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ISO 9001

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Self Operated Pressure Control Valves 5953 and 5954

Description

Fluxotrol self operated pressure control valves are used for the pressure control of liquids, steam and gases without the use of instruments and auxiliary operating fluids.
They are provided with 595 actuators fitted on double seated valve bodies (model 3 and 4).

These regulators are very simple and reliable in operation and do not require frequent maintenance even under severe working conditions. Being spring and diaphragm operated with proportional action, the controlled pressure can change slightly due to load or operating pressure varations.

When higher accuracy of controlled pressure is required, particular care must be used in sizing the valve and in selecting the control range.
According to the combination "actuator and body", following types of valves can be obtained:

Self operated pressure reducing valves:
- **5953** - double seated

Self operated pressure relief valves:
- **5954** - double seated

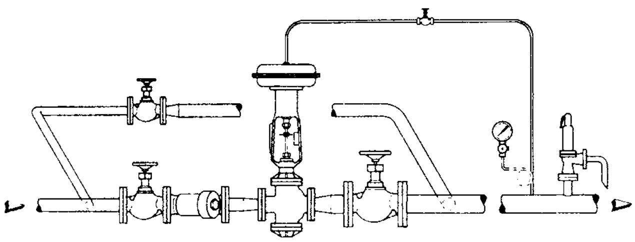

Fig. 1 - Pressure reducing valve

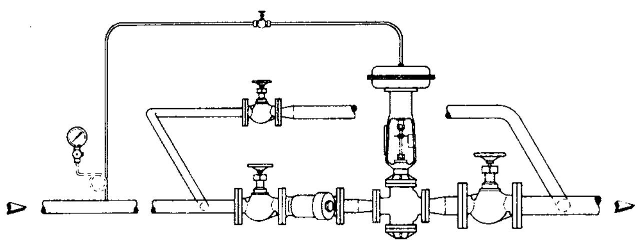

Fig. 2 - Pressure relief valve

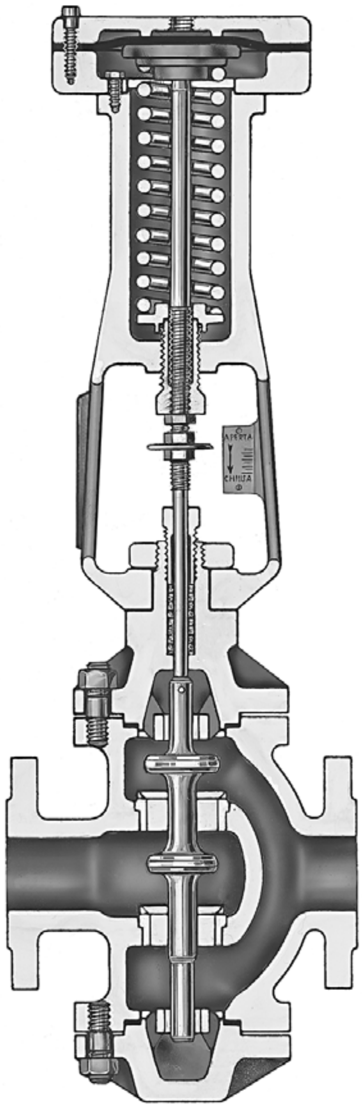

Fig. 3 - 5953 pressure reducing valve

Table 1 - Characteristics

BODY	
type	- globe double seated
connections	- steel body: flanged UNI PN16-25-40 flanged ANSI 150-300
sizes	- from 1" (DN25) to 6" (DN150) for double seated type
materials	- carbon steel EN 10213-2 GP 240 GH (ASTM A216 Gr. WCB)
bonnet	- standard for temperature up to 250°C
stuffing box packing	- PTFE rings (standard) - graphite rings

TRIM	
materials	- stainless steel AISI316 - stainless steel AISI316 stellite faced - Viton (max 90°C) or PTFE (max 180°C) soft inserts on plugs
plugs	- for throttling service
ports	- full size, standard - reduced (for ≥ DN32 double seated valves)

ACTUATOR	
type	- diaphragm operated
action	- direct (pressure pushes down)
yoke materials	- cast iron (standard) - carbon steel (on request)
diaphragm materials	- NBR
diaphragm case materials	- cast iron size 150 - pressed steel for sizes 250 to 400
accessories	- handweel for manual operation and valve travel stop (top mounted) - valve travel limit microswitches - positions trasmitter

For both applications, reducing or relief, the principle of operation is similar.
Controlled pressure in applied above the diaphragm (see fig. **3**). This pressure is balanced by the spring preset for the desired working pressure.
Any difference in the controlled pressure, in respect to the set pressure modifies the force balance between diaphragm and spring thus producing a movement of the inner valve and consequently a change in flow restoring the controlled pressure.
The principle of operation is shown in fig. **1** and **2** compared with the sectional views of valve shown in fig. **3**.
For both applications (reducing and relief) the use of double seated valves is more advisable with the advantage of higher sensitivity and accuracy of operation. If the minimun flow rate decreases to very low values, that are below the maximum allowed leakage (0.5% of K_V) of double seated valves to discharge the overpressure. To guarantee perfect tightness at no flow, special inner valves with seft ring can be supplied with restriction on maximum operating temperature.
To ensure a good perfomance of the self-operating control valves, following limits of operating conditions are recommended:

- maximum controlled pressure: 10 bar g
- minimum controlled pressure: 0.1 bar g
- pressure drop not less than 20% of the inlet pressure
- inlet pressure and flow rate not involving wide variations
- maximum recommented size DN100 (4") when wide flow rate variations are involved.
- maximum pressure drop as follows:

Table 2 - Maximum allowable differential pressures in bar g

Port size inches	5953 5954
1"	40
1 ¼"	35
1 ½"	30
2"	25
2 ½"	20
3"	15
4"	10
5"	5
6"	3

Series "I" valves: valve bodies 3-4 type have PN40 or ANSI300 rating on C steel executions (maximum working temperature 425°C; over 500°C on stainless executions).

Control valve characteristics selection

Valve is composed of different parts which must be selected or sized and combined with one another so as obtain characteristics suitable to resist erosion an corrosion and to meet process control requirements.
Proper selection of vale body material and style according to ANSI or UNI standards will be made taking into consideration pressure, temperature and type of fluid, by using the charts of figures **4** and **5**, table 3 and pertinent data given for each material.
The type of bonnet and the proper packing for stuffing box will be then selected; operating limits are shown on the next pages.
According to the process requirements (pressure reduction or relief) and the range of required flow, the valve will be selected taking into consideration the maximum leakage through the closed valve in relation to the plug style; then the proper port size will be selected using formulae and data on pages 4 and 5.
Connections and valve body size will be the same as inner port size provided that fluid velocity is kept within acceptable limits (for instance 200÷220 m/sec for steam), otherwise valve body with reduced port (up to 50% of the nominal size) has to be used.
According to the required control pressure range, the proper actuator size will be selected and the required operating spring as well using table 6.
If required by the process control system, other accessories may have to be added such as handwheel for manual operation, limit microswitches, position transmitter, etc.

Materials and operating limits

(for body, bonnet, bottom flange, fins and extension)

Valve bodies may be made of carbon steel. Maximum operating temperatures given below may be limited by the use of "O" rings or soft insert on the plugs to obtain a tight shut-off (max. 180°C).

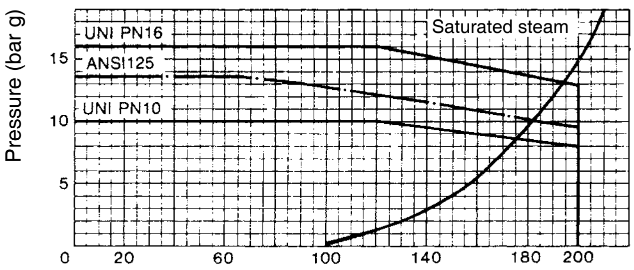

Fig. 4 - Maximum allowable pressures according to UNI and ANSI standards: valves with cast iron DIN1691 GG25 (ASTM A 126 Class C) bodies

Steels
Design limitations regarding the use of carbon steel are given in the graph fig. **5** and table 3.

Carbon steel EN 10213-2 GP 240 GH/ASTM A 216 Grade WCB
This type of steel is used mainly with gas, air, water, hydrocarbons and saturated or superheated steam. This metal possesses good welding properties and therefore may be used for valves with welding ends. Carbon steel can be used for temperature ranging from -29°C to 425°C. A quality of this type of steel is that it can be welded easily; so it's particularly suitable for valves with welding ends.

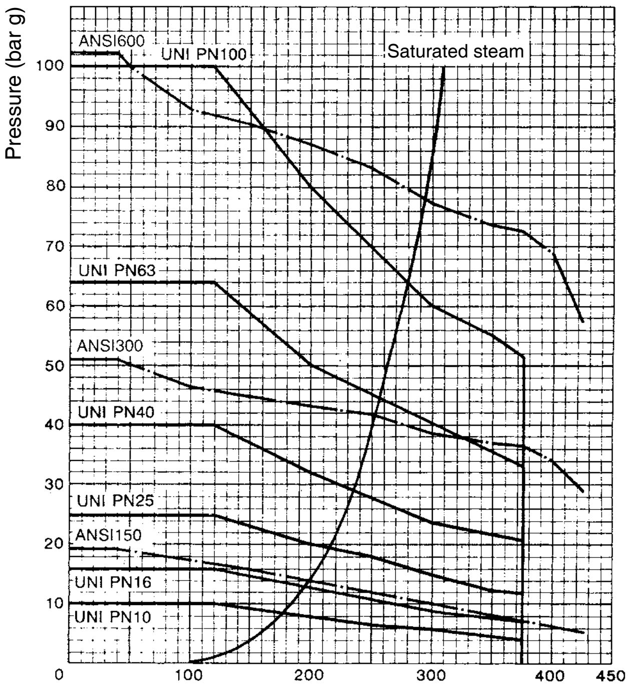

Fig. 5 - Maximum allowable pressures according to UNI and ANSI standards: valves with carbon steel EN 10213-2 GP 240 GH/ASTM A216 Gr. WCB bodies

Table 3 - Maximum allowable pressures in bar g according to ANSI standards: valves with carbon steel, (ASTM A216 Gr.WCB) bodies

Operating temperature °C	ANSI150	ANSI300
	ASTM A216 WCB	ASTM A216 WCB
-29÷38	19.6	51.1
50	19.2	50.1
100	17.7	46.4
150	15.8	45.2
200	14	43.8
250	12.1	41.7
300	10.2	38.7
350	8.4	37
375	7.4	36.5
400	6.5	34.5
425	5.6	28.8

Bonnet

The valve body bonnet is available in three styles with different packings for the stuffing box which must be selected according to the operating conditions:

- **Standard bonnet** for fluid temperatures ranging from -5°C (for series 25 valves) or -10°C (for "I" valves) to 250°C. See figures **8** and **9**.

Stuffing box packing

Stuffing box packing are the following:

- **PTFE/graphite** rings: this is the most commonly used type; it can be used with fluid at a maximum temperature of 230°C and maximum pressure of 40 bar g. See fig. **8**.
- **Graphite** rings: used with temperature from 230°C to 350°C for series 25 valves or 500°C for "I" valves (with finned bonnet over 250°C). See fig. **9** and **10**.

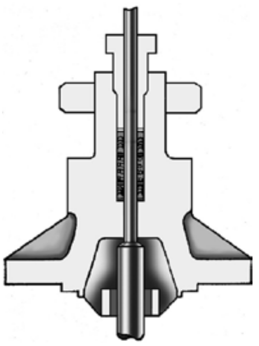

Fig. 6 - Standard bonnet and stuffing box packed with PTFE rings

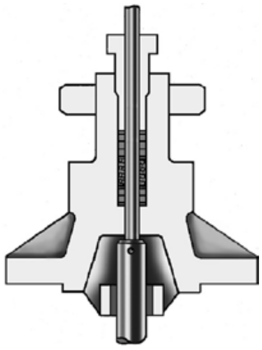

Fig. 7 - Standard bonnet and stuffing box packed with graphite rings

Construction materials

The selection of the proper valve body materials and style of construction are dependent on the operating conditions particularly when erosive and/or corrosive conditions are involved. Standard versions are shown in table 4. Special versions are available to meet specific application requirements.

Table 4 - Construction materials

Body, bonnet, bottom flange, fins and extension	Plugs* and seats	Stem	Plugs guide bushings	Plugs guide posts	Piston guide cilinder	Balancing piston **	Stuffing box lantern	Stuffing box adjusting nut	Body bolts	Body gaskets
carbon steel	AISI316 (stellite, facing, on request)	AISI316 rolled	hardened stainless steel (stellite facing, on request)	AISI316 rolled (stellite, on request)	AISI316 (stellite, faced beat, on request)	AISI316	galvanized steel (AISI316, on request)	galvanized steel (AISI316, on request)	class 8G carbon steel (AISI316, on request)	asbestos free up to 200°C graphite (PTFE up T≤ 185°C, on request)

* Plugs, with some pressure limitation, can be fitted with a viton insert for process temperatures up to 90°C and with PTFE insert for temperatures up to 180°C.

** With EPDM sealing ring for temperatures up to 90°C and PTFE/graphite ring up to 180°C (graphite ring is used for higher temperatures).

Plug and port

Plugs are of PT double are made of stainless steel and can be stellite faced against wear. Every plug can be fitted with soft insert for tight shut-off, thus slightly reducing the K_V.
Series 595 control valves are normally provided with full size port to assure the maximum flow-capacity.
On some applications reduced port valves must be used, for instance, to reduce flow velocity and excessive wear; valves can therefore be supplied with reduced port on request; the minimum available reduced port size corresponds to 50% of the valve body nominal size: for example a DN 100 (4") valve cannot be filled with a reduced port size less than 2". With metal to metal seating the maximum leakage with closed valve is 0.01% of K_V (0.5% for double port valves and 0.1% for single seated valves with balanced plug); leakage can be reduced to 0.005% of K_V (0.25% for double port valves and 0.02% for single seated valves with balanced plug) if the seating surfaces are stellite faced and accurately grinded. For operating temperatures up to 180°C, with some pressure limitation and when plugs are fitted with Viton or PTFE soft insert, perfect tightness is assured.

Fig. 8 - Type PT double plug

Valve sizing

To select valve nominal diameter (or port diameter if valves with reducing), first calculate thel flow rate coefficient K_V according to actual operating conditions for the fluids by using the following formulae. On the basis of selected plug type, determine the valve size from size tables 5 and verify that fluid velocity is kept within acceptable limits (200÷220 m/sec for steam).

LIQUIDS

$$K_V = Q\sqrt{\frac{d}{\Delta P}}$$

where:

Q [m³/h] = flow rate in m³/h at operating temperature
d [kg/dm³] = relative density of liquid (at operating temperature)
ΔP [bar] = pressure drop across the valve

Correction factors for viscous liquids

For viscous liquids, multiply K_V values calculated from the above formula by the following correction factors which are based on the viscosity expressed in degrees Engler:

2° E - coeff. 1.06	30°E - coeff. 1.38
5° E - coeff. 1.18	50°E - coeff. 1.47
10° E - coeff. 1.28	100°E - coeff. 1.60
15° E - coeff. 1.32	150°E - coeff. 1.68

STEAM

1st case: Absolute outlet pressure is greater than 58% (55% for superheated steam) of absolute inlet pressure:

for saturated steam

$$K_V = \frac{Q}{18.05\sqrt{\Delta P \cdot P_1}}$$

for superheated steam

$$K_V = Fs\,\frac{Q}{17.44\sqrt{\Delta P \cdot P_1}}$$

where:

Q [kg/h] = flow rate
ΔP [bar] = pressure drop across the valve
P_1 [bar abs] = absolute inlet pressure of steam
Fs = correction factor for superheated steam

2nd case: Absolute outlet pressure is equal or less than 58% (55% for superheated steam) of absolute inlet pressure (critical flow):

for saturated steam

$$K_V = \frac{Q}{11.7\,P_1}$$

for superheated steam

$$K_V = Fs\,\frac{Q}{11.7\,P_1}$$

Correction factors Fs for superheated steam

In the case of superheated steam introduce the following correction factors which take into account the superheating temperature:

25° C - coeff. 1.03	150°C - coeff. 1.18
50° C - coeff. 1.06	200°C - coeff. 1.24
75°C - coeff. 1.09	250°C - coeff. 1.30
100° C - coeff. 1.12	300°C - coeff. 1.36

The superheating temperature is the difference in temperature in °C between the superheated steam and the saturated steam at valve inlet pressure.

GAS

1st case: Absolute outlet pressure is greater than 53% of absolute inlet pressure:

$$K_V = \frac{Q}{480.4}\sqrt{\frac{d \cdot T}{\Delta P \cdot P_2}}$$

where:

Q [Nm³/h] = flow rate
ΔP [bar] = pressure drop across the valve
P_2 [bar abs] = absolute outlet pressure of gas
d = specific gravity of gas relative to air normal conditions (e.g. methane = 0.5545)
T [K] = absolute temperature (T in °C + 273)

2nd case: Absolute outlet pressure is equal or less than 53% of absolute inlet pressure (critical flow):

$$K_V = \frac{Q}{239.8\,P_1}\sqrt{d \cdot T}$$

where:

P_1 [bar abs] = absolute inlet pressure

Table 5 - K_V flow rate coefficients for 5953 and 5954 valves

Nominal diameter and port size								
DN25 1"	**DN32 1 ¼"**	**DN40 1 ½"**	**DN50 2"**	**DN65 2 ½"**	**DN80 3"**	**DN100 4"**	**DN125 5"**	**DN150 6"**
10.3	16.2	22	31	41	50	82	106	128

K_V flow rate coefficients are expressed in metric units (K_V = water flow rate in m³/h with 1 bar g differential pressure). To convert K_V into American C_V (water flow rate in gpm with differential pressure of 1 psi) multiply K_V values by 1.17.
To determine flow coefficient with reduced port valves read the K_V corresponding to the effective size of the port.
The use of soft insert on plugs slightly reduces the K_V.

Actuators

Table 6 - Actuators specifications and controlled pressure ranges in bar g

Reducing valves	Spring	VI - 509	8 - 10.5		0.7 - 1.4
	"	VI - 508	7 - 9.5	1.7 - 3.4	0.6 - 1.2
	"	VI - 507	4 - 7.5	1.4 - 2.8	0.3 - 0.9
	"	VI - 505	3.5 - 6	0.7 - 2.1	0.2 - 0.6
	"	VI - 504	2 - 3.5		0.15 - 0.4
Relief valves	Spring	VI - 509	7 - 10.5		0.4 - 1
	"	VI - 508	6.5 - 8	1 - 2.5	0.35 - 0.8
	"	VI - 507	3.8 - 6.3	0.8 - 2	0.25 - 0.7
	"	VI - 505	3.3 - 5	0.5 - 1.5	0.2 - 0.5
	"	VI - 504	1.9 - 3.3		0.15 - 0.35
Actuator size			150/A1	250/A1	400/A1
Effective working area (cm²)			83	295	670
Maximum allowable pressure on diaphragm casing (bar g)			15	3.5	3

Note: The pressure ranges above listed do not take into consiaeratlon the dynamic pressure unbalance due to the pressure drops and the weight of plugs.

Dimensions

Table 7 - Dimensions of actuators (mm)

Actuator size	D	E	F
150/A1	200	401	136
250/A1	285	422	164
400/A1	405	455	211

Note: Overall dimensions of complete valve may be obtained by adding body dimensions to actuator dimensions.

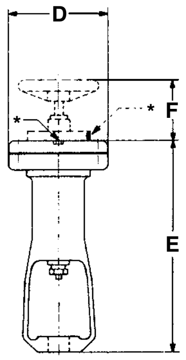

Fig. 9 - Size 150/A1 actuator

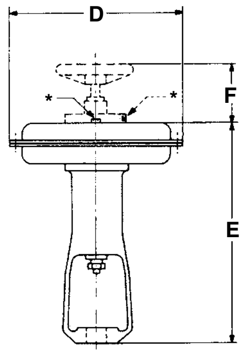

Fig. 10 - Size 250/A1 - 400/A1

* Pressure connection size: ½" NPT (female)

Table 8 - Dimensions of valve bodies models 3 and 4 (mm)

Dimensions	Valve rating	Body material	Valve nominal diameter								
			DN25	**DN32**	**DN40**	**DN50**	**DN65**	**DN80**	**DN100**	**DN125**	**DN150**
A	**UNI PN16-25-40 ANSI 150-300**	**steels**	196	212	234	266	292	317	368	425	473
B	**UNI PN16-25-40 ANSI 150-300**	**steels**	118	128	145	161	185	194	242	265	291
C for standard bonnet	**UNI PN16-25-40 ANSI 150-300**	**steels**	139	149	167	183	212	221	263	316	341
G	**UNI PN16-25-40 ANSI 150-300**	**steels**	98	106	117	133	138	143	162	193	202

Note: Dimensions A for flanged valves applies also to valves with butt welding or socket welding ends.

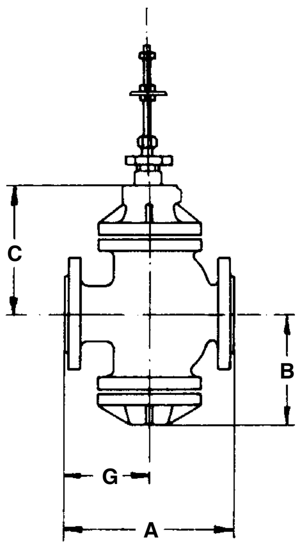

Fig. 11 - Valve bodies model 3 and 4