Pressure regulators

Aperflux 101

- High Accuracy
- Dynamically Balanced Pilot
- Top Easy Maintenance
- Integral Silencing Cage
- Installation On Any Position
**Introduction**

*Aperflux 101* is a boot style pilot-controlled pressure regulator for medium and high pressure applications. *Aperflux 101* is normally a failed open regulator and specifically will open under the following circumstances:

- breakage of main diaphragm;
- lack of feeding to the pilot circuit.

These regulators are suitable for use with previously filtered, non-corrosive gases.
**Main Features**

- Design pressure: up to 85 bar (1232.8 Psi)
- Design temperature: -20 °C to +60 °C (-4 to +140 °F)
- Ambient temperature: -20 °C to +60°C (-4 to +140 °F)
- Range of inlet pressure bpu: 1.8 to 85 bar (26.1 to 1232.8 Psi)
- Range of outlet pressure Wd: 0.8 to 74 bar (11.6 to 1073.3 Psig) depending on installed pilot
- Minimum working differential pressure: 1 bar (14.5 Psi) - Recommended > 2 bar (29 Psig)
- Accuracy class AC: up to 1 depending on the outlet pressure
- Closing pressure class SG: 10 depending on the outlet pressure
- Available size DN: 2” - 3”
- Flanging: class 300-600 RF or RTJ according to ANSI B16.5

**Materials**

<table>
<thead>
<tr>
<th>Component</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body</td>
<td>Cast steel ASTM A352 LCC for rating 300 and 600</td>
</tr>
<tr>
<td>Head covers</td>
<td>Rolled or forged carbon steel A350 LF2</td>
</tr>
<tr>
<td>Diaphragm</td>
<td>Vulcanized rubber</td>
</tr>
<tr>
<td>Valve seat</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>Seals</td>
<td>Nitril rubber</td>
</tr>
<tr>
<td>Compression fittings</td>
<td>According to DIN 2353 in zinc-plated carbon steel</td>
</tr>
</tbody>
</table>

The characteristics listed above are referred to standard products. Special characteristics and materials for specific applications may be supplied upon request.
Choosing the pressure regulator

Sizing of regulators is usually made on the basis of Cg valve and Kg sizing coefficients (table 1). Flow rates at fully open position and various operating conditions are related by the following formulae where:

\[ Q = \text{flow rate in Stm}^3/\text{h} \]
\[ Pu = \text{inlet pressure in bar (abs)} \]
\[ Pd = \text{outlet pressure in bar (abs)} \].

A > When the Cg and Kg values of the regulator are known, as well as Pu and Pd, the flow rate can be calculated as follows:

A-1 in subritical conditions: \((Pu<2xPd)\)

\[ Q = K_G \times \sqrt{\frac{Pd \times (Pu - Pd)}{Pu}} \]

A-2 in critical conditions: \((Pu \geq 2xPd)\)

\[ Q = 0.526 \times Cg \times Pu \times \text{sen} \left( K \times \sqrt{\frac{Pu - Pd}{Pu}} \right) \]

B > Vice versa, when the values of Pu, Pd and Q are known, the Cg or Kg values, and hence the regulator size, may be calculated using:

B-1 in sub-critical conditions: \((Pu<2xPd)\)

\[ K_G = \frac{Q}{\sqrt{Pd \times (Pu - Pd)}} \]
\[ Cg = \frac{Q}{0.526 \times Pu \times \text{sen} \left( K \times \sqrt{\frac{Pu - Pd}{Pu}} \right)} \]

B-2 in critical conditions \((Pu \geq 2xPd)\)

\[ K_G = \frac{2 \times Q}{Pu} \]
\[ Cg = \frac{Q}{0.526 \times Cg \times Pu} \]

NOTE: The \( \text{sen} \) val is understood to be DEG.

<table>
<thead>
<tr>
<th>Table 1: Cg, Kg and K1 coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal diameter (mm)</td>
</tr>
<tr>
<td>Size (inches)</td>
</tr>
<tr>
<td>Cg coefficient</td>
</tr>
<tr>
<td>Kg coefficient</td>
</tr>
<tr>
<td>K1 coefficient</td>
</tr>
</tbody>
</table>
The formulae are applicable to natural gas having a relative density of 0.61 w.r.t. air and a regulator inlet temperature of 15 °C. For gases having a different relative density \( S \) and temperature \( t \) in °C, the value of the flow rate, calculated as above, must be multiplied by a correction factor, as follows:

\[
F_c = \frac{175 \times 8}{5 \times (273.16 + t)}
\]

Table 2 lists the correction factors \( F_c \) for a number of gases at 15 °C.

<table>
<thead>
<tr>
<th>Type of gas</th>
<th>Relative density</th>
<th>( F_c ) Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>1.0</td>
<td>0.78</td>
</tr>
<tr>
<td>Propane</td>
<td>1.53</td>
<td>0.63</td>
</tr>
<tr>
<td>Butane</td>
<td>2.0</td>
<td>0.55</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>0.97</td>
<td>0.79</td>
</tr>
<tr>
<td>Oxygen</td>
<td>1.14</td>
<td>0.73</td>
</tr>
<tr>
<td>Carbon dioxide</td>
<td>1.52</td>
<td>0.63</td>
</tr>
</tbody>
</table>

**Caution:**
in order to get optimal performance, to avoid premature erosion phenomena and limit noise emissions, it is recommended to check that the gas speed at the outlet flange does not exceed the following values:

- \( P_d \leq 5 \) bar \( V \leq 200 \) m/sec.
- \( P_d \geq 5 \) bar \( V \leq 150 \) m/sec.

The gas speed at the outlet flange may be calculated by means of the following formula:

\[
V = 345.92 \times \frac{Q}{DN^2} \times \frac{1 - 0.002 \times P_d}{1 + P_d}
\]

where:

- \( V \) = gas speed in m/sec
- \( Q \) = gas flow rate in Stm³/h
- \( DN \) = nominal size of regulator in mm
- \( P_d \) = outlet pressure in barg.
Pilots System

Pilots

Aperflux 101 regulators are equipped with series 300 pilot as listed below:
- 302/. control range Wd: 0.8 to 9.5 bar; (11.6 to 137.7 psig)
- 304/. control range Wd: 7 to 43 bar; (101.5 to 623.5 psig)
- 305/. control range Wd: 20 to 60 bar; (290 to 870.2 psig)
- 307/. control range Wd: 41 to 74 bar; (594.6 to 1073.3 psig)
Pilots may be adjusted manually or remotely as shown in table 3:

<table>
<thead>
<tr>
<th>Pilot type .../A</th>
<th>Manual setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pilot type .../D</td>
<td>Electric remote setting control</td>
</tr>
<tr>
<td>Pilot type .../CS</td>
<td>Setting increased by pneumatic signal remote point</td>
</tr>
</tbody>
</table>

The pilot system comes complete with an adjustable AR100 restrictor. The flow rate of the pilot system is controlled by the bleed rate through AR100 restrictor.
The KG coefficients of the AR100 adjustable restrictor for its various degrees of opening are shown on Fig. 2.
KG formula used for calculating the flow rate of regulator can be applied for adjustable restrictor AR100.
It is necessary to consider that pressure drop through the adjustable AR100 restrictor should be about 2.9 PSIG (0.2) bar at the minimum opening flow of the regulator and about 14.5 PSIG (1 bar) at the maximum opening flow of regulator main diaphragm.

Accessories on request

For Regulator
- Internal connection for pilot bleed
- flow-limiting devices
- limit switches
- stainless steel fittings, single or dual sealing

For Pilot
- supplementary filter CF 14
- dehydrating filter CF 14/D
**In-line monitor**

The monitor is generally installed upstream of the main regulator. Although the function of the monitor regulator is different, the two regulators are virtually identical from the point of view of their mechanical components. The only difference is that monitor is set at a higher pressure than the main regulator. The Cg and KG coefficients of the regulator plus in-line monitor system are about 20% lower than those of the regulator alone.

![Fig.3](image1.png)  ![Fig.4](image2.png)

**M/A Accelerator**

When the monitor is required to take over more rapidly in the event of a main regulator failure, an M/A accelerator pilot is installed on the monitor (Fig. 4). Installation of the accelerator is mandatory when monitor is used on safety accessory according to PED directive. Depending on a downstream pressure signal, this device discharges the gas enclosed in the motorisation chamber of the monitor regulator, allowing the monitor to take over faster. The set point of M/A accelerator is usually higher than set point of the monitor by 0.3 to 0.5 bar. In case of monitor override configuration (two stage cut) the accelerator may be not necessary.
Installation

Whenever Aperflux 101 pressure regulator is being installed, it is essential to follow a few basic rules in order to ensure the achievement equipment’s operational and performance characteristics. These rules may be summarised as follows:

a) filtering: the gas arriving from the main pipeline must be adequately filtered; it is also advisable to make sure that the pipe upstream of the regulator is perfectly clean and void of residual impurities;
b) pre-heating: whenever the pressure drop at the regulator is considerable, the gas must be pre-heated enough to avoid the formation of ice during decompression (for reference natural gas the temperature drop is about 0,4 °C to 0,5 °C for every bar of pressure reduction);
c) condensate collector: natural gas sometimes contain traces of vapour-state hydrocarbons that can interfere with the functioning of the pilot. It is therefore necessary to install a condensate collector, complete with drainage system, upstream of the pilot circuit;
d) Outlet pipe size must also be sized correctly so the velocity is not too high. High velocity will result in improper pressure control.
e) impulse take-off: for correct operation, the impulse take-off must be located in the right position. Between the regulator and the downstream take-off there must be a straight length of pipe ≥ 4 times the diameter of the outlet pipe and downstream the take-off, there must be a further length of pipe ≥ 2 times the same diameter.

Possible installation schemes

APERFLUX 101 + APERFLUX 101

![Diagram](image)
Aperflux 101

Pressure regulators

REFLUX 819 + SB/82 + APERFLUX 101

Fig. 6

REFLUX 819/MO + SB82 + APERFLUX 101

Fig. 7
Aperflux 101

Overall dimensions in mm

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>50</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>2&quot;</td>
<td>3&quot;</td>
</tr>
<tr>
<td>A</td>
<td>78</td>
<td>100</td>
</tr>
<tr>
<td>B</td>
<td>270</td>
<td>290</td>
</tr>
<tr>
<td>C</td>
<td>175</td>
<td>185</td>
</tr>
<tr>
<td>D (ANSI 300)</td>
<td>310</td>
<td>342</td>
</tr>
<tr>
<td>D (ANSI 600)</td>
<td>320</td>
<td>352</td>
</tr>
<tr>
<td>E</td>
<td>167</td>
<td>235</td>
</tr>
<tr>
<td>F</td>
<td>255</td>
<td>290</td>
</tr>
<tr>
<td>G</td>
<td>340</td>
<td>408</td>
</tr>
<tr>
<td>H</td>
<td>348</td>
<td>390</td>
</tr>
<tr>
<td>S (ANSI 300)</td>
<td>267</td>
<td>317</td>
</tr>
<tr>
<td>S (ANSI 600)</td>
<td>286</td>
<td>336</td>
</tr>
</tbody>
</table>

Weights in Kgf (with P302)

| ANSI 300        | 24,5 | 47  |
| ANSI 600        | 26,5 | 51  |

Face to face dimensions S according to IEC 534-3 and EN 334