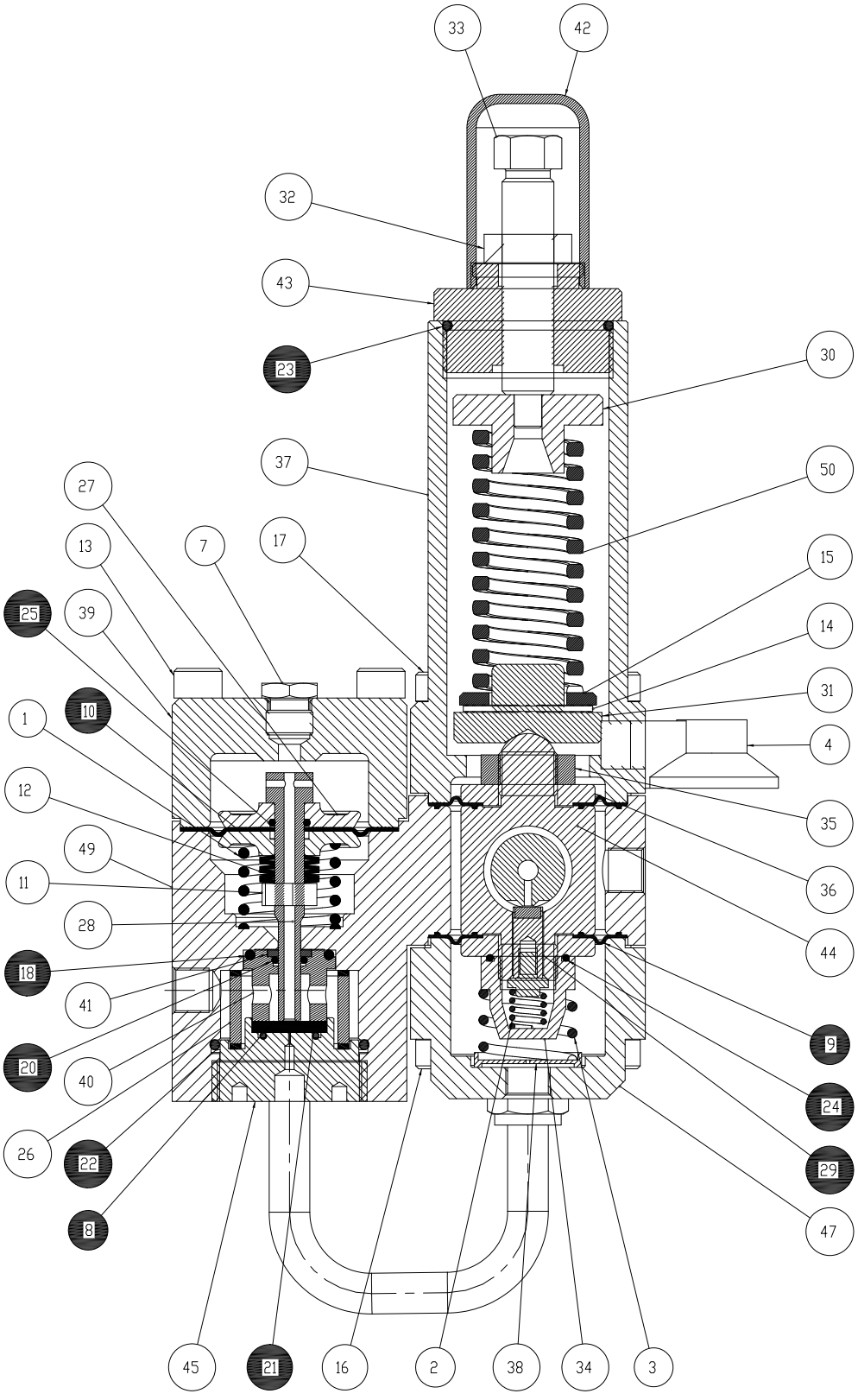
Before starting maintenance pressure regulators in GASCAT always make sure to have a replacement kit with original parts GASCAT as well as this instruction manual for reference and how to safely and efficiently while maintaining the equipment.

## 6.1 RECOMMENDED REPAIR PARTS AND KITS




| POS. | DESCRIPTION | QTY |
|---|---|---|
| 1 | DIAPHRAGM | 1 |
| 2 | PARBAK RING | 2 |
| 3 | O'RING | 1 |
| 4 | O'RING | 1 |
| 5 | SOFT SEAT | 1 |
| 6 | O'RING | 1 |
| 7 | O'RING | 2 |
| 8 | O'RING | 1 |
| 9 | O'RING | 1 |
| 10 | O'RING | 1 |

Note:
2*: The item 2 is not applicable to pressure class 150# and PN16.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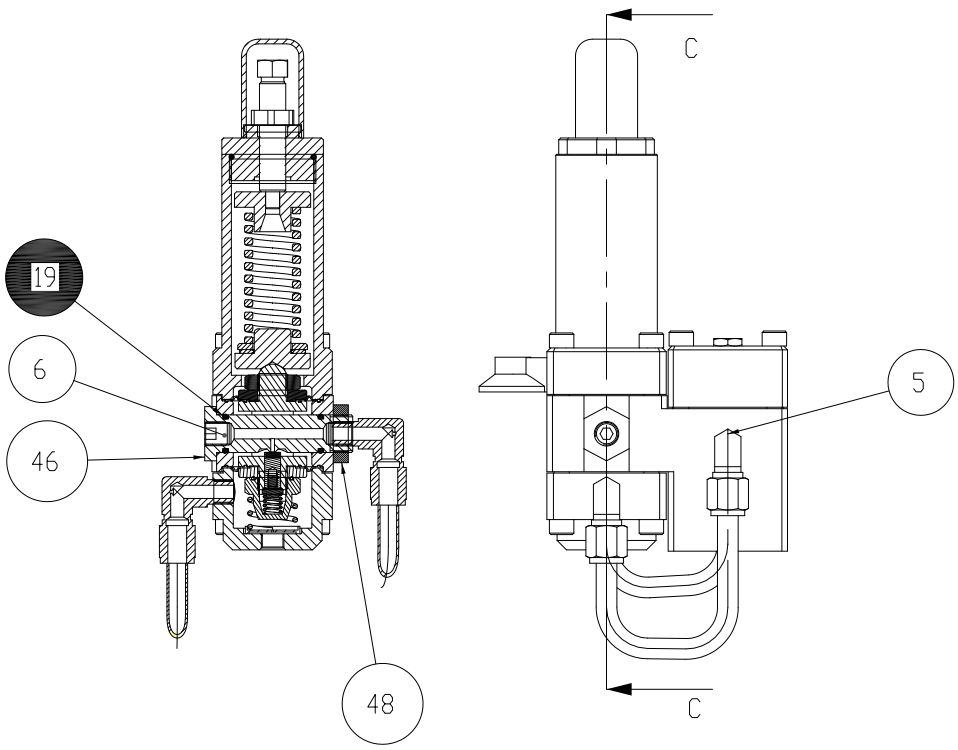
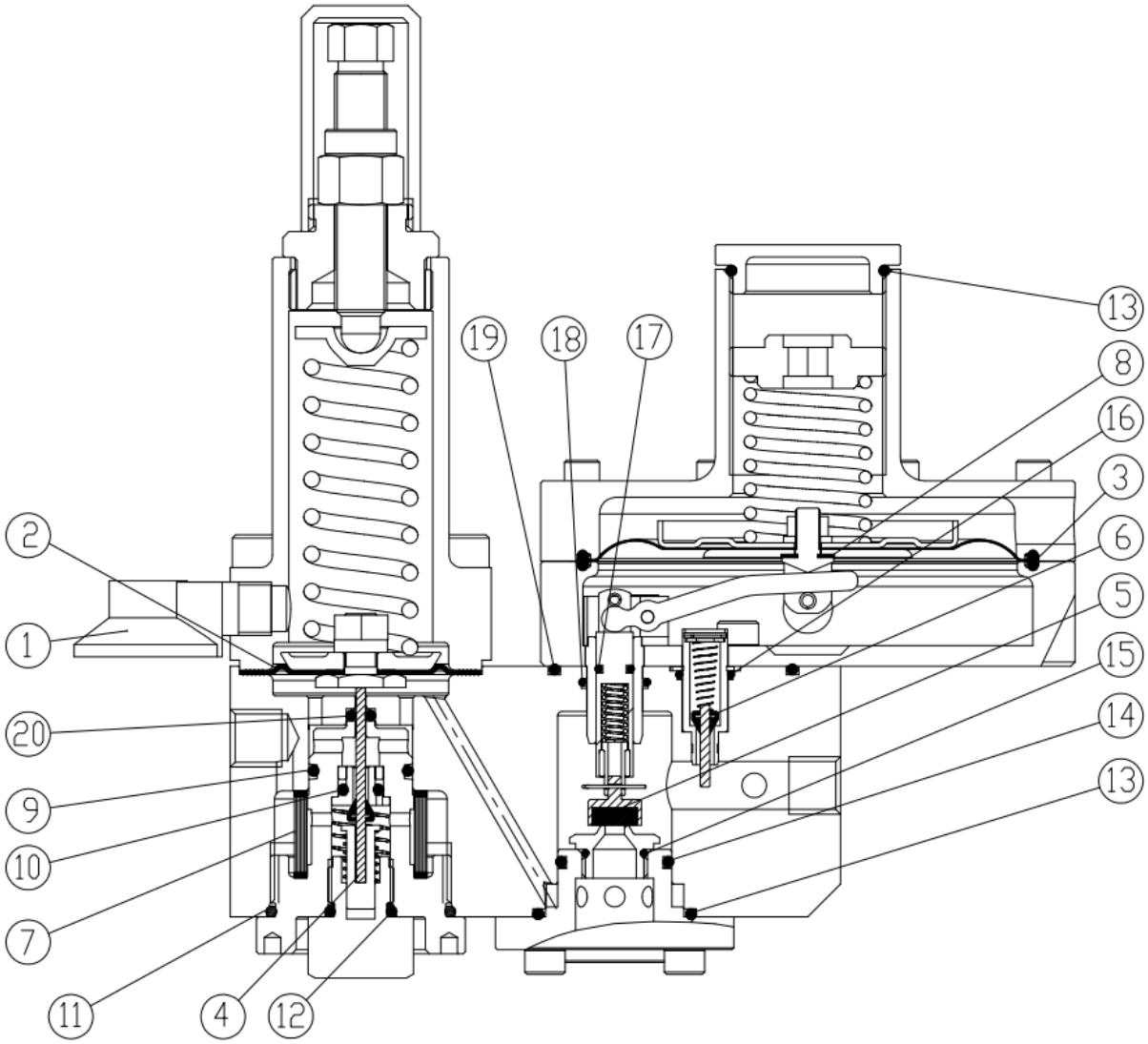
## BOOSTER G-43 + PILOT G-42/40




| BOOSTER G-43 | | |
|---|---|---|
| POS. | DESCRIÇÃO | QTY |
| 8 | GARRISON | 1 |
| 10 | DIAPHRAGM | 1 |
| 18 | O'RING | 1 |
| 20 | O'RING | 1 |
| 21 | O'RING | 1 |
| 22 | O'RING | 1 |
| 25 | O'RING | 1 |

| PILOTO G-40/42 | | |
|---|---|---|
| POS. | DESCRIÇÃO | QTY |
| 9 | DIAPHRAGM | 2 |
| 19 | O'RING | 2 |
| 23 | O'RING | 1 |
| 24 | O'RING | 1 |
| 29 | SHUTTER | 1 |

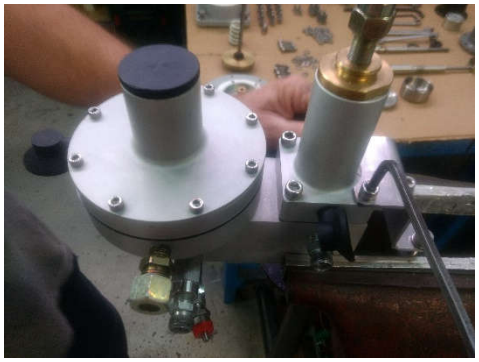
## BOOSTER G-43 + PILOTO G-42/40



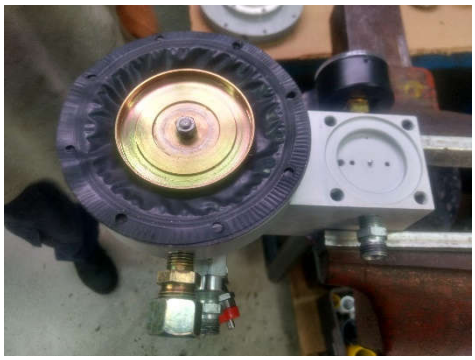
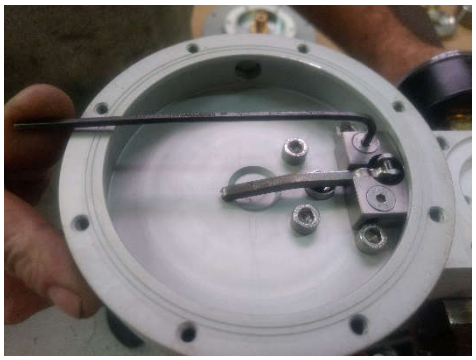

| G-80 PILOT → CODE: 28.21.28A_KIT | | | | | |
|---|---|---|---|---|---|
| POS. | DESCRIPTION | QTY | POS. | DESCRIPTION | QTY |
| 1 | RELIEF | 2 | 11 | O'RING | 1 |
| 2 | DIAPHRAGM | 1 | 12 | O'RING | 1 |
| 3 | DIAPHRAGM | 1 | 13 | O'RING | 2 |
| 4 | SHUTTER | 1 | 14 | O'RING | 1 |
| 5 | SHUTTER | 1 | 15 | O'RING | 1 |
| 6 | INTERNAL RELIEF | 1 | 16 | O'RING | 1 |
| 7 | FILTER ELEMENT | 1 | 17 | O'RING | 1 |
| 8 | GASKET | 1 | 18 | O'RING | 1 |
| 9 | O'RING | 1 | 19 | O'RING | 1 |
| 10 | O'RING | 1 | 20 | O'RING | 1 |

## 6.2 PROCEDURE FOR PILOT DISASSEMBLY G-80

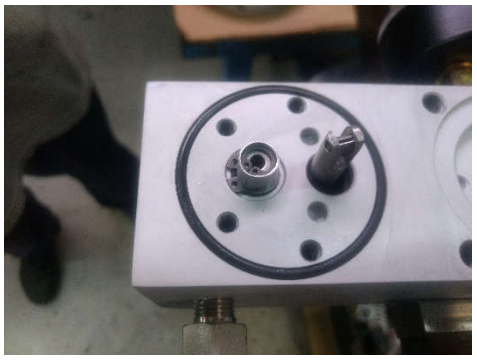
1) Remove all screws along the pilot covers (4 mm and 6 mm wrench).



2) Remove the lever screws and the lower cover screws (3 mm, 5 mm and 10 mm wrench).





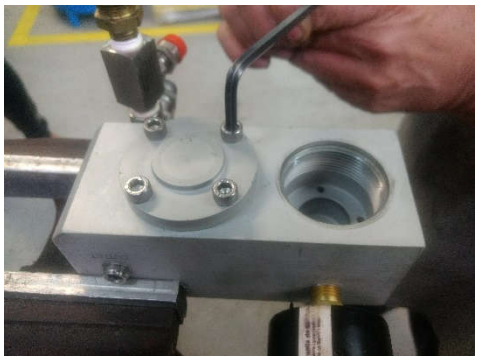
3) Turn the pilot upside down, remove the pilot cartridges (7/8”, 1.1/2” wrench and 5 mm allen wrench).

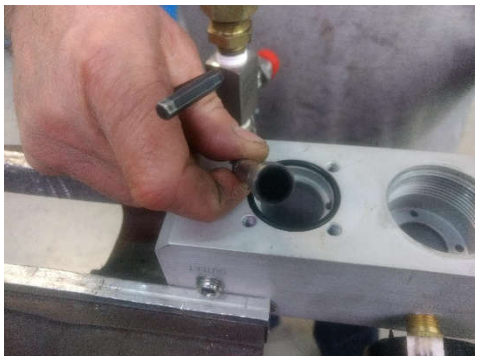
4) Remove the seat (19 mm wrench).



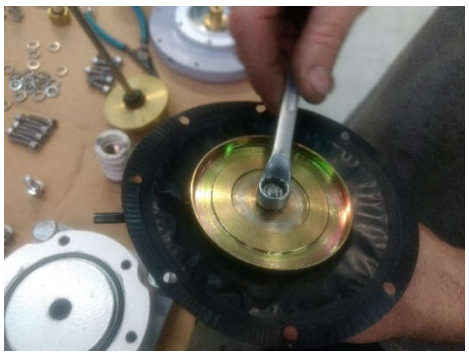




5) To disassembly the diaphragm it is necessary an allen tool 4.0mm (or similar) and a 10 mm wrench.


## 6.3 PROCEDURE FOR DISASSEMBLY G-40/42

1) Before proceeding with the disassembly of the equipment check if all the conditions set out in item 4.6.1 of this manual have been observed.

2) Go up any circumstances start the disassembly of equipment if it is pressurized.

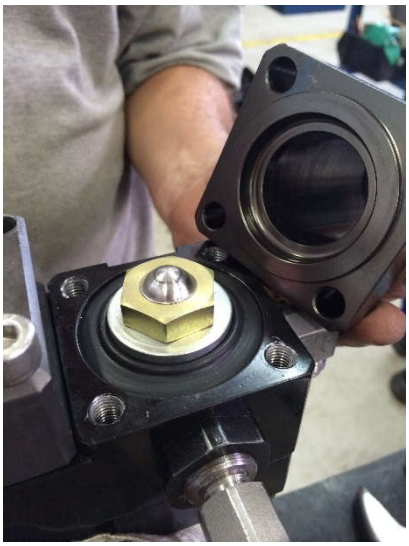
The disassembly procedure below references the positions of the components shown in the diagram available in section 6.0 of this manual.

3) Download the pilot regulating spring by turning the set screw (pos 33/30) counter clockwise.

4) Remove the guide adjusting screw (pos 43/38)

5) Remove the regulating spring (pos 50/52)

6) Remove the screws (pos 17/16) and release the sup cover (pos 37/36)

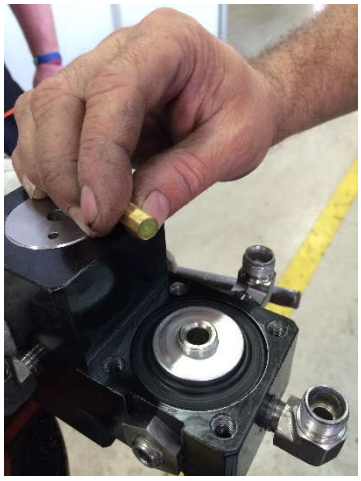


7) Turn the steering block so that the bottom of the pilot is facing up and release the screws (pos 16/15) and remove the bottom cover (pos 47/49)

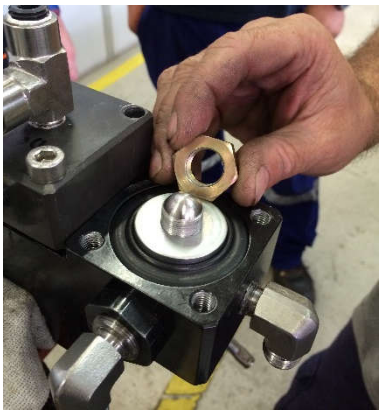
8) Remove the spring and the base (pos 38/37)

9) Remove the bushing (item 34/31) shutter spring.

10) Remove the obturator (pos 29/26)



11) Remove the diaphragm plate and the lower diaphragm (pos 9/11), turn the steering block to the starting position and proceed with the removal of the plug (pos 35/32).



12) Remove the diaphragm plate (item 36/35) and the upper diaphragm (pos 9/11),

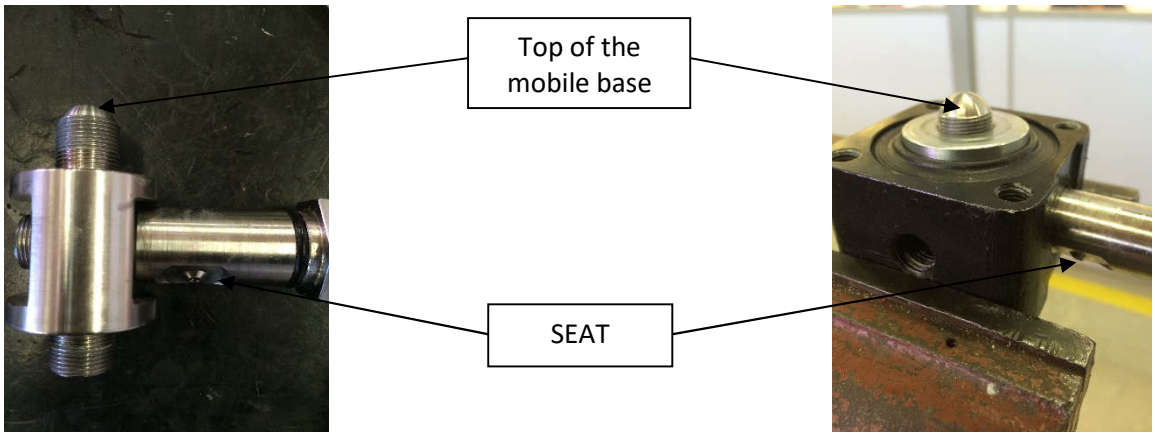
13) Remove the nut (pos 48/50), release the seat (pos 46/48) and the block (pos 44/46)



## 6.4 PROCEDURE FOR PILOT ASSEMBLY G-40/42

To perform the assembly of the G-42 pilot just follow the steps reported in the back disassembly procedure forward starting with the assembly's headquarters, but would like to make two observations on two specific points that must be evaluated thoroughly during the pilot reassembly.

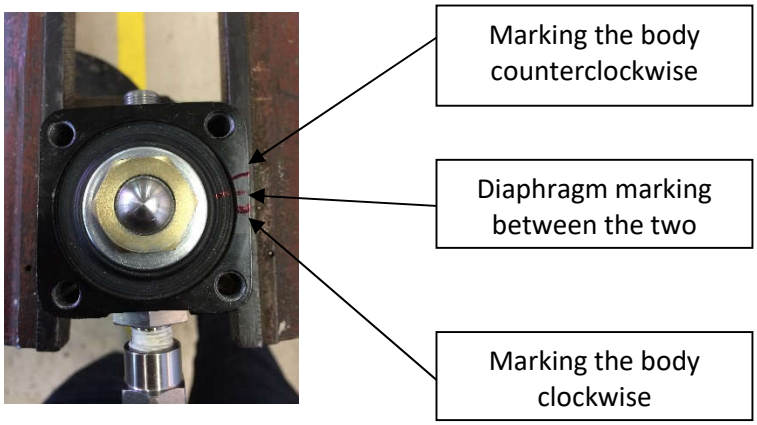
1) Pay attention to mount the seat (pos 46/48) and mobile (Pos 44/46), the seat of the hole should always be installed in the opposite position to stud the mobile base, as illustrated below, otherwise the seat will not match the shutter (pos 29/26).



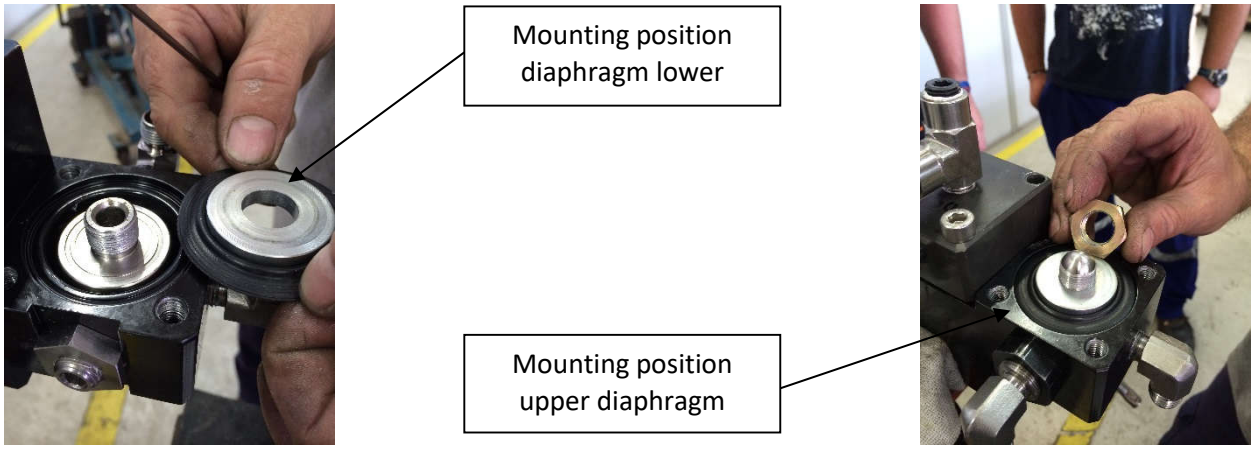

2) After mounting the seat (pos 46/48) in the mobile (Pos 44/46) is necessary to leave the perfectly aligned to the mobile base of the hole headquarters in order to prevent the same into contact with the walls of the mobile base during operation, adequate to accomplish this alignment procedure is:

2.1) After mounting the seat (pos 46/48) in the body (post 49/51) mount the lower and upper diaphragm assembly and lock with nut (pos 35/32) and diaphragm support (pos 36/35).

2.2) With the assembled unit, turn the mobile base (pos 44/46) clockwise until it stops at the headquarters (item 46/48), with a pen make a mark on the diaphragm and body, turn again towards the mobile base anti-clockwise until it stops again at headquarters (post 46/48), make a mark on the body following the marking already performed in the diaphragm (pos 9/11), position the marking performed in the diaphragm between the two markings done in the body, so we can assume that this centralized headquarters.




3) diaphragms (pos 9/11) G-42 are shaped pilot therefore have a correct mounting position and it should be observed during the assembly of the pilot, as follows:




The Model G-40 pilots use diaphragms plans, so the mounting position is indifferent to the operation.

## 6.5 PROCEDURE FOR BOOSTER DISSASEMBLY G-43

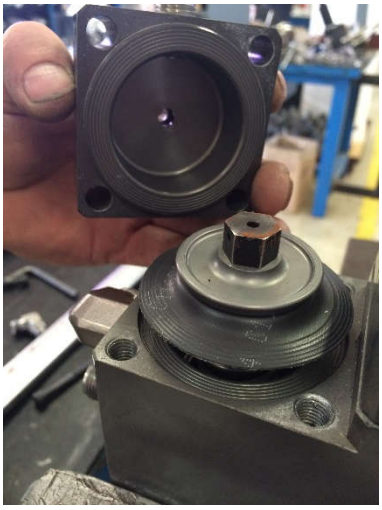
1) Before proceeding with the disassembly of the equipment check if all the conditions set out in item 4.6.1 of this manual have been observed.

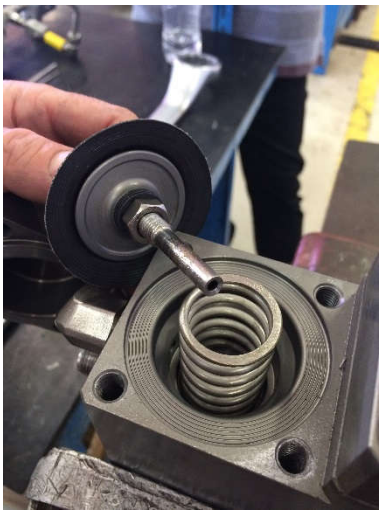
2) Go up any circumstances start the disassembly of equipment if the same is pressurized.

The disassembly procedure below references the positions of the components shown in the diagram available in section 6.0 of this manual.

3) Release the cover screws (pos 13), use an allen wrench to push the diaphragm assembly down simultaneously through the upper outlet of the booster, in order to facilitate the operation and prevent damage to the diaphragm.

1) Remove the cover (pos 39) and the diaphragm assembly (item 28).



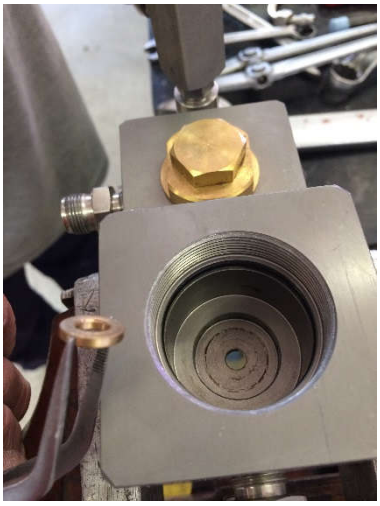


2) Lock the shaft (pos 28), release the nut (pos 11), remove the disc springs (pos 12) and the lower diaphragm plate (item 27) to release the diaphragm (pos 10).

3) Now let's move to dismantle the bottom of the booster, so the ideal is that it is rotated so that the bottom is face up, made it proceed with the removal of the door trim (pos 45).

4) Remove the filter element (pos 26) and release the trim (item 8) of the door trim (item 45) and their respective o'ring (pos 21).

5) Remove the shaft guide (item 40) and the thrust bushing (item 41)



## 6.6 PROCEDURE FOR BOOSTER ASSEMBLY G-43

To perform the assembly of the booster G-43 just follow the steps reported in the back disassembly procedure forward starting with the assembly's headquarters, but would like to make some observations on some specific points that must be evaluated thoroughly during reassembly of the booster.

1) When installing the axis diaphragm assembly (item 28) is necessary to perform the assembly of disc springs (pos 12) are in total 6 pieces and the arrangement thereof must be given as shown below:

1) After assembly of all the internal booster, when be performed at its closure, by placing the cover and screws (pos 13), we recommend that during tightening of the diaphragm assembly screws being pushed through with a key allen the upper plug (Pos 7) so that the diaphragm can be adequately clamped between the lid and the body of the booster.

## 6.7 LIST OF RECOMMENDED TOOLS FOR MAINTENANCE

| TOOLS | DIMENSIONS |
|---|---|
| KEY COMBINED | 5/8”,3/4”, 1”, 1-1/8”, 2”, 13mm |
| ALLEN KEY | 6mm, 1/4" |
| COMPASS KEY | --- |