G4 Installation and Maintenance ES/G4/0/007

All Bailey G4 Regulators are manufactured to the highest quality, each being precision built to ensure accurate control of reduced pressure. In order to achieve long and trouble free service it is necessary for the G4 Regulator to be properly installed and regularly inspected and maintained. These instructions are designed to guide you in the installation and maintenance of your Bailey G4 Regulator.

Operational Information

The reduced pressure is regulated by the lift (or opening) of the main valve (2), which controls the flow. It is opened by steam supplied to the piston (5) from the pilot valve (26) and closed by the main valve spring (21). The pilot valve opening (and hence the piston pressure) is determined by the combination of the reduced pressure on the underside of the diaphragm (29) and the adjusting spring (33) load.

The reduced pressure is therefore accurately maintained despite variations of inlet pressure or capacity.

"First Aid"

Regulators occasionally pose problems (particularly on new installations) due to dirt and other foreign matter fouling the internals. However, in the unlikely event of this the trouble can often be quickly eliminated by applying the following "first aid" treatment:

1. **a.** With the pressure "off", (ensure that no pressure can enter the G4 regulator), remove the complete pilot valve top assembly (which is secured by four nuts) and check, by pushing down, that the piston and main valve are moving freely and that the main valve returns to its seat.
   b. Unscrew the bottom plug and withdraw main valve.
   c. Clean all parts and re-seat the main valve, if necessary.
   d. Reassemble and test.

If the G4 is still not working properly try method 2.

2. **a.** With the pressure "off", (ensure that no pressure can enter the G4 regulator). Remove the top cap, adjusting screw, spring top cover and diaphragm.
   b. Check the spring, diaphragm and joint.
   c. Turn on the steam or air supply and close the outlet stop valve.
   d. Leakage from the low pressure port (adjacent to the pilot valve) may originate at the pilot and/or main valve. A pilot valve leak can sometimes be stopped by lightly tapping the valve end of the stem with a hammer while under pressure. Take care, there will be a steam discharge upwards from the port hole.

If the G4 is still not working properly try method 3.

3. **a.** With the pressure turned off, (ensure that no pressure can enter the G4 regulator), unscrew the pilot valve plug, check the pilot valve, the spring and seat.
   b. Clean and reseat, if necessary.
   c. Check the pilot valve plug bottom joint (copper).

d. Reassemble and test.

The valve is now mechanically correct but if it is still not giving satisfaction consult our fault finding chart (p.12) and detailed servicing instructions (p.9).

If you are still in doubt send us a sketch of the layout, together with answers to the following questions:

1. What is the inlet pressure and limits of variation?

2. Please state the reduced pressure, minimum and maximum and whether this is oscillating.

3. Please state the maximum quantity and temperature of steam, air or gas. Please give an estimate if an accurate figure is not available. Pipe size alone is not sufficient.

4. What is the minimum operating flow? This is important, particularly if it is less than 10% of the maximum.

5. Is dead tight shut-off being obtained under “no-flow” conditions?

6. How long has the valve been in service?

7. Describe the symptoms of the problem.

8. Describe the remedies applied so for and with what effect.

Please note that the diagram of the layout should give details of:

(a). Piping dimensions including bends.
(b). Fittings such as valves. strainers, steam traps etc. in the vicinity of the reducing valve.

Recommended Spares

Spares Kits

Pre-packed spares kits are available (see below for details). Each carton of spares contains a leaflet, which identifies the particular parts and illustrates the most common causes of reducing valve problems. These are in the form of a series of “Check Points” which should be examined in the course of an overhaul.

(a). Routine Service Packs

Contents: 1 Diaphragm
1 Set of piston Rings
1 Pilot Valve Cap
1 Set of Joints

These parts enable a valve to be stripped down and re-assembled as part of a routine maintenance check. It is assumed that the valve is in good working order and that other spares would not be required

(b). Complete Repair Kits

Contents:
1 Diaphragm
1 Set of piston Rings
1 Pilot Valve Assembly
1 Main Valve
1 Main Valve Seat
1 Main Valve Spring
1 Set of Joints

These parts are for use when a valve is known to be giving trouble and a complete set of spares may be needed to put it into normal working order.

Size of order	**Recommended spares**
For each Regulator	1 Routine Service Pack
For every six (*) Regulators (various sizes)	1 Pilot Valve complete - for sizes up to 2 ½" (65mm). 1 Pilot Valve complete for 3" & 4" (80 & 100mm) sizes.
For every six (*) Regulators (of the same size)	1 Complete Repair Kit
For twelve (*) or more Regulators	1 Pilot Valve Top Assembly – for sizes up to 2 ½" (65mm). 1 Pilot Valve Top Assembly – for 3" & 4" (80 & 100mm) sizes.

* These are optional for numbers less than the listed figures. Consideration should be given to holding complete G4 Regulators to facilitate maintenance or for emergency changeover.

Diaphragm Information (for valve sizes up to 4"/100mm).

Reduced Pressure Range	Diaphragm Dia.	Code No.	No. Fitted	Notes
5 lbf/in² 0.35 kg/cm² and below	5" 127mm	3507A	One	Low Pressure Top
5 to 150 lbf/in² 0.35 to 10.5 kg/cm²	3 ¼ 82mm	3529	One	Standard Top
150 lbf/in² 10.5 kg/cm²	3 ¼ 82mm	3529	Two	Standard Top

Spring Identification (for valve sizes up to 4" /100mm)

Spring range	Code No.	Colour Code*	Wire Dia.	Notes
1 to 5 lbf/in² 0.07 to 0.35 kg/cm²	6350	Yellow	5/32" 4 mm	Use a Low Pressure Top
5 to 50 lbf/in² 0.35 to 3.5 kg/cm²	6350	Yellow	5/32" 4 mm	
10 to 100 lbf/in² 0.7 to 7.0 kg/cm²	6351	Black	3/16" 4.76mm	Use a Standard Top
40 to 150 lbf/in² 2.8 to 10.5kg/cm²	6352	White	7/32" 5.56mm	Two diaphragms are required for reduced pressures of 150 lbf/in² (10.5kg/cm²) and above.
50 to 200 lbf/in² 3.5 to 14 kg/cm²	6353	Green	1/4" 6.35mm	
100 to 300 lbf/in² 7 to 21 kg/cm²	6354	Red	9/32" 7.14mm	

* Springs are nickel plated and enamelled, for half of their length, with the colour indicated. **The free length of all springs is 1¾" / 45mm.**

Tools

Seat Insertion Tools

These have lugs which engage in a slot around the flange of the valve seat. A separate tool is required for each valve size, although the tools are common to the various types of valves – as listed.

½" to 2" (15 to 50mm) - Fig. 2042, 2043.
2½" to 6" (65 to 150mm) – Fig. 2044, 2045 and 2046.

Seat tools for the 1" (25mm) and 2" (65mm) Fig. 2046 valves are of the expanding type which engage in the valve seat bore. Separate tools are required for the ½", ¾", 1¼" and 1 ½" (15, 20, 32 and 40mm) restricted internals.

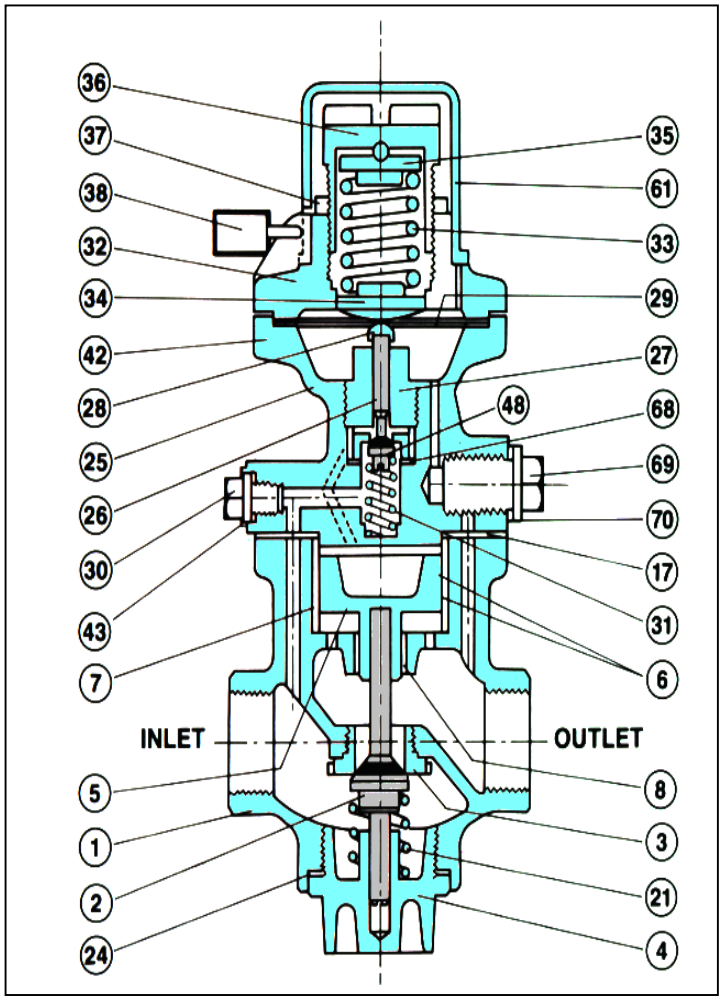
G4 Pilot Valve Key

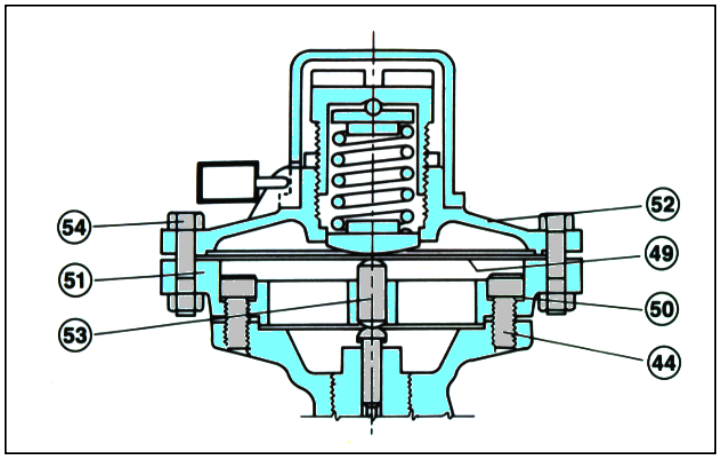
The standard pilot valve key is suitable for Fig. 2042, 2043, 2044, 2045 and 2046 valves and is common to all types and sizes, up to and including 4". A special key is required for sizes 5" (125mm) and above.

Parts List

When you order spare parts please quote:

(a). Regulator serial number, size and type of valve.
(b). The approximate date when the valve was originally supplied.
(c). The part number and the name on the diagram.



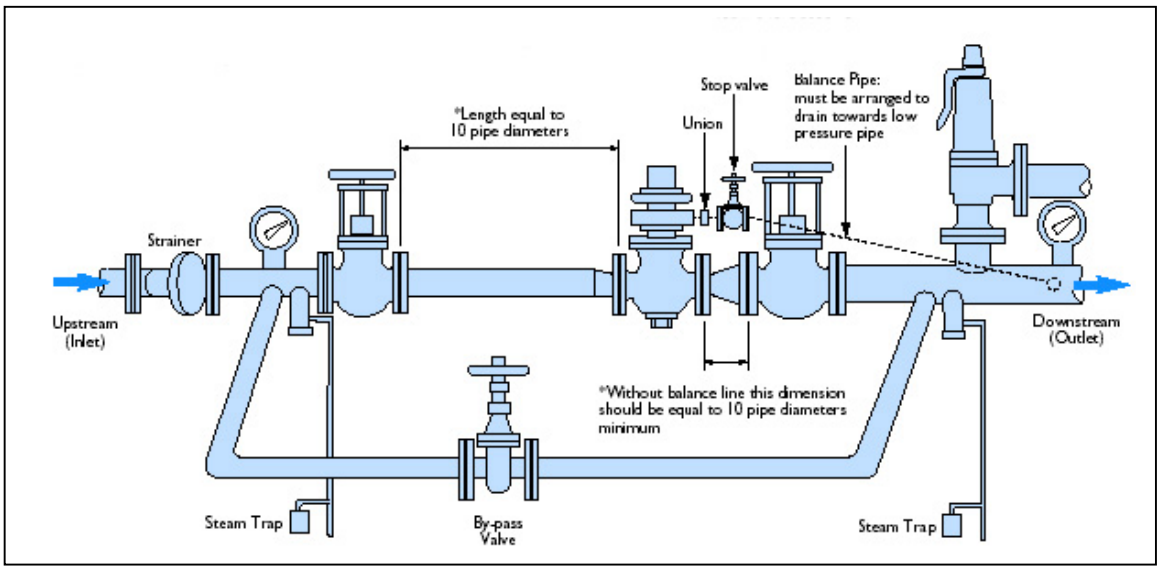


1. Body
2. Main Valve
3. Main valve Seat
4. Bottom Plug
5. Piston
6. Piston Rings
7. Piston Liner
8. Piston Guide
17. Valve Body Top Joint
21. Main Valve Spring
24. Bottom Plug Joint
25. Pilot Valve Top
26. Pilot Valve
27. Pilot Valve Plug
28. Pilot Valve Cap
29. Diaphragm
30. H.P. Port Plug
31. Pilot Valve Spring
32. Pilot Valve Top Cover
33. Adjusting Spring
34. Adjusting Spring Bottom Plate
35. Adjusting Spring Top Plate
36. Adjusting Screw
37. Locking Ring
38. Padlock
42. Diaphragm Joint
43. H.P. Port Plug Joint
44. Cap Headed Screws
48. Pilot Valve Head
49. L.P. Diaphragm
50. L.P. Screw Joint
51. L.P. Adaptor Flange
52. L.P. Top Cover
53. L.P. Push Rod
54. L.P. Top Cover Bolts
55. L.P. Top Cover Nuts
61. Top Cap
68. Pilot Valve Plug Joint (Copper)
69. Remote Control Plug
70. Remote Control Plug Joint

Note: Items 2 and 26 are Stainless Steel for steam duty but on air and gas duties they have a variety of elastomeric or PTFE seats, to suit the application.

Installation

A Typical Steam Reducing Valve Installation Using Globe Stop Valves.
*(Note: if you use parallel slide stop valves, they can be close coupled to the G4).



The majority of troubles experienced with pressure regulators can be attributed to installation faults. These can be avoided by giving attention to the following points:

Sizing
The correct sizing and layout of regulators, pipework, stop valves, strainers and other fittings is extremely important for good performance.

Inlet Strainer
Dirt, grit and pipe scale are common causes of regulator failure. A strainer of upstream pipe size should be fitted at least 10 pipe diameters before the regulator.

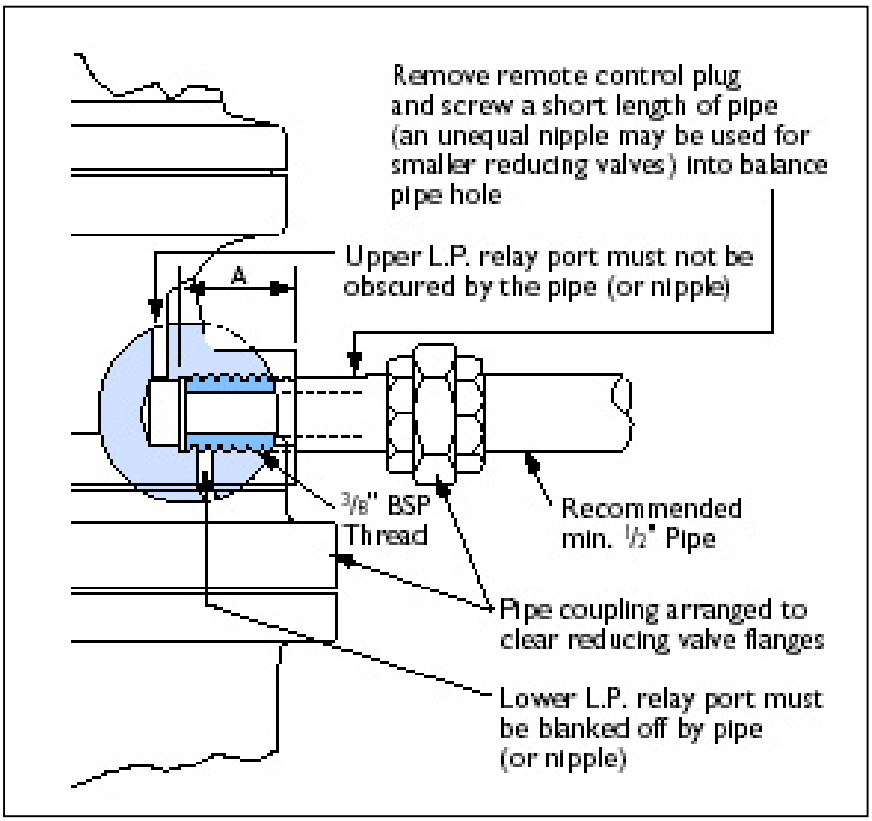
Steam Traps
Steam reducing valve stations should have steam traps fitted on the inlet and outlet pipes to prevent a build up of condensate in the regulator, particularly under no flow conditions.

Relief Valve
Every installation should be fully protected against regulator failure by a safety valve. Care should be taken to ensure that the discharge from such a valve cannot cause damage to property or create a hazard to personnel. The safety valve should be sized to pass the maximum capacity of the regulator.

Pipework
All pipework and fittings should be properly supported and free from any strain or vibrations which could affect their correct operation. All flanges should be correctly aligned and joints carefully fitted to avoid blockage of valve ports. If a jointing compound is used it should not be allowed to foul the internal ports or working parts of the valve.

Balance Pipe (Steam applications only – do not fit balance pipes on gas duty)

A balance pipe should be fitted when the reduced pressure is 55% or less of the inlet pressure, or to counteract turbulent downstream conditions caused by pipe fittings, valves or bends. The method of connecting the balance pipe to the reducing valve is shown in the sketch. It should drain downwards and be connected into the side of the downstream pipe at a point where smooth flow occurs (preferably downstream of the safety valve). Where isolation of the regulator is desired, a stop valve should be fitted in the balance line.



A = $^{15}/_{16}$" + or – $^{1}/_{16}$"

Before putting a regulator into service

All pipes should be thoroughly blown through to remove any dirt, grit or pipe scale. This can be done by removing the regulator bottom plug, main valve and spring, before carefully opening the inlet stop valve by a small amount. Remove any dirt lodged in the valve body and replace the parts.

Setting

Setting Under No-flow Conditions

This is the more accurate method and may be carried out as follows:

1. Condensate should be removed from the pipeline by firstly applying a little tension to the regulator adjusting spring (by rotating the adjusting screw clockwise for a few turns) and then slowly opening the outlet and inlet stop valves. When the downstream pressure starts to rise, close the inlet stop valve and remove all tension from the regulator adjusting spring.

2. Close the outlet stop valve and slowly open the inlet stop valve. Wait for about one minute to confirm that the reduced pressure is maintained at zero. This is to check that the regulator gives “dead tight” shut off under no-flow conditions.

3. Slowly raise the reduced pressure (by rotating the regulator adjusting screw clockwise) until the desired pressure is obtained. Do not forget to set the safety valve 15% above the reduced pressure, if necessary. The valve is now correctly set and the adjusting screw should be locked with the lock nut provided.

4. Slowly bring the outlet stop valve to “full open” and apart from a possible initial “fall-back” of the reduced pressure (whilst the system is warmed through) the regulator should continue to maintain the reduced pressure.

Setting On Flow

With the inlet and outlet stop valves closed, apply a little tension to the regulator adjusting spring (by rotating the adjusting screw clockwise for a few turns). Open the inlet and all of the downstream stop valves. Then wait until all of the condensate has removed and the system is properly warmed through. Then slowly raise the reduced pressure by rotating the adjusting screw clockwise until the desired reduced pressure is obtained. **Do not forget to set the Safety Valve, if necessary**. If the flow is varying, some trial and error may be necessary before the correct setting is finally achieved . The reduced pressure under no-flow conditions should be checked as soon as is convenient.

Special Note – The regulator should be kept under supervision for the first few days after its commissioning and any defects which may occur whilst the new system settles down should be noted.

We strongly recommend that the inlet strainer and reducing valve should be cleaned out one week after commissioning, with the strainer and steam traps checked at regular intervals thereafter.

Outlet Pressure Regulation

Up to 80mm (3") size $\pm$ ½% of the outlet pressure
[$\pm$ 0.035 Barg(½ Psig) below 6.9 Barg (100 Psig)]

Above 80mm (3") size $\pm$ 1% of the outlet pressure
[$\pm$ 0.07 Barg (1 Psig) below 6.9 Barg (100 Psig)]

Pressure rise to dead end = 1%

Inspection and Servicing

Regulators should be given a complete service every 12 months. They should, if possible, be removed from the line and stripped down. In order to simplify re-assembly each port should be examined and put aside in order. For a complete service carry out instructions contained in sections (1) to (5). If the regulator is being serviced in the pipeline, ensure that no pressure can enter the regulator and that all isolating valves are closed.

1. **Changing Adjusting Springs:** Unlock the valve, remove the top cap and completely unscrew the adjusting screw. Replace the spring using the existing top and bottom spring plates and re-assemble.

2. **Changing Diaphragms:** Remove the adjusting spring.
   For regulators fitted with a Standard Top - remove the pilot valve body top cover by undoing four cap-headed screws. Then remove the diaphragm and joint. (N.B. Two diaphragms should be fitted if the reduced pressure is 150 lbf/in² [10.5kg/cm²] or above).
   For regulators fitted with a Low Pressure Top – This has a larger diaphragm than standard, which is removed by undoing twelve bolts and nuts and then detaching the top cover. The top cover has a beaded joint instead of the separate diaphragm joint and care should be taken not to damage it. The low pressure top is necessary for reduced pressures of 5 lbf/in² (0.35 kg/cm²) or less.

   Diaphragm Condition: All flat diaphragms become “moulded” by the reduced pressure without detriment to their performance. They should only be replaced if fractures, or sharp, concentric or radial ridges, develop. Using both hands it should be possible to flex the central area of the diaphragm, and even though it may be moulded, produce an oil can effect. Diaphragms that are too rigid should be rejected.

   Pilot Valve Standout: Check that the pilot valve cap is in line with the top service of the diaphragm joint (or the push-rod and the top face of the adaptor flange in the case of the low pressure top). This can be done by resting a straight edge (saw blade) across the joint and through the slot provided in the flange. This height should be adjusted by filing down the pilot valve spindle (or push rod). Re-assembly is otherwise straightforward.

3. **Pilot Valve:** Remove the adjusting spring, diaphragm (see sections 1 and 2), the adaptor flange and the push rod if it is a low pressure top. Remove the pilot valve cap and unscrew the pilot valve plug (with a removing key or box spanner). Withdraw the pilot valve and spring and check the copper plug joint.

   Standard Pilot Valve: This has a stainless steel plug and valve, and should be examined for signs of deposits or erosion. If necessary clean and grind the valve into the seat (see later note).

   Soft Seated Pilot Valve: This has a PTFE or elastomeric valve and a stainless steel spindle. The valve should be replaced if worn.

When re-assembling pilot valves check the standout as described in section (2). The torque required to obtain a good seal between the pilot valve plug and copper washer is approximately 120 lbs ft.

4. Piston and Rings: Remove the top assembly completely from the main valve body. Withdraw the piston and the rings, before examining them, along with the liner and piston guide for wear and deposits.

The piston ring gaps should be as follows and each will be subject to a tolerance of ± 0.003" (± 0.076mm).

Valve Size	Fig. 2042, 2043	Fig. 2044, 2045	Fig 2046
½" (15mm)	0.023" (0.58mm)	-	
¾" (20mm)	0.025" (0.64mm)	-	
1" (25mm)	0.025" (0.64mm)	-	0.025" (0.64mm)
1¼" (32mm)	0.029" (0.74mm)	-	
1½" (40mm)	0.039" (0.94mm)	-	
2" (50mm)	0.045" (1.14mm)	-	0.045" (1.14mm)

Valve Size	Fig. 2042, 2043	Fig. 2044, 2045, 2046
2½" (65mm)	-	0.052" (1.32mm)
3" (80mm)	-	0.065" (1.65mm)
4" (100mm)	-	0.081" (2.06mm)
5" (125mm)	-	0.095" (2.14mm)
6" (150mm)	-	0.106" (2.69mm)

Clean and re-assemble. The piston should move quite freely with only a light pressure required to overcome frictional resistance. When replacing the main flange body top joint, ensure that it does not foul the relay ports.

5. Main Valve: Remove the bottom plug or cover and withdraw the main valve and spring. Examine both the valve and seat for deposits or erosion (evidence of the latter would indicate that the regulator is oversized or subjected to long periods of operation at very low loads). If necessary clean and grind the main valve into its seat (see later note). Re-assemble the main valve, spring and bottom plug or cover.

Grinding-In (Metal Valve)

The valve should have a thin layer of very fine emery paste smeared on its face and then inserted in its seat. Apply a light pressure with the aid of a screwdriver to push the valve onto the seat and simultaneously grind it in with the aid of an oscillating motion; occasionally moving the valve round in the seat. Continue until there is a bright uniform bearing surface on both the valve and the seat. This surface must be free from grooves or pitting without forming a ridge on the valve. The valve and seat must then be carefully cleaned. If there is any sign of a ridge it must be removed by turning in a lathe (carefully maintaining the mitre angle of 45°) and then regrinding into the seat.

Inspection of the Strainer

The inlet strainer should be examined and cleaned regularly. It is particularly important that this should be done at the end of the first week after commissioning.

Jointing Materials

In order to prevent corrosion of the stainless steel diaphragm, the diaphragm joint must be completely free from graphite (either impregnated or coated). However, graphite joints are quite suitable elsewhere on the valve.

Re-setting

After the service has been completed and the valve has been replaced in the line, the reduced pressure should be re-set as recommended in our **"Setting"** instructions.

IMPORTANT
Danger can emanate from the incorrect installation, maintenance and adjustment of these products. For this reason only suitably qualified persons should work on these devices within the guidelines supplied in this document. This document is controlled from Safety Systems UK Ltd QA Department and is subject to change. Therefore, it is important that suitably qualified persons, who work with these products, check to ensure that they are using an up to date copy.

Failure to adhere to these instructions will invalidate CE approval.

SYMPTOM	POSSIBLE CAUSE	REMEDY
A. Leakage from the spring chamber bleed hole	Broken diaphragm	Replace diaphragm and joint.
B. Reduced pressure not maintained as flow varies. Relief valve blows when flow ceases.	Piston stuck due to:	
	(a) Dirt in the chamber.	Clean out and re-assemble. Check the inlet strainer and clean, if necessary.
	(b) Excessive deposit of solids from steam.	Clean out and re-assemble. Check condensate and modify water treatment as necessary.
	(c) Broken or scored piston rings.	Replace and check the piston ring cap.
	(d) Scored piston liner.	Replace and check the piston ring cap.
	Relay port between diaphragm chamber and valve outlet blocked.	Clear blockage.
C. Reduced pressure not maintained when flow approaches maximum, but is correct at 'low-flow' and 'no-flow' conditions.	Regulator undersized.	Replace with a larger valve or consider fitting another regulator in parallel (assuming pipework is suitable for larger capacities).
	Pressure differential across the regulator is too small.	None – unless inlet or reduced pressure can be adjusted to give increased differential.
	Downstream pipework and fittings undersized.	Try fitting a balance pipe.
	Upstream pressure not being maintained.	None – this is the basic system fault.
D. Reduced pressure correct on large flow and 'no-flow' conditions but erratic on small flows.	Regulator oversized.	Fit smaller regulator or replace main valve with restricted main valve. Check the main and pilot valves for erosion and service as necessary.
E. Reduced pressure builds up on 'no-flow' conditions but otherwise operates correctly.	Main valve 'wiredrawn' or stuck in guides.	Free and grind the main valve into the seat.
	Pilot valve 'wiredrawn'.	Grind pilot valve into plug.
	Inlet steam leaking past the pilot valve plug joint.	Tighten down the pilot valve plug. Renew the copper joint if necessary.
	Condensate accumulating in the regulator.	Fit steam traps.

SYMPTOM	POSSIBLE CAUSE	REMEDY
F. Violent reduced pressure fluctuations under all flow conditions	Inlet pipe and/or strainer and fittings undersized.	If badly undersized, replace pipework and fittings.
	Inlet flange joint restricting flow to the regulator.	Rectify joint.
	Relay port from valve inlet to pilot valve partially blocked.	Clear blockage.
	Regulator oversized.	Fit a small regulator or replace the main valve with a restricted main valve.
G. Reduced pressure erratic under all conditions	Main valve spring weak or broken.	Replace
	Condensate accumulating in the valve.	Fit steam traps to the inlet and outlet pipes.
H. Reduced pressure oscillates slowly	Relay port from diaphragm chamber to valve outlet partially blocked.	Clear blockage.
J. Reduced pressure oscillates for a short period when starting up after a systems shut-down.	Condensate accumulating in the regulator.	Fit steam traps to the inlet and outlet pipes.
K. Relief valve subject to periodic blowing off without apparent change of operation.	Condensate accumulating in the regulator.	Fit steam traps to the inlet and outlet pipes.
L. A reduced pressure not obtainable (regulator will not open when adjusted).	Relay port between the valve inlet and the pilot valve blocked.	Clear blockage.
	main valve or piston stuck in closed position.	Check and service as necessary.
M. Water or steam leaking through the joints	Joints not properly tightened.	Adjust as necessary.
	Condensate accumulating in the regulator.	Fit steam traps to the inlet and outlet pipes.
N. Joints de-composing	Chemical attack resulting from wrong feed-water treatment.	Check and if necessary modify treatment.

SYMPTOM	POSSIBLE CAUSE	REMEDY
N. (cont'd)	Maximum recommended working temperature of the valve exceeded.	Replace with the appropriate type of regulator.
P. Appreciable reduced pressure rise on 'no-flow' but correct at flow conditions.	Pilot valve standout too high.	Adjust. See Inspection and Servicing instructions.
Q. Appreciable fall of reduced pressure to open the valve from 'no-flow' condition	Pilot valve standout too low.	Adjust. See Inspection and Servicing instructions.