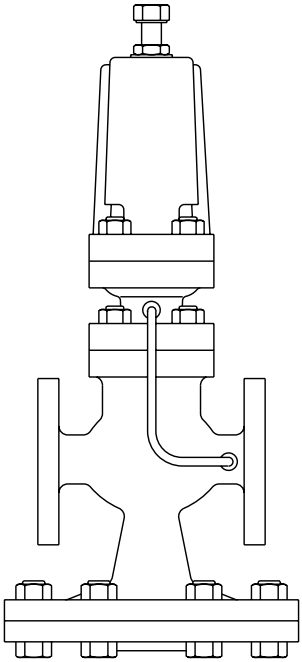
Installation and Maintenance Manual

Forbes Marshall Pilot Operated Pressure Reducing Valve

FMPRV53



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PLEASE NOTE - Throughout this manual this cautionary symbol is used to describe a potential damage or injury that might occur if the safety considerations are overlooked. This symbol denotes CAUTION, WARNING or DANGER.

1. Preface:

This manual is intended for anyone using, commissioning, servicing, or disposing the below mentioned productssafely and efficiently.

Forbes Marshall Pilot Operated Pressure Reducing Valve [FMPRV53]

Sizes: DN 15 (1/2“), DN 20 (3/4”), DN 25 (1”), DN 40 (1 1/2”), DN 50 (2”), and DN 80 (3”)

PLEASE NOTE:

Throughout this manual the following cautionary symbol is used to describe a potential damage or injury that might occur if the safety considerations are overlooked.

2. Important Safety Notes:

Read this section carefully before installing/operating/maintaining the product. The precautions listed in this manual are provided for personnel and equipment safety. Further more, Forbes Marshall accepts no responsibility for accidents or damage occurring as a result of failure to observe these precautions. Note that the product is designed to perform for non-contaminated fluids only. A contamination in the form of chemical, foreign particle etc. can lead to problem with product performance and life of the product.

If these products in compliance with the operating instructions are, properly installed, commissioned, maintained and installed by qualified personnel (refer Section 2.7), the safety operations of these products can be guaranteed. General instructions for proper use of tools and safety of equipments, pipeline and plant construction must also be complied with.

2.1 Intended use:

Check, if the product is suitable for intended use/ application by referring to the installation and maintenance instructions, name plates and technical information sheets. (TIS)

i) The product is suitable for use as defined in the technical information sheet. In case the need arises to use the product on any other fluid please contact Forbes Marshall for assistance.

ii) Check for the suitability in conformance to the limiting conditions specified in technical information sheet of the product.

iii) The correct installation and direction of fluid flow has to be determined.

iv) Forbes Marshall products are not intended to resist external stresses, hence necessary precautions to be taken to minimize the same.

2.2 Accessibility and Lighting:

Safe accessibility and working conditions are to be ensured prior to working on the product.

2.3 Hazardous environment and media:

The product has to be protected from hazardous environment and check to ensure that no hazardous liquids or gases pass through the product.

2.4 Depressurizing of systems and normalizing of temperature:

Ensure isolation and safety venting of any pressure to the atmospheric pressure. Even if the pressure gauge indicates zero, do not make an assumption that the system has been depressurized.

To avoid danger of burns allow temperature to normalize after isolation.

2.5 Tools and consumables:

Ensure you have appropriate tools and / or consumables available before starting the work. Use of original Forbes Marshall replacement parts is recommended.

2.6 Protective clothing:

Consider for the requirement of any protective clothing for you/ or others in the vicinity for protection against hazards of temperature (high or low), chemicals, radiation, dangers to eyes and face, noise and falling objects

2.7 Permits to work:

All work to be carried out under supervision of a competent person. Training should be imparted to operating personnel on correct usage of product as per Installation and Maintenance instruction. “Permit to work” to be complied with (wherever applicable), in case of absence of this system a responsible person should have complete information and knowledge on what work is going on and where required, arrange to have an assistant with his primary goal and responsibility being safety. “Warning Notices” should be posted wherever necessary.

2.8 Handling:

There is a risk of injury if heavy products are handled manually. Analyze the risk and use appropriate handling method by taking into consideration the task, individual, the working environment and the load.

2.9 Freezing:

Provision should be made to protect systems which are not self-draining, against frost damage (in environment where they may be exposed to temperatures below freezing point) to be made.

2.10 Returning products:

Customers and Stockist are reminded that, when returning products to Forbes Marshall they must provide information on any hazards and the precautions to be taken due to contamination residues or mechanical damage which may present a health, safety or environmental risk.

This information must be provided in writing including Health and Safety data sheets relating to any substances identified as hazardous or potentially hazardous.

3. Brief Product Information:

3.1 Description

The Forbes Marshall Pilot Operated Pressure Reducing Valve, FMPRV53, is a cast steel pilot operated pressure reducing valve suitable for steam or compressed air.

3.2 Sizes and Pipe Connections

1/2", 3/4", 1", 1½", 2" and 3"

ANSI 300 and 600

Also available for air applications.

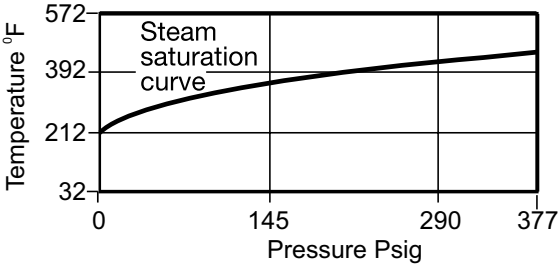
3.3 Limiting Conditions

Maximum working conditions	377 Psig at 572 °F
Body design conditions	609 Psig at 797 °F
Cold hydraulic test pressure without internals	566 Psig

Two color coded pressure adjustment springs are available for the following down stream pressure ranges:

Natural	3 to 247 Psig (conical spring)
Grey	232 to 348 Psig

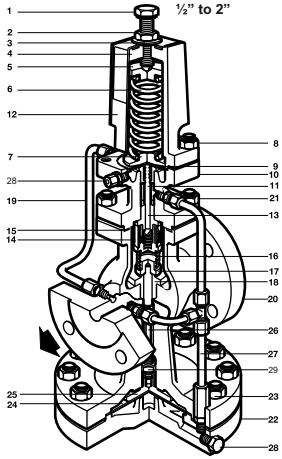
3.4 Operating range

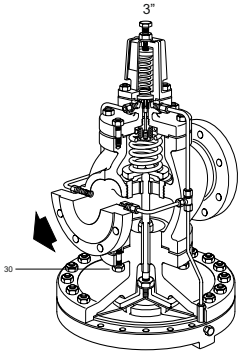


3.5 Pressure Sensing Pipe

The FMPRV53 valve controls the downstream pressure by sensing the downstream pressure through an external sensing pipe taken from downstream to the pilot valve chamber (10). Fitting of this external pressure sensing pipe is described in the user manual.

If the external sensing pipe is not provided then the valve controls by internal pressure sensing pipe (19). However the capacity in this case will be reduced.





Material

Sr. No.	Description	Material	Standard
1	Adjustment screw	Carbon Steel	H.T.IS 1367 Gr. 8.8 (ASTM A 193, B7)
2	Adjustment lock nut	Carbon Steel	H.T.IS 1367 Gr. 8.0 (ASTM A 194, 2H)
3	Washer	Stainless Steel	ASTM A 240, Type 304
4	Spring	SG iron	EN-JS1025 (ASTM 60-40-18)
5	Top spring plate	C-20	IS 2062 (ASTM A36)
6	Pressure adjustment spring	Spring steel	IS 4454 Part IV Gr. 1 (ASTM A227)
7	Bottom spring plate	Stainless Steel	ASTM A276 Type 304
8	Spring housing securing studs nuts	Carbon Steel Carbon Steel	H.T. IS: 1367 Gr. 8.8 (ASTM A193, B7) H.T. IS: 1367, Gr. 8 (ASTM A194, 2H)
9	Pilot diaphragm	Stainless Steel	ASTM A240, Type 304
10	Pilot valve chamber	Cast Steel	ASTM A216 Gr. WCB
11	Pilot valve plunger	Stainless Steel	ASTM A276, Type 304
12	Spring housing cover	Stainless Steel	ASTM A240, Type 304
13	Pilot valve and seat unit	Stainless Steel	ASTM A276, Type 304
14	Internal strainer	Stainless Steel	ASTM A240, Type 304
15	Body gasket	Reinforced exfoliated graphite	(ASTM F 104)

Sr. No.	Description	Material	Standard
16	Main valve Return spring	Spring Steel	IS 4454 part IV Gr. 1 (ASTM A 227)
17	Main valve	Stainless Steel	ASTM A276, Type 304
18	Main valve seat	Stainless Steel	ASTM A276, Type 420
19	Pressure sensing	Stainless Steel pipe	ASTM A213, Type 304
20	Main valve body	Cast Steel	ASTM A216 Gr. WCB
21	Pilot valve securing studs nuts	Carbon Steel Carbon Steel	H. T IS 1367, Gr. 8.8 (ASTM 193, B7) H. T IS 1367, Gr. 8 (ASTM A194, 2H)
22	Main diaphragm chamber	Cast Steel	ASTM A216, Gr. WCB
23	Main diaphragm securing studs nuts	Carbon Steel Carbon Steel	H.T. IS 1367, Gr. 8.8 (ASTM 193, B7) H.T. IS 1367, Gr. 8 (ASTM A194, 2H)
24	Main diaphragms	Stainless Steel	ASTM A240, Type 304
25	Main diaphragm plate	Stainless Steel	ASTM A276, Type 304
26	Push rod	Stainless Steel	ASTM A276, Type 431
27	Pipe assembly	Stainless Steel	ASTM A213, Type 304
28	Plug 1/8” BSP	Carbon Steel	ASTM A105
29	Lock nut	Carbon Steel	H.T IS: 1367, Gr 8 (ASTM A194, 2H)
30	Body stud nut	Carbon Steel Carbon Steel	H T IS: 1367, Gr. 8.8 (ASTM A 193, B7) HT IS 1367, Gr. 8 ASTM A 194, 2H)

Note: Material specification in bracket are for reference only.

3.6 Product Dimension and Drawing:

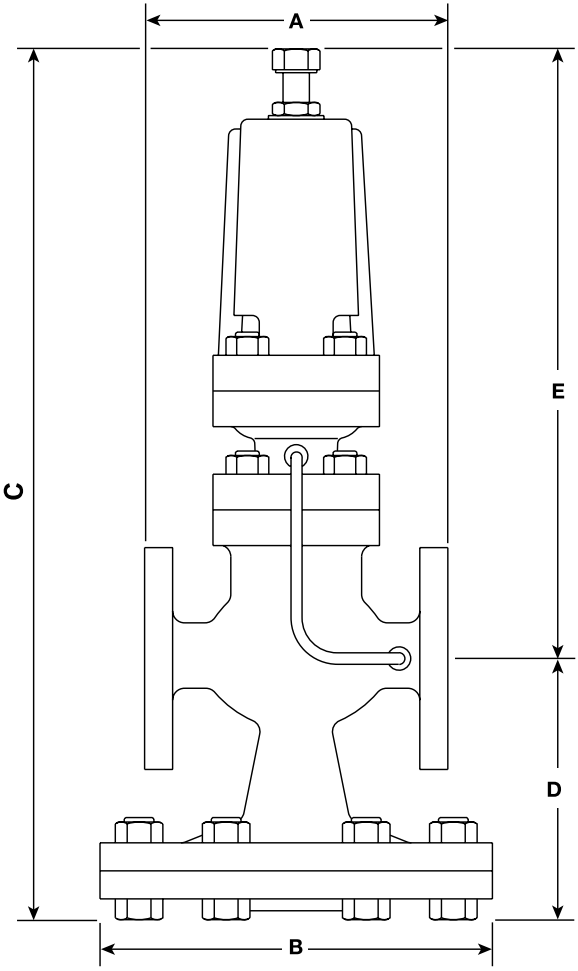
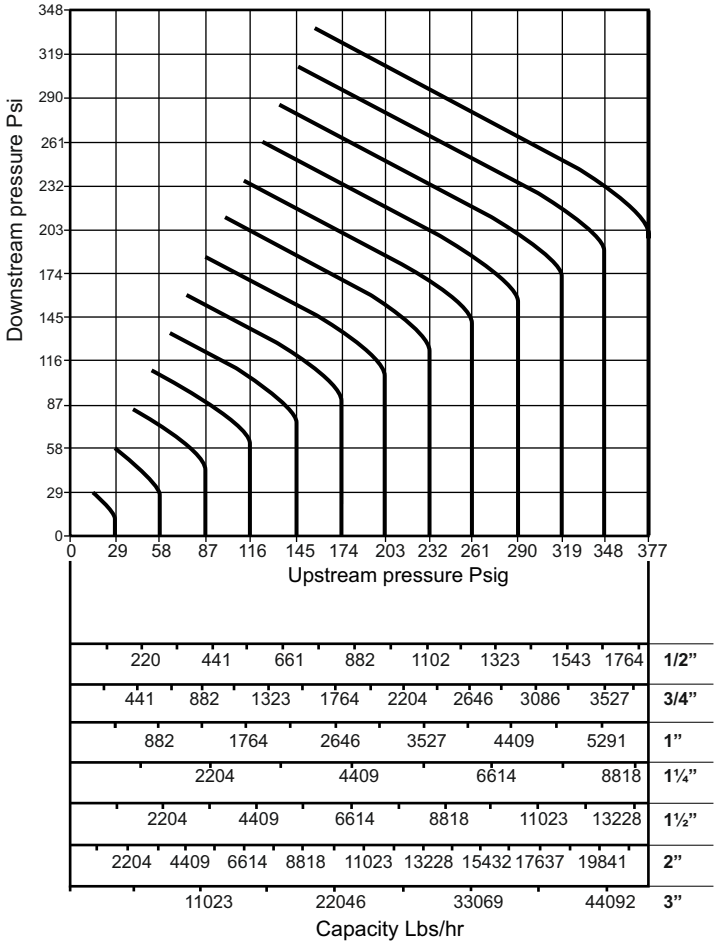


Figure 2: Dimensional Drawing of FMPRV53

3.7 Capacity Chart

3.7.1 Steam Capacity Chart



Note: The capacities quoted on the above charts are based on valves fitted with external pressure sensing pipes. Reliance on the internal pressure sensing pipe will mean that capacities may be reduced. In the case of low downstream pressure this reduction could be up to 30% of the valve capacity.

How to Use the Chart

Saturated Steam

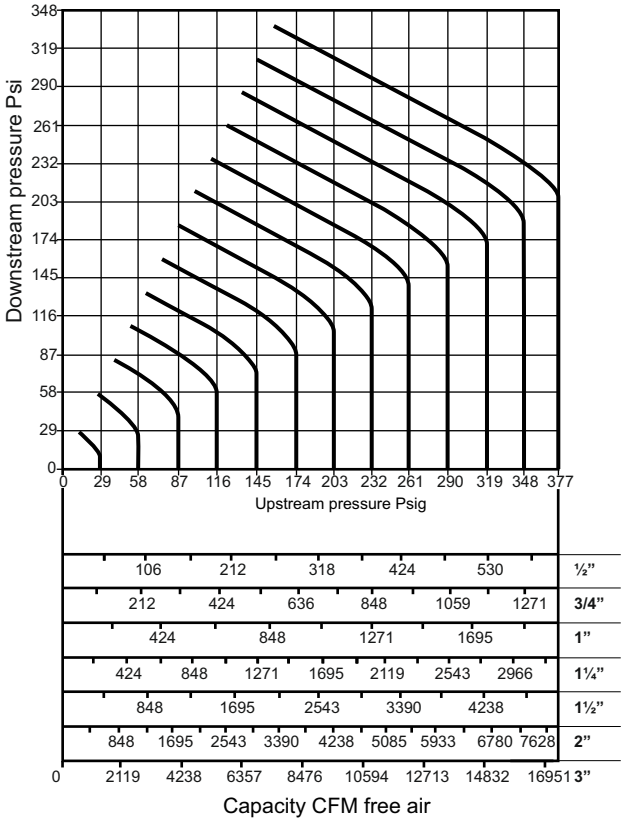
Required a valve to pass 882 Lbs/hr reducing from 87 Psig to 58 Psig Find point at which curved 87 Psig upstream pressure line. A perpendicular drop from this point gives the capacities of all FMPRV53 sizes under these conditions. A 1" valve is the smallest size which will carry the required load.

Superheated Steam

Because of the higher specific volume of superheated steam correction factor must be applied to the figure obtained from this chart. For 131 °F of superheat the factor is 0.95 and for 212 °F of superheat is 0.9.

Using the example given for saturated steam, the 1” valve would pass 1139 x 0.95=1082 Lbs/hr if the steam had 131 °F of superheat. It is still big enough to pass the required load of 882 Lbs/hr.

3.7.2 Compressed Air Capacity Chart



Compressed Air

Capacities are given in CFM of free air. The use of the capacity chart can be best explained by an example. Required a valve to pass 212CFM of free air reducing from 174 to 116 Psi. Find the point at which the curve 174 Psi upstream line crosses the horizontal 116 Psi downstream pressure line. A perpendicular dropped from this point shows that 1/2” line will pass about 254 CFM under these conditions and is the correct valve size.

4. Product Working Principle : (Refer to Figure 1)

A Forbes Marshall Pilot Operated Pressure Reducing Valve (FMPRV53) balances the downstream pressure through the pressure sensing pipe (19) against the pressure adjustment control spring (6). This in turn moves the pilot valve plunger (11) in the pilot valve assembly, to modulate a control pressure which is directly proportional to the pilot valve opening. This control pressure is transmitted to the underside of the main diaphragm (24) through the control pipe. This movement in the diaphragm (24) pushes the pushrod (26) up and the main valve (17) opens in proportion to the pilot valve opening.

Under stable load conditions, the pressure underneath the pilot diaphragm (9) balances the force which is set on the pressure adjustment spring (6). This settles the pilot valve, allowing a constant pressure working under the main diaphragm (24). This makes sure that the main valve (17) is also settled, hence giving a stable downstream pressure.

When downstream pressure rises, the pressure under the pilot diaphragm (9) becomes greater than the force created by the pressure adjustment spring (6) and this makes pilot diaphragm (9) to move upwards. This closes the pilot valve seat (13) and will interrupt the transmission of steam pressure underneath the main diaphragm (24). The top of the main diaphragm (24) is always subjected to downstream pressure at all the times and, as there is more pressure above the main diaphragm (24) than below, the main diaphragm (24) moves down pushing the steam underneath it into the downstream outlet through the pipe assembly (27) and surplus pressure orifice. The pressure on either side of the main diaphragm (24) is balanced, and a small excess force created by the main valve return spring (16) closes the main valve seat (18).

Any variation in load or pressure will immediately be sensed on the pilot diaphragm (9), which will act to adjust the position of the main valve accordingly, ensuring a constant downstream pressure.

5. Installation Guidelines:

Note: Before implementing any installations observe the 'Important Safety notes" in section 2. Referring to the Installation and Maintenance Instructions, name-plate and Technical Information Sheet, check that the product is suitable for the intended installation.

5.1 Fitting:

The FMPRV53 should always be fitted in an horizontal pipework with the main diaphragm chamber below the line (Fig 3). To meet high capacities or widely varying loads, or where standby facility is required, two or more valves may be used in parallel (Fig 4). Where a large turndown in pressure is required (generally above 10 to 1) consideration should be given to using the two valves in series. If the valves are to work correctly, then some capacity or space is needed between the two valves in order to achieve stability. This "space" should represent 50 pipe diameters or the equivalent volume of larger bore pipe. It is also important to ensure adequate drainage of the space between the two reducing valves (Fig 5).

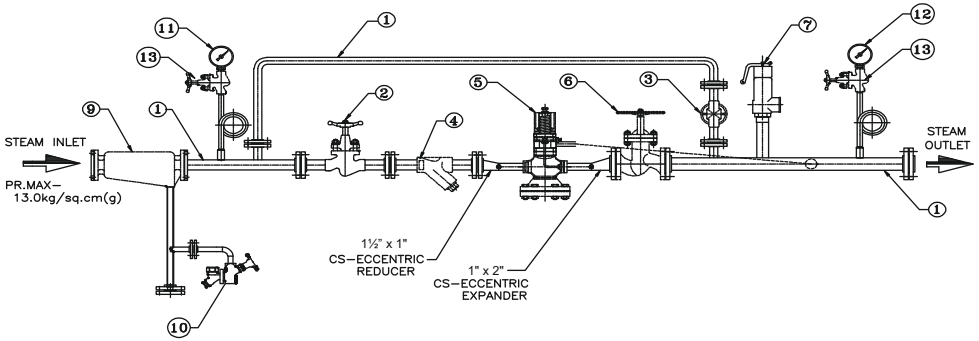


Figure 3: Recommended installation of Pressure Reducing Valve FMPRV53
***This is a typical representation of Pressure Reducing Station – (Pilot Operated)**

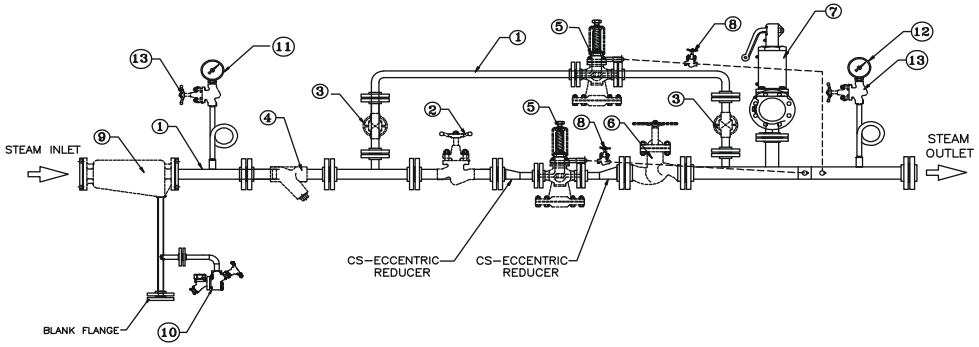


Figure 4: Installation of Two Pressure Reducing Valve FMPRV53 in parallel
***This is a typical representation of Pressure Reducing Station – (Pilot Operated)**

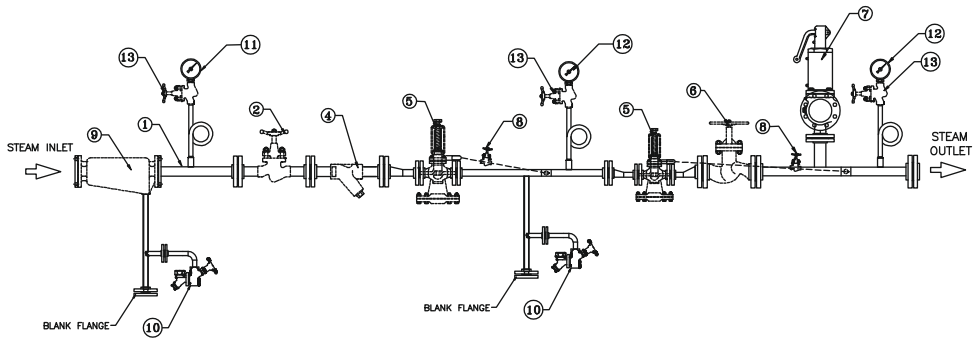


Figure 5: Installation of Two Pressure Reducing Valve FMPRV 53 in series
***This is a typical representation of Pressure Reducing Station – (Pilot Operated)**

Sr. No.	DESCRIPTION
1	Interconnecting Pipework for Pressure Reducing Station
2	Stop Valve (Inlet)
3	Stop Valve (Bypass)
4	Strainer
5	Forbes Marshall Pilot Operated Pressure Reducing Valve
6	Stop Valve (Outlet)
7	Safety Valve
8	Stop Valve (Pressure Balancing Line)
9	Moisture Separator
10	Drain Trap Assembly
11	Dial Pressure Gauge (Inlet)
12	Dial Pressure Gauge (Outlet)
13	Stop Valve (Dial Pressure Gauge)

5.2 Pipeline sizing:

The piping on both sides of the valve must be sized so that velocities do not exceed 82 ft/sec. This means that a properly sized valve will be smaller than the connecting pipe work.

5.3 Pipeline stresses:

Line stresses caused by expansion or inadequate support should not beimposed on the valve body.

5.4 Isolating Valves:

These should preferably be of the fullbore type.

5.5 Removal of condensate:

Ensure that the pipework is supplied with dry steam. The ideal arrangement is to fit a separator inthe in the steam supply. If the steam is known to be dry then a drain pocket may be adequate. If there is a rise in the low pressure line after the valve then a further drain point should be provided to keep the valve drained after shutdown.

5.6 EPreventing Dirt:

The valve should be protected from dirt / foreign particles using pipeline strainer. The strainer should be fitted on its side to prevent the accumulation of water.

5.7 Pressure Control Pipe:

The valve will be supplied complete with a control pipe assembly connecting the side of the body with the side of the pilot valve chamber. When close control of pressure and / or maximum capacity is required, an external pressure control pipe must be fitted. To fit this alternative downstream sensing control pipe, first remove the control pipe assembly. The resulting 1/8" BSP tapping in the side of the body should be blanked using a plug provided in the bag attached to the valve. The other 1/4" BSP tapping in the side of the pilot valve chamber should be blanked off using the plug fitted in the tapping provided on the front of the pilot valve chamber. Into this latter tapping, fit the compression fitting with compression ring. This should be suitable for the fitting of 1/4" pipe. If suitable pipe is not available the compression fitting can be removed and 1/4" nominal bore steel pipe screwed directly to the pilot valve chamber. The pressure control pipe should be connected in to the top of the reduced pressure main at a point where in either direction there is a length of straight pipe uninterrupted by fittings for at least 3 feet or 15 pipe diameters whichever is the greater. It should be arranged with a positive fall so that any condensate can drain away from the FMPRV53. Where the size of the reduced pressure main makes it difficult to maintain a fall when entering the top of the main, the pressure control pipe may be connected in the side of the main. A stop valve should be fitted for isolating purposes.

5.8 Pressure gauges:

It is essential to fit a pressure gauge on the downstream side so that the valve can be properly set. A pressure gauge on the upstream side can also be useful.

5.9 By – pass:

If it is essential to maintain a constant supply of steam and reducing valve station does not include duplication or stand-by equipment, it may be necessary to install a by-pass to ensure continuation of supply when the reducing valve is being serviced. Ref. Fig 3. The by-pass valve will normally be the same size as the reducing valve. The hand wheel should be padlocked to prevent use by unauthorised personnel, and when in use should be under constant manual supervision. The by-pass may be arranged above or to the side of the main assembly but never below it.

5.10 Safety Valve:

This valve is intended to protect the downstream equipment from excessive pressure. It should be set to blow below the safe working pressure of the down stream equipment, and will normally be sized to pass the full capacity of the FMPRV53 when the FMPRV53 fail in the fully open position. It should not be set too close to the setting of FMPRV53, and should discharge to a safe place.

6. Startup and Commissioning :

6.1 Setting on Valve:

1. Ensure that all connections are properly made and that all valves are closed.

2. Close all valves at reducing valve station, including valves on by pass line if fitted.

3. Check that adjustment screw is turned fully anti-close wise until spring is slack.

4. Open small valve in pressure control line.

5. Blow through the approach pipework by removing the cap and screen from the strainer protecting the stream trap draining the upstream pipework. Replace upon completion. Do not remove the screen from the main line strainer during this operation. Although this should remove most of the dirt which is present, it may be necessary to examine and clean the main line strainer at regular intervals.

6. Slowly open the upstream isolating valve until it is fully open.

7. Using a suitable spanner slowly turn adjustment screw in a clockwise direction until desired downstream pressure reading is obtained.

8. Holding the adjustment screw in position with the spanner tighten down the locknut to secure the setting of the adjustment spring, making sure that the "C" washer stays in position.

9. Slowly open the downstream valve until it is fully open.

6.2 Two or more valves in parallel:

When more than one reducing valve is used it is an advantage to use two valves of unequal size, the smaller one being chosen to meet the lower load requirements and the larger valve to come into operation so that both meet the normal and maximum demand. Refer Fig. 4.

It is necessary to set each valve independently one at a time following the start-up procedure as detailed in the section but setting the smaller valve at some 1.5 Psi higher than the larger.

Maintenance Guidelines:

Before undertaking any maintenance on the valve it must be isolated from both supply line and return line and any pressure should be allowed to safely normalize to atmosphere.

7.1 Routine and Preventive Maintenance:

Please refer to the maintenance schedule mentioned in the table below to undertake routine maintenance of the FMPRV53.

SR. NO.	PARAMETERS TO BE CHECKED	FREQUENCY FOR CHECKING VARIOUS PARAMETERS					
A	**PRESSURE REDUCING VALVE**	**Daily**	**Weekly**	**Monthly**	**Quarterly**	**Half Yearly**	**Annually**
1	Clean pilot valve strainer				Y		
2	Clean Pilot valve chamber assembly kit					Y	
3	Check & clean Main / Pilot diaphragm						Y
4	Clean SS tube & stud coupling with split pin					Y	
5	Main valve cleaning					Y	
6	PRV overhauling and push rod checking						Y

7.2. Tool Kit:

To carry out maintenance of the pressure reducing valve FMPRV53 refer the tools mentioned in the table below.

Size	Component	Tool used and Size
1/2", 3/4"	Main valve seat assembly	Ring spanner 1 3/8" (A/F)
1/2"	Vernier to measure depth and lift of the push rod (main valve head and seat assembly)	0.07" lift
3/4"	Vernier to measure depth and lift of the push rod (main valve head and seat assembly)	0.09" lift
1"	Main valve seat assembly	Ring spanner 1 5/8" (A/F)
	Vernier to measure depth and lift of the push rod (main valve head and seat assembly)	0.11" lift
1/2", 3/4", 1"	Push rod lock nut	Open spanner 1/2" (A/F)
	Lower body tightening 1/2" bolt and nut	Box spanner 11/16" (A/F)
	1/2" bolt and nut for bottom plate assembly	Box spanner 3/4" (A/F)
	Pilot Valve Chamber Assembly	
	3/8" studs	Stud Runner 3/8" X 1/16"
	Nut	Ring spanner 11/16" (A/F)
	Housing and chamber	Ring spanner 9/16" (A/F)
	Control Plug Assembly	Box Spanner 9/16" (A/F)
	Lower drain	Box Spanner 1/2" (A/F)
	Pilot valve seat and cap	Ring Spanner 1" (A/F)
	Bellow	Ring spanner 1" (A/F)
1½"	Main valve assembly (1.22" slot and OD 1.46")	Customer made tool has to be designed.
	Vernier to measure depth and lift of the push rod (main valve head and seat assembly)	0.18" lift
2"	Main valve assembly (1.65" slot and OD 1.93")	Customer made tool has to be designed.
	Vernier to measure depth and lift of the push rod (main valve head and seat assembly)	0.19" lift
3"	Main valve assembly (0.39" slot Y type and OD 3")	Customer made tool has to be designed.

Size	Component	Tool used and Size
1½", 2" & 3"	Vernier to measure depth and lift of the push rod (main valve head and seat assembly)	0.29" lift
	Push rod lock nut	Open spanner 11/16"(A/F)
	Stud coupling and long nut on lower plate	Box spanner 1/2" (A/F)
	1/2" bolt and nut for bottom plate assembly	Box spanner 3/4" (A/F)
	Split Nut	Nose Plier
	Pilot Valve Chamber Assembly	
	5/8" stud	Stud Runner 5/8" X 1/12"
	Nut	Ring spanner 1" (A/F)
	Strainer cap	Box spanner 3/4" (A/F)
	Pilot valve seat	Open spanner 3/4" (A/F)
	3/8" bolt for housing and spring	Box spanner 11/16" (A/F)
	4 No. control pipe (elbow fitting)	Open spanner 1/2" (A/F)
	Low drain	Open spanner 1/2" (A/F)

7.3. Maintenance/Replacement Procedure : (Refer to Figure 6)

For a detailed maintenance/replacement procedure of the FMPRV53 body internals, please refer to the instructions given in the subsequent sections;

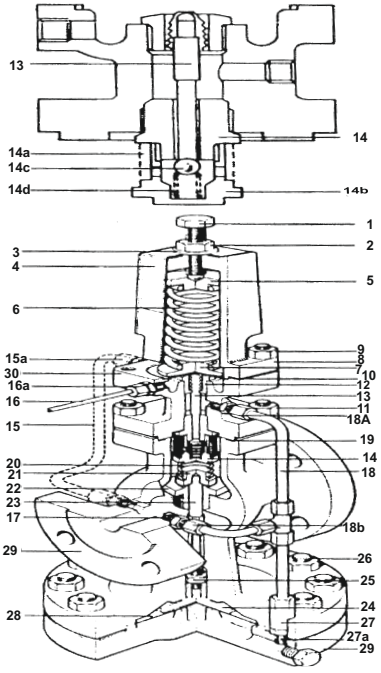


Figure 6: Routine Maintenance

7.3.1. Routine maintenance:

It is recommended that the valve is dismantled once every twelve to eighteen months for a complete overhaul and ideally this should be carried out with the valve removed from the line.

The following parts should be inspected and refurbished or replaced as necessary:

- Main valve seat (22) and main valve head (21).

- Pilot valve assembly (14).

- Pilot diaphragms (10).

- Main diaphragms (28)

In addition to the above items the push rod (23) liner bush, and control orifices (17) and (27a) should, if necessary, be cleaned of any scale deposit.

7.3.2. Diaphragms and Cleaning:

If the valve is dismantled and either the main diaphragms or the pilot diaphragm are not renewed care must be taken not to turn the diaphragms over – refit them in exactly the same position as when dismantled. The control orifices in the adapters (17) and (27a) and the interconnecting pipe assembly (18) as well as the pressure sensing pipework (16) or (15) must be kept clear of dirt.

Blow through with compressed air if necessary – do not use a drill on either of the control orifices, one of which contains a spilt pin, as enlargement of the orifices might upset the operation of the valve.

7.3.3. To renew or change the adjustment spring:

It is not necessary to isolate the valve in order to change the spring.

1. Release locknut (2) and turn adjustment screw (1) anticlockwise until spring is slack.

2. Slide out 'C' washer (3) from underneath locknut and remove cover (4).

3. Remove old spring (6) and replace with new one remembering to replace top spring plate (5).

4. Replace cover and 'C' washer, and turn adjustment screw clockwise until desired pressure reading is obtained.

5. Holding the adjustment screw in position, tighten down the locknut making sure the 'C' washer stays in position.

7.3.4. To Renew the pilot valve assembly and bellows seal:

1.Isolate the reducing valve and zero the pressure.

2. Release locknut (2) and turn adjustment screw (1) anticlockwise until spring is slack.

3. Slide out 'C' washer (3) from underneath locknut and remove cover (4).

4. Remove spring (6) and top spring plate (5).

5. Unscrew the four, 3/8" nuts and remove spring housing (8), bottom spring plate (7) and diaphragm (10).

6. Unscrew the union nut (18a) and the union nut (16a) or (15a) and release the 1/4" stainless steel pipework.

7. Unscrew the nuts (11) and remove the pilot valve block (30) making sure that the main valve spring (20) is still positioned correctly on top of the main valve head (21).

8. Unscrew pilot valve seat assembly (14) which includes the integral strainer screen (14a) by using a 1 1/16" A/F socket, and also remove plunger (13).

9. Unscrew bellows seal assembly (12) using a 1" A/F socket. If necessary this bellows seal assembly can be replaced.

10. With the bellows seal still removed screw in new pilot valve assembly (14) and tighten down to a torque of 85 Ft-Lbsf.

11. Insert plunger (13) in from the top and check that there is a gap of 0.03" between the top of the plunger and a straight edge placed across the diaphragm location recess. (Refer to Figure 7)

(**Note:** Because of production tolerances the plunger is supplied slightly longer than is always required and it will generally be necessary to grind or machine material off the top end to give the correct length. After machining make sure the sharp edges are removed from the top of the plunger as these could damage the bellows. The 0.03" gap (see point 11 above), ensure that with the bellows seal fitted there is just a slight gap between it and the diaphragm in its neutral position).

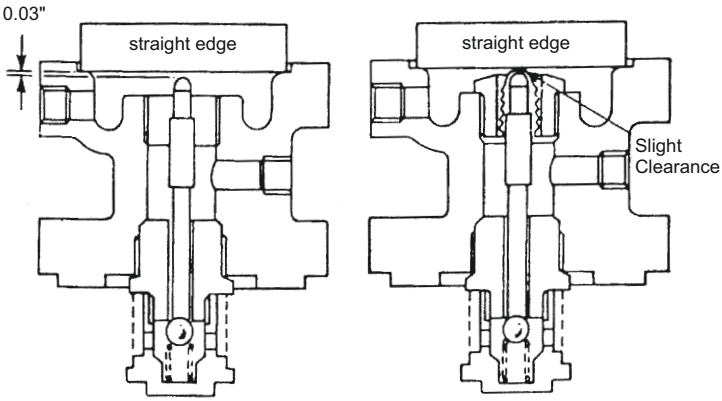


Figure 7 : Fitting the plunger

12. After locating bellows seal assembly carefully over the plunger tighten down to a torque of 85 Ft-lbsf.

13. Check with straight edge again that with the top of the bellows pressed lightly on to the top of the plunger, there still a slight clearance – a mere line of light between the straight edge and the top of the bellows (Refer figure 7).

14. Before reassembling valve make sure that the gasket faces on both the pilot valve block and the body are clean and that the main valve spring (20) is positioned correctly on top of the main valve head.

15. Fit new gasket (19) and screw the pilot valve block assembly on to the body with the nuts (11). Tighten the nuts to the torques shown in the table below.

16. Refit the 1/4" stainless steel pipework and retighten union nut (18a) and union nut (16a) or (15a) to ensure a steam tight seal.

Table 1:

Recommended tightening torques for Pilot Valve Block Securing Nuts item (11)		
Size of Valve	**Nut Size**	**Tightening Torque**
1/2", 3/4"	3/8"	30 Ft-Lbsf
1"	1/2"	44 Ft-Lbsf
1½", 2"	5/8"	81 Ft-Lbsf
3"	1/2"	59 Ft-Lbsf

17. Refit the two diaphragms (10) making sure that they are fitted the same way round as they were removed and that all contact surfaces are clean.

If necessary, two new diaphragms can be fitted.

18. Place the bottom spring plate (7) in position and secure the spring housing with the four 3/8" nuts (9) tightening to a torque of 37 Ft-lbsf.

19. Replace the spring (6) and top spring plate (5) turning the adjustment screw (1) until it just locates on the top spring plate. Replace cover (4) and 'C' washer (3).

20. Bring valve back in operation by following as many steps as are necessary in section 6.

7.3.5. To clean Pilot Valve Strainer Screen:

1. Isolate the reducing valve and zero the pressure.

2. Release locknut (2) and turn adjustment screw (1) anticlockwise until spring is slack.

3. Undo the union nut (18a) and the union nut (16a) or (15a) and release the 6mm stainless steel pipework.

4. Undo the nuts (11) and remove the pilot valve (30) complete with the spring housing assembly making sure that the main valve spring (20) is positioned correctly on top of the main valve head (21).

5. Holding the pilot valve block upside down, unscrew the screen retaining nut (14b) using a 1 1/16" A/F spanner.

6. Remove the screen (14a) for cleaning, taking care not to lose the small return spring (14d) and ball (14c) which can also be cleaned if necessary.

7. Refit ball, spring and screen and refit screen retaining nut (14b), tightening it to a torque of 11 Ft-lbs.

8. Make sure that the gasket faces on both the pilot valve block and the body are clean. Make sure that the main valve spring (20) is positioned correctly on top of the main valve head.

9. Fit new gasket (19) and secure the pilot valve block assembly onto the body with the nuts to the torque shown in Table 1.

10. Refit the 1/4" stainless steel pipework and retighten union nut (18a) and union nut (16a) or (15a) to ensure a steam tight seal.

11. Bring the valve back in to commission by following as many steps as are necessary in section 6.

7.3.6. To renew Pilot Valve Diaphragms:

1. Isolate the pressure reducing valve and zero the pressure.

2. Release the locknut (2) and turn adjustment screw (1) anticlockwise until spring is slack.

3. Slide 'C' washer (3) from underneath locknut and remove cover (4).

4. Remove spring (6) and top spring plate (5).

5. Undo the four, 3/8" nuts (9) and remove spring housing (8) bottom spring plate (7) and old diaphragms (10)

6. Refit two new diaphragms (10) making sure that all the contact faces are clean.

7. Place the bottom spring plate (7) in position and securing the housing with the four 3/8" nuts (9) tightening to a torque of 37 Ft-lbsf.

8. Replace the spring and top spring plate (5), turn the adjustment screw (1) until it just locates on the top spring plate. Replace cover (4) and 'C' washer (3)

9. Bring valve back in to commission by following as many steps as are necessary in section 6.

7.3.7. To renew the main Diaphragms:

1. Isolate the reducing valve and zero the pressure.

2. Undo long union nut (27) and pull it away.

3. Undo the 1/2" nuts and bolts (26) and drop away the lower diaphragm chamber (29), and two stainless steel diaphragms (28) and the main diaphragm plate and push rod assembly (24)

4. Thoroughly clean off the lower diaphragm chamber and make sure that the contact surfaces are clean.

5. Replace the main diaphragm plate and push rod assembly (24) and loosely refit lower diaphragm chamber (29) on the two bolts either side ofthe union connection, (see fig 8) so that the spigot is located in to the recess. Also ensure that the connecting stainless steel pipework is located in to its fitting.

6. Bring the two main diaphragms in position, first easing the diaphragm plate upwards to clear, (see fig 8.)

7. With the main diaphragms in position, push the lower diaphragm chamber home to locate in the recess and refit the 1/2" nuts and bolts (26). Tighten to a torque of 70 Ft-Lbsf.

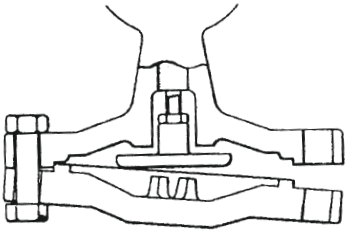


Figure 8 : Positioning the diaphragms

8. Re-tighten long union nut **(27)** to ensure a steam tight seal on the stainless steel pipework.

9. Bring back value in to commission by following as many steps as are necessary in section 6

7.3.8. To service or Renew the main valve and seat:

1. Isolate the reducing valve and zero the pressure.

2. Undo the union nut (18a) and union nut (16a) or (15a) and release the 6mm stainless steel pipework.

3. Undo the nuts (11) and remove the pilot valve block (30) complete with the spring housing assembly.

4. Remove the main valve spring (20) and the main valve head (21).

5. Remove the main seat (22)

Table 2 :

Recommended tightening torques for main valve seat item 22	
Size of Valve	**Tightening Torque**
1/2"	81/89 Ft-lbsf
3/4"	103/111 Ft-lbsf
1"	125/133 Ft-lbsf
1½"	221/229 Ft-lbsf
2"	295/302 Ft-lbsf
3"	443/516 Ft-lbsf

6. The seating faces of the main valve head and main seat may now be examined. If they are slightly worn, both the main valve head and main seat may be lapped on a flat plate using a fine grinding paste.

If either is badly worn or unfit for further use they will need to be replaced in pairs. Please check the code nos. given in “available spares' carefully.

7.Making sure that the thread and seating surface in the body are clean refit the seat and tighten to the torque as shown in Table 2.

8. Where a part has been fitted or where extensive lapping has taken place, it will be necessary to reset the main valve push-rod (23) to give the correct valve lift.

9. To do this it is necessary to expose the main diaphragm plate and push rod assembly (23) by following steps 1,2 and 3 in section 7.3.7

10. Refit the push rod assembly (23) and replace main valve head (21) making sure that it is located onto main seat.

11. The main valve can now be opened by pushing on the plate (24) until it comes up against the stop on the body. See fig 9. Check the valve lift by using a depth gauge as shown in Table 3.

12. If the lift is different from that shown in the table 3 slacken the locknut (25) and adjust the lift by screwing the push rod (23) in or out of the main diaphragm plate (24). When the lift is correct retighten locknut (25)

Table 3: Size of Valve lift.

Size of Valve	Lift
1/2"	0.07"
3/4"	0.09"
1"	0.11"
1½"	0.17"
2"	0.19"
3"	0.30"

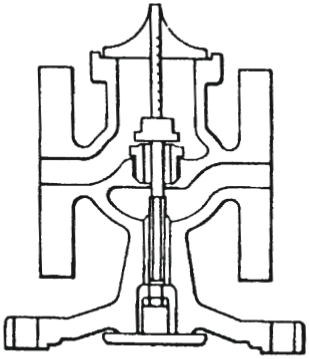


Figure 9 : Main valve seat service

13. Replace lower end of the valve by following steps 4 to 8 in section 7.3.7

14. Make sure that the gasket faces on both the pilot valve block and body are clean. Refit the main valve head (21) and replace the main valve spring (20) correctly on top of the main valve head.

15. Fit new gasket (19) and the pilot valve block assembly (30) onto the body with the nuts (11). Tighten these nuts to the recommended torques (Ref. Table 1).

16. Refit the 1/4" stainless steel pipework and re-tighten union nut (18a) and union nut (16a) or (15a) to ensure a steam tight seal.

8. Troubleshooting:

Before undertaking the following fault finding procedure, ensure the valve has been isolatedand that upstream and downstream pressures are zero. Possible fault checks are given in alogical order below.

A PRV typically has the following failure modes:

1) Downstream pressure zero or too low:

If downstream pressure of Pressure reducing valve is zero, please check following before dismantling the Pressure reducing valve.

1. Downstream pressure gauge: - Please ensure that it should be in working condition.

2. Upstream pressure: - It should be as per the PRV upstream design pressure.

3. Isolation valve not fully Open - Ensure Upstream & Downstream Isolation valves are in full open condition

4. Upstream Strainer Clogged – Ensure upstream Strainer is in clean condition: Clean it, if it is found as clogged.

Failure Mode	Possible Cause	Remedy
Downstream pressure zero or too low	Pressure adjustment bolt	Please ensure that pressure adjustment bolt is not in loose condition. If so, rotate it clockwise slowly to set the desired downstream pressure.
	Clogging in PRV	Ensure Pilot valve strainer, Control pipe assembly & SS hex coupling fixed to bottom diaphragm chamber are clean. If found clogged clean it properly. Check the internal balancing line for blockage.
	Main Diaphragms	If main diaphragms are permanently deformed or punctured - replace the same.
	Jamming of push rod	Please check if Push rod is jammed in liner bush at lower position. Open & clean it.
	Main valve lift disturbed:	Check that pushrod lock nut is intact & it is in full tightened condition. If it is loose there is a chance that the main valve lift may be reduced. To re adjust the main valve lift, Please refer the main valve lift setting video clip.

2) Downstream pressure is equal to upstream pressure:

If downstream pressure of Pressure reducing valve is equal to upstream pressure, please check following before dismantling the Pressure reducing valve.

1. By Pass isolation valve: - Please ensure that it should not be leaking & should be in full closed condition.

2. Feedback line: - Isolation valve installed in the feedback line should be fully open and the line should not be clogged, clean it if necessary.

Failure Mode	Possible Cause	Remedy
Downstream pressure is equal to upstream pressure	Pressure adjustment bolt	**1.** Please ensure that pressure adjustment bolt is not in full tight condition. Release it fully, ensure that the downstream pressure is zero and re adjust the required downstream pressure by slowly rotating it clockwise. **2.** If downstream pressure does not respond to the adjustment bolt rotation, check the pilot valve or main valve leakage by following the next step. **A)** Close the upstream isolation valve. **B)** Loosen the pressure adjustment bolt and make the downstream pressure zero. **C)** Remove the SS tubing from Pilot valve chamber & center T Joints. **D)** Open the upstream isolation valve slowly & check for steam leakage **E)** If steam coming from Pilot valve chamber - it means Pilot valve is leaking. **F)** Clean the Pilot valve or replace it, if required. **G)** If steam coming from “T” joint - It means either Main valve is leaking or Main valve return Spring is broken - Clean & lap the main valve head or replace the MV return spring if found broken. If the problem still persists then follow the next step.
	Check the control orifice	Clean it, if found clogged.
	Check pilot diaphragm	Replace, if found deformed or damaged.
	Pushrod locknut	Check that pushrod lock nut is intact & it is in full tightened condition. If it is loose there is a chance that the main valve lift may be disturbed. To re adjust the main valve lift.

3) Hunting:

Hunting or Pressure Fluctuations may coincide with variations in steam load. In such case, check following before dismantling the pressure reducing valve.

1. WET Steam- Ensure steam is not wet and Moisture separator is installed before the PRV & the steam trap below it, is operational.

2. Up Stream Pressure – It is recommended to have stable upstream pressure. However the Pressure Reducing valve will give constant downstream pressure with + or - 20% variation in designed Upstream pressure.

3. Partial Blockage in Upstream - If the pressure drops during full-load conditions, it is possible that there is a partial blockage in the upstream line or that the upstream pipe work is undersized. Steam Line should be sized properly to carry the required steam flow rate at given pressure considering steam velocity of 82 ft/s. Please refer steam line sizing chart for correct steam line size.

4. Isolation valves - Ensure Upstream & Downstream Isolation valves are in full open condition. By pass valve should be in full closed condition and it should not be leaking.

5. Upstream Strainer Clogged – Ensure upstream Strainer is in clean condition: Clean it, if it is found as clogged.

6. Bypass valve – Check whether the bypass valve is leaking. Replace, if found so.

Failure Mode	Possible Cause	Remedy
Hunting	Sticking of push rod in the Main Valve Chamber	Check that the Main valve pushrod is not sticking. Open & clean it. Also check whether the push rod outer surface is not deformed. Replace the push rod, if it is found deformed.
	Diaphragms Over Stretched / permanently deformed	If Pilot diaphragms or main diaphragms overstretched or deformed -replace the same.
	PRV sizing.	Set the PRV in no flow condition i.e. all process valves are closed. Now Apply full- load to the PRV by opening all the process valves. If the downstream pressure drops excessively during full-load condition but it is maintaining by opening of by-pass valve, it is likely that the valve is undersized; in which case it should be replaced. Please refer the PRV sizing chart given in Technical information sheet to know the correct PRV size. Consult Forbes Marshall for correct sizing of the valve.
	Check Split pin (NRV) port	Check the port is clean and the split pin is free to move

9. Available Spares:

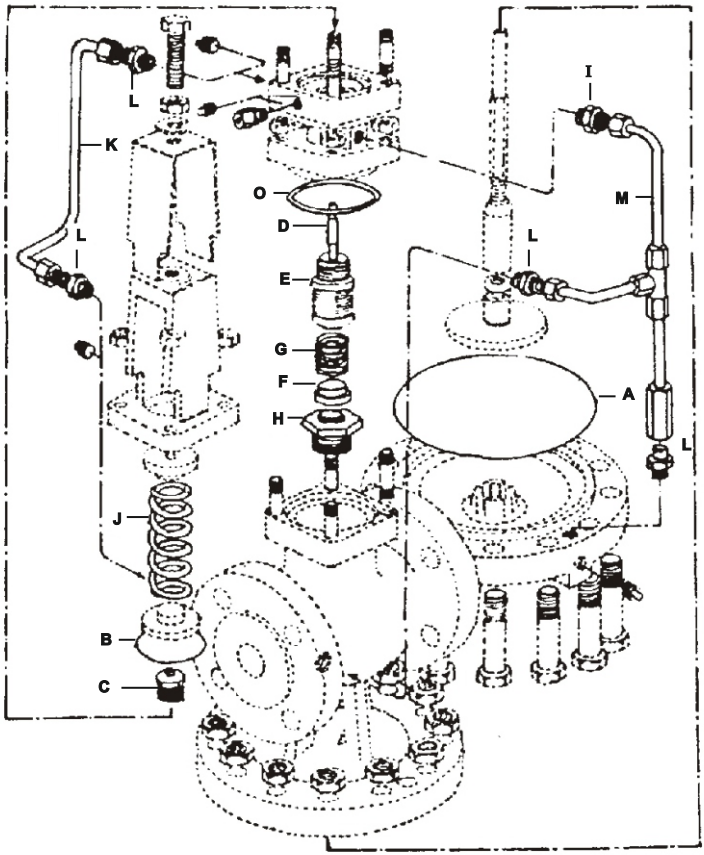


Figure 10 : Spares

Description	Symbol	Code No.
Main Diaphragm 1/2", 3/4" (pack of 10)	A	S2038855
Main Diaphragm 1" (pack of 10)	A	S2038856
Main Diaphragm 1½", 2" (pack of 10)	A	S2038857
Main Diaphragm 3" (pack of 5)	A	S2039067
Main Valve Assly 1/2"	O, G, F, H	S2038864
Main Valve Assly 3/4"	O, G, F, H	S2038865
Main Valve Assly 1"	O, G, F, H	S2038866
Main Valve Assly 1½"	O, G, F, H	S2038867
Main Valve Assly 2"	O, G, F, H	S2038868
Main Valve Assly 3"	O, G, F, H	S2039064
Pressure Adj Spring (232" to 248 Psig) For all sizes	J	S2038821
Pressure Adj Spring (3 to 247 Psig) For all sizes	J	S2038822
Control Pipe Assly 1/2"	K,L	S2038889
Control Pipe Assly 3/4"	K,L	S2038890
Control Pipe Assly 1"	K,L	S2038891
Control Pipe Assly 1½"	K,L	S2038892
Control Pipe Assly 2"	K,L	S2038893

Description	Symbol	Code No.
Control Pipe Assly 3"	K,L	S2039065
Balance Pipe Assly 1/2"	M,L	S2038894
Balance Pipe Assly 3/4"	M,L	S2038895
Balance Pipe Assly 1"	M,L	S2038896
Balance Pipe Assly 1½"	M,L	S2038897
Balance Pipe Assly 2"	M,L	S2038898
Balance Pipe Assly 3"	M,L	S2039065
Body Gasket 1/2", 3/4" (pack of 10)	O	S2038855
Body Gasket 1" (pack of 10)	O	S2038856
Body Gasket 1½", 2" NB(pack of 10)	O	S2038857
Body Gasket 3" (pack of 5)	O	S2039067
Pilot Diaphragm kit for all sizes	B	S2019680
Pilot Valve & Plunger kit for all sizes	D,E	S2038862
Pilot seal Assembly kit for all sizes	C	S2019704
Spring Hsg with stud and nut kit 1/2", 3"	-	S2031934
Main valve Return Spring Kit 1/2", 3/4"	O,G	S2038823
Main valve Return Spring Kit 1"	O,G	S2038824
Main valve Return Spring Kit 1½, 2"	O,G	S2038825
Main valve Return Spring Kit 3"	O,G	S2038826
Push Rod Assembly Spare Kit 1/2"	I	S2055940
Push Rod Assembly Spare Kit 1/2"	I	S2055941
Push Rod Assembly Spare Kit 1/2"	I	S2055942

How to Order:

Example :

3/4" Forbes Marshall Pilot Operated Pressure Reducing Valve, FMPRV53, for steam, flanged to BS 10 table 'K'

or

1½" Forbes Marshall Pilot Operated Pressure Reducing Valve, FMPRV53, for air, flanged to ASA 300.

10 Warranty Period:

As per the ordering information and agreement in the contract.

Doc# Intops/0316/UM-FMPRV53/V3.R0

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www.forbesmarshall.com

Forbes Marshall Arca
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Forbes Marshall Steam Systems

A: **Forbes Marshall Pvt. Ltd.**
Opp. 106th Milestone, CTS 2220,
Mumbai-Pune Road, Kasarwadi,
Pune MH 411034 INDIA

P: +91(0)20-68138555

F: +91(0)20-68138402

E: ccmidc@forbesmarshall.com

Forbes Marshall International Pte. Ltd.
16A, Tuas Avenue 1,
#05-21, JTC Space @Tuas
Singapore - 639533

P: +65 6219 3890

CIN No: U28996PN1985PTC037806