DIRECT-OPERATED REGULATOR

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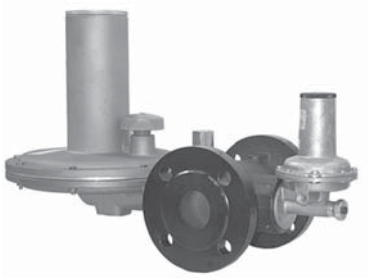
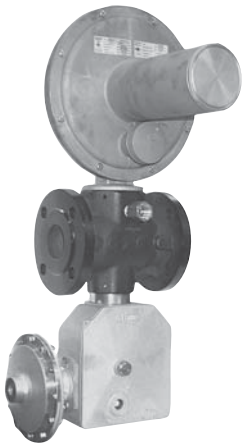


Type Regal 3/VSX2



Type Regal 3/OS2

Figure 1. *Type REGAL 3 Direct-Operated Regulator*

INTRODUCTION

The REGAL 3 is a direct-operated, spring set point pressure regulator, used for supplying industries and commercial businesses.

As an option, it can be equipped with a slam shut type VSX2 or OS2 which permits the gas flow to be cut off rapidly and totally in the case of under or over outlet regulator pressure.

As a standard feature for outlet pressure settings inferior or equal to 180 mbar, a relief valve is provided.

On request, this relief valve may be disconnected and replaced by a dampener.

Upon request, for pressures 180 mbar <Pd <= 1100 mbar, the REGAL 3 can be equipped with a relief valve.

This relief valve can be factory adjusted.

An Non-PED version of the Regal 3 is also available.

The **REGAL 3** is in conformity with the Pressure Equipment Directive PED 97/23/EC and is classified under category I.

Equipment and pipeline situated on the outlet side of the regulator are either;

- not subject to the PED (Pd <= 0.5 bar), or
- subject to (Pd > 0.5 bar): in this case the Regal 3 is classified under category 1 maximum.

DECLARATION OF CONFORMITY REGAL 3

Manufacturer:	**FRANCEL**	
Address:	3 avenue Victor Hugo, 28008 Chartres	
Equipment:	REGAL 3	**Identification no.:**
Conformity Assessment Module:	Module A	

The undersigned declare that the design, manufacture and inspection of this equipment are in conformity with the Pressure Equipment Directive 97/23/EC (PED)

Name:	***Function:***	***Company stamp:***
Date:	***Signature:***	

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Process Management

DESCRIPTION

The Regal 3 consists of:

A Version without Integral Slam Shut

- A body, a diaphragm actuator (LP or HP), a bottom
- A diaphragm-balanced valve plug, an orifice
  Depending on set point required:
  - A Pd set point adjustment spring

A Version with Integral Slam Shut Type VSX2

- A body, a diaphragm actuator (LP or HP)
- A diaphragm-balanced valve plug, an orifice
- An integral bypass slam shut (LP or HP) in place of the bottom (see D103695X012 manual)
  Depending on set point required:
  - A Pd set point adjustment spring
  - A tripping spring set to max
  - A tripping spring set to min

A Version with Integral Slam Shut Type OS2

- A body, a diaphragm actuator (LP or HP)
- A diaphragm-balanced valve plug, an orifice
- A slam shut connecting part in place of the bottom
- A valve plug with integral bypass
- A release relay type OS2 (see D103683X012 manual)
  - A safety manometric box (BMS) for connection outlet side of the regulator
  - A mechanism box (BM)

  Depending on the set point required:
  - A Pd set point adjustment spring
  - A max. and min. set point tripping spring

A Version with Relief Valve (set point option 180 to 1100 mbar)

- Replacement of the disconnecter by an internal partial relief valve

Orientation and Regulator Impulse Line

The actuator and slam shut can be orientated 360°.

The regulator impulse line is connected directly onto the body, which makes maintenance easier (the actuator can be removed without disconnecting the impulse pipeline).

CHARACTERISTICS

Table 1. *General Characteristics for Type Regal 3 Regulator*

Operating pression				**REGULATOR**			
Body, valve plug, slam shut		PS	10 bar	**Accuracy**		AC	10
Actuator	(Pd <= 1.5 bar PED version)		1.5 bar	**Inlet/outlet diameter**		DN	50
	(Pd <= 3.0 bar Non-PED version)		*3.0 bar*	**Pu min**			0.5 bar
BMS* associed, according to size			5 bar	**Pu max**			10 bar
Operating temperature		TS	- 30 / 71 °C	**Spring set point**	(PED version)	Pd	0.008 to 1.5 bar
					(Non-PED version)		*2.0 / 3.0 bar*
Outlet pressure	(PED version)	Pd	8/1500 mbar	**Fluid**	Groups 1& 2 according to PED 97/23/EC, 1st and 2nd family gas according to EN 437, or other gases (compressed air, nitrogen). The gas must be noncorrosive, clean (filtration on inlet side necessary) and dry.		
	(Non-PED version)		*2000/3000 mbar*				

* BMS : Safety Manometric Box

Relief Valve

Relief valve set point:

- Pd + 20 mbar up to 90 mbar setting
- Pd + 30 mbar up to 140 mbar setting
- Pd + 40 mbar up to 180 mbar setting
- Pd + 60 mbar up to 340 mbar setting (option)
- Pd + 100 mbar up to 550 mbar setting (option)
- Pd + 200 mbar up to 1100 mbar setting (option)

Material

Body	Ductile iron
Sitting part	Brass
Actuator	Aluminium
Regulator/slam shut orifice	Brass
Regulator valve plug	Aluminium
Slam shut valve plug	Aluminium
Regulator/slam shut plug disc	Nitrile

Table 2. *Regulator Set Point Spring Table*

Pd (mbar)			Spring		Spring code
Nominal	Min.	Max.	Wire Ø (mm)	Length (mm)	
20	8	25	3.0	171	144 136
35	20	55	4.0	171	122 832
60	40	90	4.5	165	131 919
100	60	140	5.5	165	131 918
160	80	180	6.0	165	142 539
300	100	340	7.5	180	137 054
500	300	550	8.0	170	131 793
1000	400	1100	10.0	170	144 035
1500	750	1500	8.0	170	131 793
*2000**	*1400*	*2600*	*10.0*		*144 035*
*3000**	*2000*	*4000*			

* Non-PED version

Table 3. *Slam Shut Set Point Spring Table*

Nominal Pd (mbar)	Spring wire Ø			Nominal set point (mbar)		
	VSX2		OS2	Min	Relief valve	
	Min	Max	Min & Max		Max with	Max without
20	1.1	1.7		10	50	40
35		2.0		17	70	60
60	1.4			35	100	90
100		2.3	3.5	60(1)/70(2)	160	150
160	1.7	2.6		110	235	225
300	2.4	3.1	5.0	200	430	400
500		3.5		350	700	650
1000	3.2	4.1	6.5	700	1400	1300
1500	2.4	3.1		1000	2000	
*2000**	*2.4*	*3.5*	*6.5*	*1400*	*2600*	
*3000**	*3.2*	*4.1*		*2000*	*4000*	

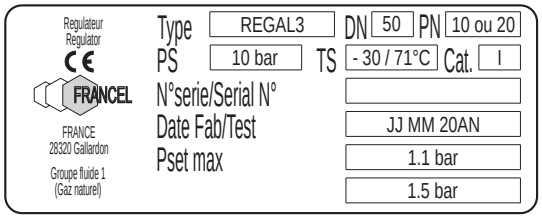
(1) VSX2 (2) OS2 * Non-PED version

Connections

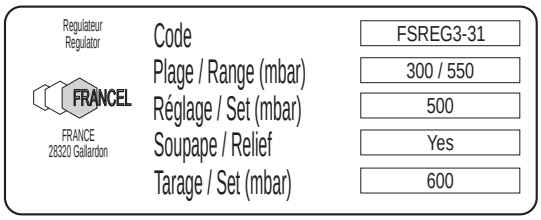
Inlet/Outlet: ISO PN 10/16
ISO PN 20/ANSI 150
Actuator impulse line ISM : 1/2'' NPT tapped
Actuator vent: 3/4'' NPT tapped
Impulse line: Internal pipe Ø >= 15 mm

Slam shut impulse line (VSX2 / OS2) IS : 1/4" NPT tapped
Impulse line (VSX2) : Internal pipe Ø >= 4 mm
(OS2) : Internal pipe Ø >= 8 mm
Slam shut vent (VSX2/OS2) : 1/4'' NPT tapped
Contact (OS2) : See D103683X012 manual

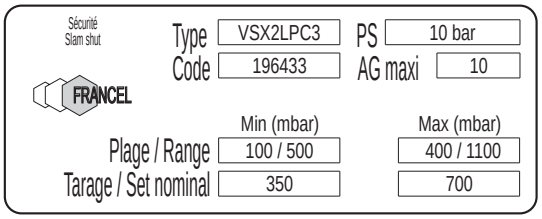
LABELLING



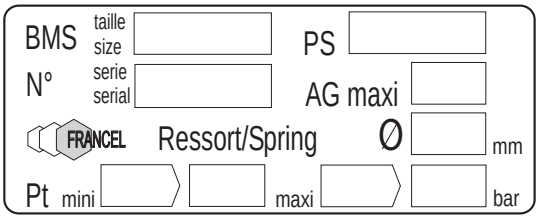
PED label - Pd <= 100 mbar



Regulator label (example Pd 500 mbar)



Type VSX2 slam shut label (example Pd 500 mbar)



Type OS2 slam shut label (example Pd 300 mbar)

Figure 2. *Type Regal 3/VSX2 and Regal3/OS2 Labels*

DIMENSIONS AND WEIGHTS

Weight

With slam shut: 18.8 kg VSX2 / 24 kg OS2 Without slam shut: 18 kg

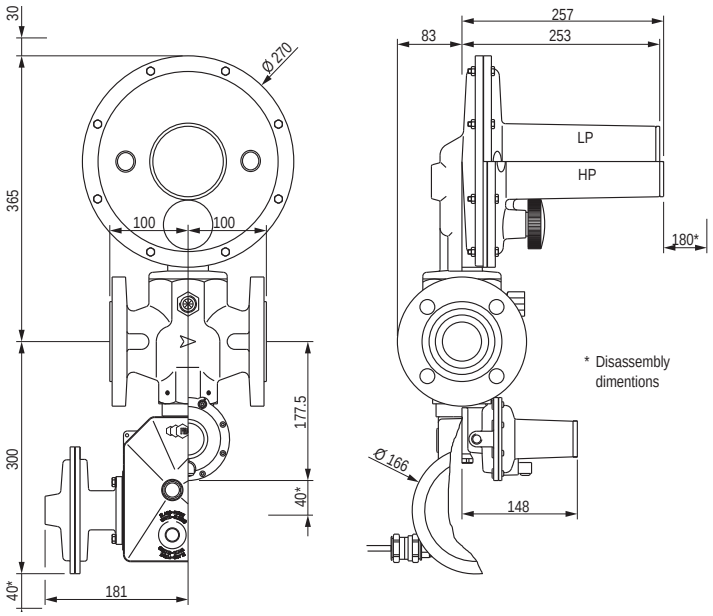


Figure 3. *Type Regal 3/VSX2 and Regal3/OS2 Dimensions (mm)*

OPERATION

The Regal 3 is a pressure regulator with expansion achieved by a balanced valve plug and pressure control by a direct-operated actuator.

The balanced valve plug/stem assures accuracy independent of inlet and outlet pressures.

Pressure control is achieved through the actuator diaphragm, which receives, on the one side, the outlet pressure and, on the other side the spring load, adjusted to the desired value by the set point spring.

Tight shutoff is ensured by the regulator plug disc pushing on the orifice.

The regulator can be equipped with a slam shut using a release relay type VSX2 or OS2.

For the EC standard version and for a Pd <= 180 mbar, an actuator with an integral partial relief valve avoids slam shut tripping in the case of the gas flow being abruptly cut off or temperature increase on the outlet side when the regulator is not in operation.

For the version without relief valve, in the case of over pressure, the diaphragm plate assembly will travel up the actuator and sit into the cap, without any leak or deterioration of the components (disconnecter).

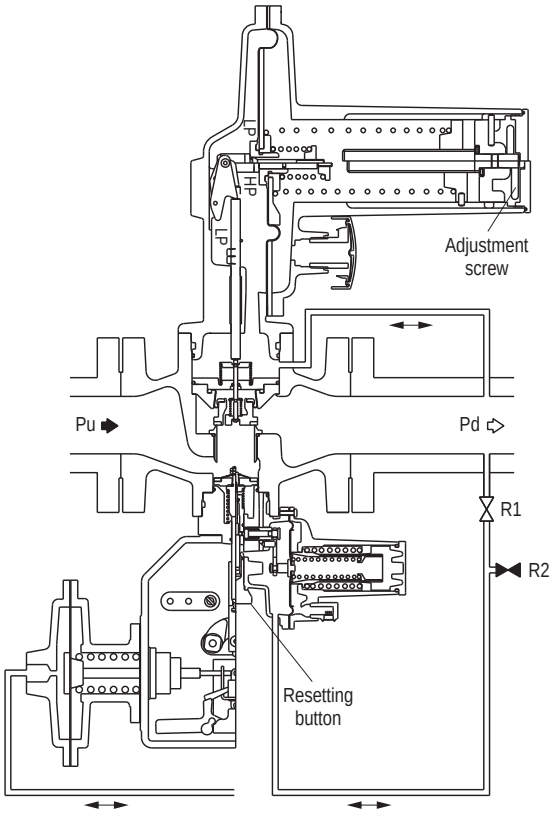


Figure 4. *Type Regal 3/VSX2 and Regal3/OS2 Operational Schematic*

RELIEF VALVE ADJUSTMENT (Figure 9) (Pd < 180 mbar)

- Unscrew the cap (key 6)
- Unscrew the adjustment screw (key 5)
- Press the adjustment screw
- Turn the sub-assembly (key 5) a 1/4 turn to release it
- Remove the adjustment screw assembly (key 5)
- Remove the set point spring (key 4)
- Screw the relief valve set point nut 3 to maximum (without blocking it) with a box spanner 30
- Load the relief pressure via the actuator impulse line

The pressure required depends on the spring

- Spring 20 and 35 mbar
  - Loading pressure = relief setting - Pd + 7 mbar
- Spring 60 and 100 mbar
  - Loading pressure = relief setting - Pd + 8 mbar
- Spring 160 mbar
  - Loading pressure = relief setting - Pd + 15 mbar

For example, for a Pd pressure setting = 25 mbar (20 mbar spring) for a relief pressure setting of 45 mbar, load a pressure of 45-25+7 = 27 mbar

- Unscrew the nut (key 3) until the relief valve opens
- Replace the set point spring (key 4)
- Replace the adjustment screw assembly (key 5)
- Replace the cap (key 6) (after adjusting the set point)

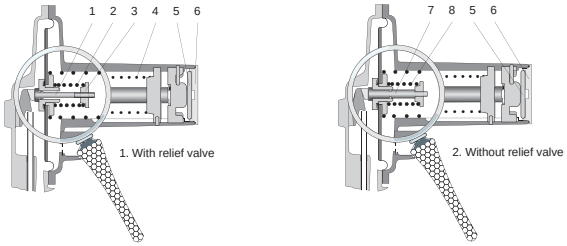


Figure 5. *Relief Valve*

Table 4. *Type Regal 3 Assemblies with/without Relief Valve*

Assembly with relief valve				**Assembly without relief valve**			
Standard assembly				**Standard assembly**			
Pd (mbar)	**Description**	**Item**	**Code**	**Pd (mbar)**	**Description**	**Item**	**Code**
<= 140	Relief valve stem	1	144089	**> 180**	Disconnecter stem	7	144041
	O-ring	-	400505		O-ring	-	400505
	Spring D3	2	116006		Spring D4	8	116816
> 180	Spring D4		116816				
Assembly possibility				**Assembly possibility**			
Pd (mbar)	**Description**	**Item**	**Code**	**Pd (mbar)**	**Description**	**Item**	**Code**
> 180 < 1100	Relief valve stem	1	144089	**<= 180**	Disconnecter stem	7	144041
	O-ring	-	400505		O-ring	-	400505
	Spring D5 Pd <= 550	2	120588		Spring D4	8	116816
	Spring D5.5 Pd > 550		120904				

INSTALLATION

CAUTION

All interventions on equipment should only be performed by qualified and trained personnel.

WARNING

The regulator is installed on horizontal (recommended) or vertical pipeline. Version with slam shut, the release relay can be situated towards the bottom or the top.

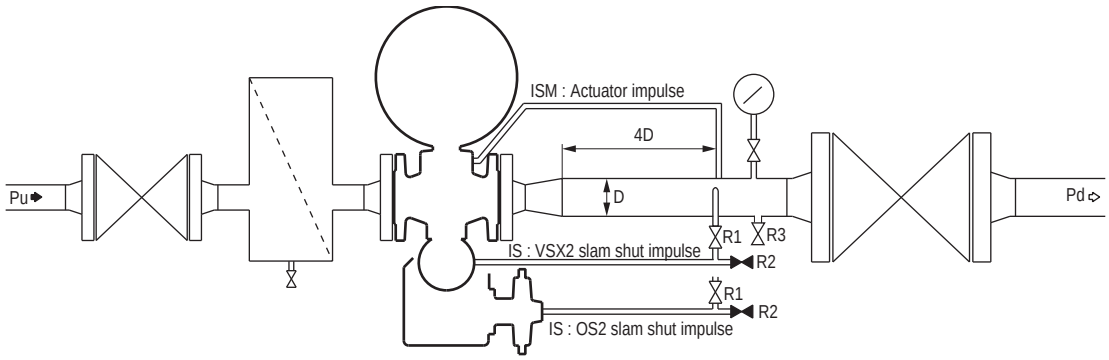


Figure 6. *Type Regal 3/VSX2 and Regal3/OS2 Installation Schematic*

Installation according to EN12186 or EN12279 recommended.

Install according to direction of fluid flow (arrow).

When assembling with adjacent elements care must be taken not to create pressure force on the body and the assembling elements (bolts, O-rings, flanges) should be compatible with the geometry and working conditions of the equipment.

If the case arises a support must be used to avoid pressure force on the body (a support can be installed under the flanges).

Connect the actuator (ISM) to the impulse at 4D minimum on a straight run of the outlet pipe.

Version with integral slam shut, connect the safety manometric box (IS) to the impulse at 4D on a straight run of the outlet pipe.

It is recommended to separate the slam shut impulse line (IS) from that of the actuator (ISM). Do not connect the impulses on the lower generator line.

Version with integral slam shut, it is recommended to install an isolation valve (R1) and an atmospheric valve (R2), which are useful for tripping and verifications.

No modification should be made to the structure of the equipment (drilling, grinding, soldering...).

It is recommended to install a servicing valve (R3) on the outlet pipeline to facilitate adjustments and bleeding off to the atmosphere.

Verify that the inlet side is protected by an appropriate device(s) to avoid exceeding the limits of utilization (PS, TS).

Verify that the limits of utilization correspond to the appropriate operating conditions.

Version without slam shut, verify that a pressure limiting device on the outlet side of the regulator guarantees a pressure limit < or equal to the actuator PS.

Version with slam shut, verify that the springs (for VSX2), and the safety manometric box (BMS) and its spring (for OS2) correspond to the appropriate operating conditions on the outlet side of the regulator.

The equipment should not receive any type of shocks.

Fire, seismic and lightening are not taken into consideration for standard regulators. If required, a special product selection and/ or specific calculations may be supplied according to specific requirements.

The user should verify or carry out a protection adapted to the environment.

Version with slam shut, if the outlet side is subject to the PED and not protected by any other means, verify that no component is superior to category 1.

COMMISSIONING (Figure 4)

CAUTION

All interventions on equipment should only be performed by qualified personnel.

Operations concerning the integral slam shut version type VSX2 and OS2 are in italic.

Preliminary Verifications

Start-up Positions

- Inlet and outlet valves
  - Closed

Verify the absence of pressure between inlet and outlet valves

- Set point adjustment screw
  - Unscrewed (case 1) or set (case 2)
- *Slam shut valve plug*
  - *Closed*
- *Impulse isolating valve (R1)*
  - *Closed*

Slam shut set point verification

Type VSX2

Using the atmospheric valve (R2), inject a pressure equal to the pressure required for the regulator

- *Slam shut valve plug*
  - *Set (Unscrew, pull, rescrew the resetting button (see D103683X012 manual))*
  - *Progressively increase the pressure to reach tripping*
  - *Adjust the setting if necessary (see D103695X012 manual)*

Note the set point value on the equipment or mark it on a commissioning document

Type OS2 (Figure 7)

Using the atmospheric valve (R2), inject a pressure equal to the pressure required for the regulator

- *1st release relay stage*
  - *Set (Stage 1)*
- *Slam shut valve plug*
  - *Set (Stages 2 and 3)*
  - *Progressively increase the pressure to reach tripping*
  - *Adjust the setting if necessary (D103683X012)*

Note the set point value on the equipment or mark it on a commissioning document

Positions before Commissioning

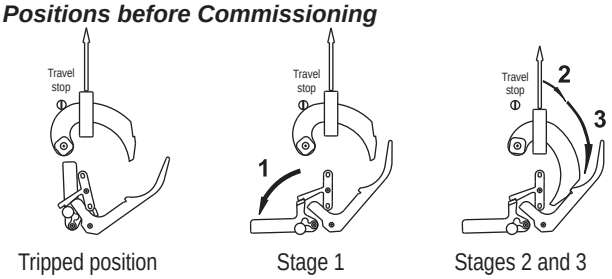


***Figure 7**. Release Relay Activation Stages*

- *Impulse isolating valve (R1)*
  - *Open*
- *Impulse atmospheric valve (R2)*
  - *Closed*
- *Slam shut valve plug*
  - *Closed*
- Servicing valve
  - Closed

The equipment is commissioned

Commissioning

- Inlet valve
  - Open **very** slowly
- Slam shut valve plug

Type VSX2

- *Slowly unscrew (bypassage)*
  - *Verify that the outlet pressure corresponds to the set point required. If not, adjust the regulator set point (adjustment screw)*
  - *Pull (set, when the bypassage is completed)*
  - *Gently push back and rescrew*

Type OS2 (Figure 7)

- *1st release relay stage*
  - *Set (Stage 1)*
- *Slam shut valve plug*
  - *Bypassage (Stage 2)*
  - *Open (Stage 3)*
- Servicing valve
  - Slightly open
- Set point adjustment screw
  - Slowly adjust to required value (adjustment screw)
- Outlet valve
  - Open slowly
- Servicing valve
  - Closed

The equipment is commissioned.

It is recommended to seal the release relay.

MAINTENANCE

Operations concerning the integral slam shut versions are in italic.

Servicing Check

Recommended frequency:

Twice yearly minimum

Verification:

- Verification of the set point
- Regulator valve plug tightness
- *Tripping and slam shut valve plug set point value*
- *Slam shut valve plug tightness*

Departure positions

- Inlet valve
  - Open
- Outlet valve
  - Open
- *Slam shut valve plug*
  - *Open*
- Regulator
  - In operation

Inlet and outlet sides of regulator under pressure

Tightshut verification (and tripping verification for versions with integral slam shut)

- *Inlet valve*
  - *Closed*
- *Outlet valve*
  - *Closed*
- *Regulator*
  - *Observe the evolution of the outlet pressure (control regulator tightness)*

Disassembly of Regulator and Slam Shut

Recommended frequency:

Every 4 to 6 years (or less depending on operating conditions)

Verification:

Diaphragms, valve disc plug, lubrication

Replacement:

O-rings, diaphragms (depending on condition and usage), tightshut rings

Table 5. *Corresponding Spanner / Torque Information*

Spanner	Torque (N.m)
4	4
6	15
10	6
13	15

Table 6. *Troubleshooting for Types Regal 3/VSX2 and Regal 3/OS2 Regulators*

SYMPTOMS	CAUSE	ACTIONS
If the outlet pressure increases	Internal leak	Control the regulator valve plug Control the regulator orifice or contact after-sales
If the outlet pressure decreases	External leak	Locate and seal the leak or contact after-sales
If the outlet pressure is constant	The regulator is tightshut	Close the impulse isolation valve Open the impulse atmospheric valve Progressively inject pressure (without exceeding outlet pressure limits)
If the slam shut valve plug will not close	*Operating fault*	*Control the release relay* *Control the slam shut valve plug* *or contact after-sales*
If the slam shut valve plug closes	*Operating correctly*	
Observe the evolution of the outlet pressure (control tightness)		
If the outlet pressure is constant		Purge the outlet side of the regulator
Observe the evolution of the outlet pressure (control tightness)		
If the outlet pressure increases	*Internal leak*	*Control the slam shut valve plug* *Control the slam shut orifice* *Control the internal bypass* *or contact after-sales*
If the outlet pressure is constant	*Slam shut valve plug is tightshut*	

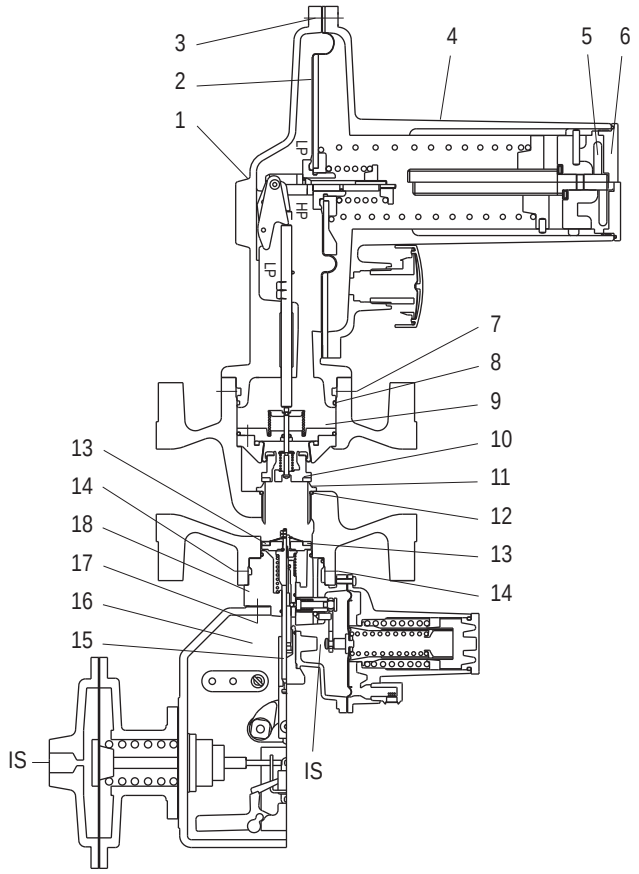


***Figure 8**. Type Regal 3/VSX2 and Regal 3/OS2 detail*

Tools

Male spanners for six-sided wrench: 2.5, 4 and 6

Flat spanner: 10

Box spanner: 30 and 46

2 flat spanners for flanges: 24

Adjustment spanner for VSX2: Ref. 197 226

Regulator

- Valve plug closed (no flow)
- Inlet and outlet valves closed
- **Bleed off outlet pressure**
- **Bleed off inlet pressure**
- Unscrew the cap (key 6)
- Unscrew the adjustment screw (key 5)
- Remove the adjustment screw assembly (key 5)
- Unscrew the actuator screws (key 3)
- Remove the cover (key 4)
- Unscrew the main diaphragm assembly (key 2)

CAUTION

Before disassembling the diaphragm, not e the dimension between the relief valve setpoint nut and the diaphragm plate assembly (key 2)

- Unscrew screws (key 7) and remove the actuator body (key 1)
- Control the O-ring (key 8)
- Unscrew screws (key 9)
- Remove the valve plug assembly (key 10)
- Unscrew the orifice (key 11)
- Control the O-ring (key 12)

Slam Shut

Version with Type VSX2 integral slam shut

- Disconnect the impulse pipe (IS)
- Unscrew the screws (key 14) and remove the VSX2 slam shut
- Control the valve plug (key 13)
- Disassembly : see manual D103683X012

Version with Type OS2 integral slam shut

- Disconnect the impulse pipe (IS)
- Unscrew the screws (key 14) and remove the OS2 slam shut
- Unscrew screws (key 17) from the mechanism box (key 16)
- Disconnect the valve axe (key 15) from the mechanism box yoke (key 16)
- Remove the connecting part (key 18) and the valve axle (key 15)
- Contrôler le clapet de sécurité (key 13)

Reassembly

- Perform the above operations in reverse order (respect tightening torques)
- Diaphragms to be changed every 6 years or less depending on condition
- Respect the relief valve setpoint dimension noted during disassembly
- Replace O-rings at each disassembly

- Lubricate screws before tightening
- Lightly lubricate O-rings (silicone grease)
- Lightly lubricate the valve plug stem (silicone grease)
- Lightly lubricate the slam shut valve plug stem (silicone grease)
- Lubricate springs (molybdenum graphite grease)

SPARE PARTS

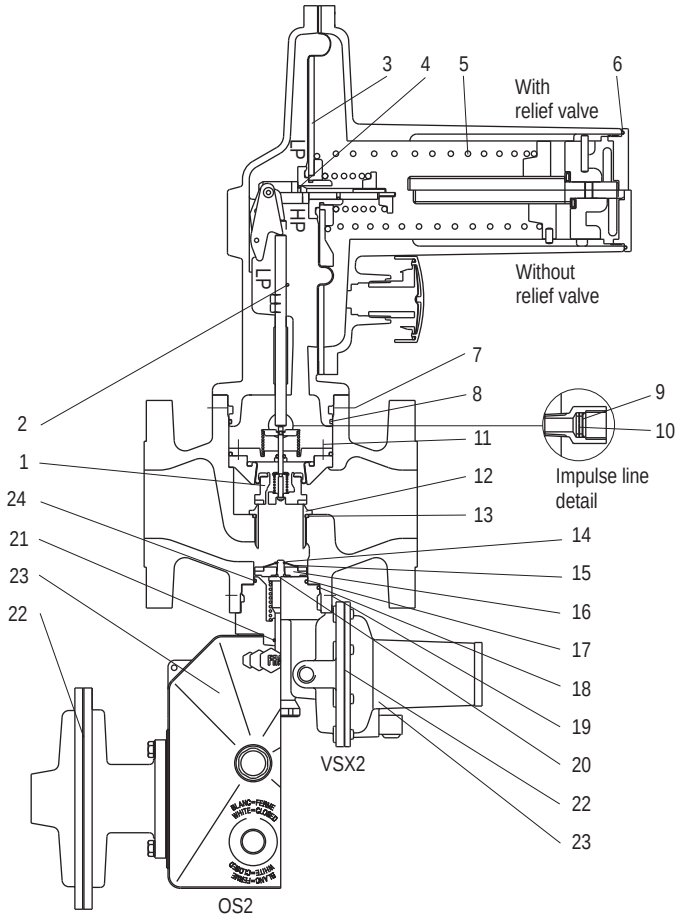


***Figure 9**. Type Regal 3/VSX2 and Regal 3/OS2 Spare Parts detail*

Table 7. *Spare Parts*

Item	Description	LP		HP
1	Valve plug assembly	181 058		
2	O-ring	400 506		
3	Diaphragm	142 033		142 980
4	Relief valve/clutch O-ring	400 505		
5	Spring	See Table 2		
6	Cap O-ring	400 080		
7	Screw	403 030		
8	Actuator/body O-ring	400 029		
9	Truarc ring	406 201		
10	Sensing diaphragm (d2) standard	138 369		
	Sensing diaphragm (d4)(1)	144 155		
11	Washer	461 173		
12	Orifice	142 017		
13	Orifice O-ring	400 102		
With Slam Shut		**Type VSX2**		**Type OS2**
		LP	**HP**	**BMS 162**
14	Circlips	406 153		
15	Spring	144 064		
16	Valve plug	142 130		
17	Slam shut Pu O-ring	400 081		
18	Slam shut Pd O-ring	400 074		-
19	Screw	403 028		
20	Bypass O-ring	400 501		
21	Stem O-ring	-		400 505
22	Diaphragm assembly	181 017	181 027	181105
23	Slam shut assembly	196 433	196 250	196245
Without Slam Shut				
24	Bottom O-ring	400 081		
Spare parts kit (commissioning spares)		197 338		197 347

(1) On special request, for low inlet pressure applications (< 1 bar)

REGAL 3

Industrial Regulators

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