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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.
Preface:
This manual is intended for anyone using, commissioning, servicing, or disposing the below mentioned products safely and efficiently.

Clean Steam Pressure Reducing Valve [CSPRV]:
Size: DN 15 (½”), DN 20 (¾”), DN 25 (1”), DN 40 (1½”) and DN 50 (2”)

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.

This symbol denotes CAUTION, WARNING or DANGER

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. Furthermore, 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
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 Product Disposal:
It is necessary to dispose this product only in accordance with local regulations at the authorized, qualified collecting point specified for equipment's and its parts—Please refer the part details mentioned in the material table of this manual. Please follow all waste disposal guidelines (Management & Handling) as published by local governing authorities in India & abroad

2.11. Safety information - Product specific:
Provision must be made to protect products which are not self-draining against frost damage if they are inoperative in environments where they may be exposed to temperatures below freezing point. This product should not be dismantled without first releasing the compression on the control spring. This valve contains an Viton component. If the valve has been subjected to a temperature approaching 315 C (599 F), the Viton material may have decomposed and formed hydrofluoric acid. Avoid skin contact and inhalation of any dust or fumes as this acid causes deep burns and damage to the respiratory system. This valve contains a PTFE component. If PTFE is heated to its sintering temperature it gives rise to gaseous decomposition products or fumes which can produce unpleasant effects if inhaled. Smoking should therefore be prohibited in workshops where PTFE is handled and care should be taken to avoid personal contamination with PTFE particles. To enhance diaphragm life following care should be taken
1. Diaphragm water reservoir to be filled before startup.
2. Never insulate the diaphragm adaptor

2.12 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 Clean Steam Pressure Reducing Valve, CSPRV, is an angle pattern self-draining sanitary pressure regulating valve of all 316 type stainless steel construction suitable for use on steam, water and gases. This has been designed in accordance with ASME BPE guidelines. It is available with hygienic sanitary clamp compatible connections to ISO 2852 & ASME BPE, requires no external pressure sensing line and has clean-in-place (CIP) and sterilize-in-place (SIP) capacity.

3.2 **Typical Applications Include:**

Clean steam, gas and liquid supplies to bioreactors, centrifuges, freeze dryers, sterilizers, autoclaves, process tank, humidifiers and culinary equipment.

3.3 **Valve Tightness:**

Valve tightness in accordance with VDI / VDE guidelines 2174 (leakage rate <0.05 of Kvs Value)

3.4 **Surface Finish:**

Internal wetted parts-Ra<0.5 µm electro-polished

3.5 **Features:**

- Self-draining and crevice free design
- Non-fluted stem, guided in non-wetted region
- FDA approved PTFE bonded viton diaphragm
- Mechanical stopper to prevent over stroking
- Duel clamp design, easy to dismantle for cleaning
- Oil and grease free wetted components

3.6 **Certification:**

This product is available with following certification

- EN10204 material certifications
- Internal surface finish
- FDA certificate for diaphragm

3.7 **Sizes and End Connections:**

DN15, 20, 25, 40 and 50

ISO 2852 & ASME BPE sanitary clamp compatible
**Figure 1: Clean Steam Pressure Reducing Valve.**

**Materials:**

<table>
<thead>
<tr>
<th>No.</th>
<th>Part</th>
<th>Material</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Body</td>
<td>Stainless Steel</td>
<td>ASTM A 276 SS 316L</td>
</tr>
<tr>
<td>2</td>
<td>Stem</td>
<td>Stainless Steel</td>
<td>ASTM A 276 SS 316L</td>
</tr>
<tr>
<td>3</td>
<td>Guide Bush</td>
<td>Stainless Steel</td>
<td>PTFE Coating</td>
</tr>
<tr>
<td>4</td>
<td>Adaptor</td>
<td>Stainless Steel</td>
<td>ASTM A 276 SS 316L</td>
</tr>
<tr>
<td>5</td>
<td>Step Bush</td>
<td>Stainless Steel</td>
<td>ASTM A 276 SS 316L</td>
</tr>
<tr>
<td>6</td>
<td>Upper Disc</td>
<td>Stainless Steel</td>
<td>ASTM A 276 SS 316L</td>
</tr>
<tr>
<td>7</td>
<td>Lower Disc</td>
<td>Stainless Steel</td>
<td>ASTM A 276 SS 316L</td>
</tr>
<tr>
<td>8</td>
<td>Diaphragm</td>
<td>Viton + PTFE</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Diaphragm Gasket</td>
<td>PTFE</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Spring Housing</td>
<td>Stainless Steel</td>
<td>ASTM A 351 CF8M</td>
</tr>
<tr>
<td>11</td>
<td>Spring</td>
<td>AISI 304</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Spring Nut</td>
<td>Stainless Steel</td>
<td>ASTM A 276 SS 304</td>
</tr>
<tr>
<td>13</td>
<td>Disc washer</td>
<td>PTFE</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Gasket</td>
<td>PTFE</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Sanitary Clamp</td>
<td>Stainless Steel</td>
<td>SS 316</td>
</tr>
<tr>
<td>16</td>
<td>Spring Clip</td>
<td>AISI 304</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Allen Screw</td>
<td>Stainless Steel</td>
<td>BS 6105 A4 70</td>
</tr>
<tr>
<td>18</td>
<td>Washer</td>
<td>Stainless Steel</td>
<td>304</td>
</tr>
<tr>
<td>19</td>
<td>Nut</td>
<td>Stainless Steel</td>
<td>304</td>
</tr>
<tr>
<td>20</td>
<td>Stem Seal</td>
<td>PTFE</td>
<td></td>
</tr>
</tbody>
</table>
3.8 Limiting Conditions:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inlet:</strong></td>
<td>PN10</td>
</tr>
<tr>
<td><strong>Outlet:</strong></td>
<td>see “pressure setting range” below</td>
</tr>
<tr>
<td><strong>Maximum design pressure</strong></td>
<td>10 bar g @ 50 °C</td>
</tr>
<tr>
<td><strong>Maximum design temperature</strong></td>
<td>250 °C</td>
</tr>
<tr>
<td><strong>Minimum design temperature</strong></td>
<td>-10 °C</td>
</tr>
<tr>
<td><strong>Maximum operating temperature</strong></td>
<td>180 °C</td>
</tr>
<tr>
<td><strong>Maximum operating pressure</strong></td>
<td>(DN 15-25) 7.6 bar g</td>
</tr>
<tr>
<td></td>
<td>(DN 40-50) 6 bar g</td>
</tr>
<tr>
<td><strong>Minimum operating temperature</strong></td>
<td>-10 °C</td>
</tr>
<tr>
<td><strong>Max. cold hydraulic test pressure</strong></td>
<td>15 bar g</td>
</tr>
</tbody>
</table>

3.9 Pressure Setting Range:

<table>
<thead>
<tr>
<th>Size</th>
<th>DN 15-50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inlet / Outlet rating</td>
<td>PN10</td>
</tr>
<tr>
<td><strong>Spring range</strong></td>
<td>0.8-2.5 bar g</td>
</tr>
</tbody>
</table>

Maximum permitted outlet pressure = 1.5 times set pressure

3.10 Kv Values:

<table>
<thead>
<tr>
<th>Valve Size (mm)</th>
<th>DN15</th>
<th>DN20</th>
<th>DN25</th>
<th>DN40</th>
<th>DN50</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maximum Kv</strong></td>
<td>2.4</td>
<td>3.9</td>
<td>4.9</td>
<td>6.4</td>
<td>7.8</td>
</tr>
</tbody>
</table>

For conversion,

Cv (UK) = Kv × 0.93

Cv (US) = Kv × 1.156

The required Kv can be calculated from the following formulae,

where,

\[
ms = \text{Steam mass flow (kg/h)}
\]

\[
V = \text{Liquid Volume flow (m}^3\text{/h)}
\]

\[
V_g = \text{Gas flow at standard conditions : 0°C @ 1.013 bar a (m}^3\text{/h)}
\]

\[
X = \frac{P_1 - P_2}{P_1} \quad \text{(pressure drop factor)}
\]

\[
P_1 = \text{Upstream pressure (bar absolute)}
\]

\[
P_2 = \text{Downstream pressure (bar absolute)}
\]

S = Specific gravity

T = Absolute average gas temperature (Kelvin = °C + 273)
Steam critical pressure drop $P_2 \leq 0.58 P_1$

$$K_v = \frac{\dot{m}s}{12 P_1}$$

Non-critical pressure drop $P_2 \geq 0.58 P_1$

$$K_v = \frac{\dot{m}s}{\frac{12 P_1}{\sqrt{1-5.67(0.42-x)}}}$$

Gas

$$K_v = \frac{V_g \sqrt{ST}}{287 \sqrt{(P_1-P_2)(P_1+P_2)}}$$

Liquid

$$K_v = \frac{V \sqrt{S}}{P_1-P_2}$$

Calculating the $K_v$ and selecting a suitable valve:
Using your maximum flowrate and smallest differential pressure $(P_1-P_2)$, calculate the required $K_v$ from one of the above formulae. **Max $K_v = 1.3 \times$ calculated $K_v** (now refer the above table of $M_x$ $K_v$ for size selection.)

**Recommended Fluid Velocities:**

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Saturated</th>
<th>10 to 40 m/s</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Superheated</td>
<td>15 to 60 m/s</td>
</tr>
<tr>
<td>Gas</td>
<td>Up to 2 bar g</td>
<td>2 to 10 m/s</td>
</tr>
<tr>
<td></td>
<td>above 2 bar g</td>
<td>5 to 40 m/s</td>
</tr>
<tr>
<td>Liquids</td>
<td></td>
<td>1 to 5 m/s</td>
</tr>
</tbody>
</table>

**3.11 Operating Range:**

![Steam saturation curve](image)

- The product must not be used in this region

<table>
<thead>
<tr>
<th>Temperature °C</th>
<th>Pressure bar g</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>10</td>
</tr>
<tr>
<td>200</td>
<td>8</td>
</tr>
<tr>
<td>150</td>
<td>6</td>
</tr>
<tr>
<td>100</td>
<td>4</td>
</tr>
<tr>
<td>50</td>
<td>2</td>
</tr>
</tbody>
</table>

Note: For hygienic / sanitary clamp ends the maximum pressure / temperature may be restricted by the gasket or sanitary clamp used. Please consult Forbes Marshall.

* Max operating pressure 7.6 bar (g)
3.12 Product Dimension and Drawing:

Figure 2: Dimensional Drawing CSPRV

Dimensions (approx) in mm:

<table>
<thead>
<tr>
<th>Size (DN)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>øE1</th>
<th>øE2</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>83.5</td>
<td>105</td>
<td>324</td>
<td>118</td>
<td>25</td>
<td>25</td>
<td>2.5 Kg</td>
</tr>
<tr>
<td>20</td>
<td>70</td>
<td>55</td>
<td>273</td>
<td>118</td>
<td>34</td>
<td>25</td>
<td>3.8 Kg</td>
</tr>
<tr>
<td>25</td>
<td>80</td>
<td>55</td>
<td>273</td>
<td>118</td>
<td>50.5</td>
<td>50</td>
<td>4 Kg</td>
</tr>
<tr>
<td>40</td>
<td>80</td>
<td>65</td>
<td>289</td>
<td>118</td>
<td>50.5</td>
<td>50</td>
<td>4.3 Kg</td>
</tr>
<tr>
<td>50</td>
<td>80</td>
<td>75</td>
<td>305</td>
<td>118</td>
<td>64</td>
<td>63.5</td>
<td>5 Kg</td>
</tr>
</tbody>
</table>
4. **Product Working Principle:**

As steam or other operating fluid passes through the valve the pressure on the downstream side of the valve increases and acts directly on the diaphragm. Pressure acting on the area of the diaphragm transmits a force which acts against that of the control spring. When the downstream pressure exceeds the set pressure the force acting through the diaphragm will overcome the force of the control spring and the valve will shut. Conversely, if the downstream pressure is too low then the control spring will exert sufficient force to open the valve.

**Valve seat leakage:**

These direct acting PRVs are not desired to provide a leak proof seal. Factory set valves are perfectly leak proof at valve seat as per VDI/VDE guideline 2174. However during actual operation the solid particles may cause damage and seat leakage.
5. **Installation Guidelines:**

Before installing the valve thoroughly flush the pipeline. Ideally the valve should be installed in a pressure reducing valve station, see Figure 3, at the very minimum there should be a separator and strainer fitted upstream. The CSPRV should always be fitted with the inlet vertical and the spring housing directly above the valve. Most applications will require a safety valve to be installed downstream in case of accidental overpressure. It should be noted that **the valve should not be used as a shut-off valve**, a separate valve should therefore be used for isolation purposes if required. If it is possible for equipment downstream of the valve to be shut off then a further trap set should be installed to prevent downstream flooding.

![Diagram of installation guidelines](image)

**Fig. 3 Typical installation**

For typical applications like autoclaves, it is recommended that the pneumatic on-off valve should be installed on upstream side of CSPRV to avoid pressure shocks acting on the diaphragm this will help to enhance the diaphragm life( see figure 4)

![Diagram of preferred installation for autoclaves](image)

**Fig. 4 Recommended installation for ON-OFF applications like autoclaves**
6. **Start-up and Commissioning:**

1. First make sure that all stop valves are closed.

2. Check that the control spring is not compressed, wind the adjuster screw anticlockwise if necessary.

3. Open the stop valves in the following order:
   i) Open the stop valves immediately in front of the steam traps.
   ii) Open the downstream stop valve.
   iii) Very gently open the upstream valve on the inlet supply line to avoid any sudden mechanical or thermal shock.

4. Slowly turn the adjuster screw clockwise until the desired downstream pressure is achieved. If the valve is set under no load conditions then there will be a proportional offset causing the controlled pressure to drop by about 20% under flowing conditions. If the valve is set under normal flowing conditions then there will be a pressure rise of about 20% due to the proportional offset of the valve as the load reduces to zero. It is important that any downstream safety valve is set such that the no load set pressure of the CSPRV is below the safety valve reseat pressure.
7. Maintenance Guidelines:

7.1. General inspection:

While a program of planned maintenance is always recommended, the Forbes Marshall CSPRV will give long and trouble free service if correctly selected, and kept reasonably free of dirt and foreign matter. Dirt and foreign matter are most likely to collect during installation and later trouble can be avoided by inspecting the installation after a few days.

Check the following:

1. Clean all pipeline filters or strainers (remove elements or screens to clean).
2. Clean all joints for leakage.

7.2. Inspecting/replacing diaphragm and valve assembly:

Before attempting any maintenance operation read the product specific safety information in section 2.10.

1. Isolate the valve, first closing the upstream isolating valve and then the downstream isolating valve. Check that the pressure is zero and allow the valve to cool.
2. Release the compression on the control spring by turning the adjustment screw anticlockwise.
3. Remove the CSPRV from the pipeline.
4. Lift off the spring housing and the control spring by first releasing the upper sanitary clamp wing nut and then removing the clamp.
5. Grip the flats visible on the stem end and undo the lock-nut clamping the diaphragm, remove nut, washer, diaphragm plates & step bush. Release the lower sanitary clamp & remove the adaptor (note that when refitting the diaphragm plates the side with the radius should rested on the diaphragm face.
6. The diaphragm and diaphragm plates can then be removed from the main valve which should be carefully lowered and removed via the valve inlet.
7. Reassemble in reverse order ensuring the PTFE(light color) side of the diaphragm is on the wetted side (Steam side).
8. Available Spares Parts:

The spare part available is detailed below. No other parts are supplied as spares.

<table>
<thead>
<tr>
<th>SPARE CONSIST OF</th>
<th>SPARE SPECIFICATION</th>
<th>SPARE CODE</th>
</tr>
</thead>
<tbody>
<tr>
<td>VALVE STEM PACK OF 1 NO</td>
<td>15NB</td>
<td>SPARE-15CSPRV-STKIT</td>
</tr>
<tr>
<td>VALVE STEM PACK OF 1 NO</td>
<td>20NB</td>
<td>SPARE-20CSPRV-STKIT</td>
</tr>
<tr>
<td>VALVE STEM PACK OF 1 NO</td>
<td>25NB</td>
<td>SPARE-25CSPRV-STKIT</td>
</tr>
<tr>
<td>VALVE STEM PACK OF 1 NO</td>
<td>40NB</td>
<td>SPARE-40CSPRV-STKIT</td>
</tr>
<tr>
<td>VALVE STEM PACK OF 1 NO</td>
<td>50NB</td>
<td>SPARE-50CSPRV-STKIT</td>
</tr>
<tr>
<td>DIAPHRAGM, DIAPHRAGM GASKET, STEM SEAL 1 NO</td>
<td>15-50NB</td>
<td>SPARE-1550CSPRV-DKIT</td>
</tr>
<tr>
<td>SPRING 1 TO 5 BAR G PACK OF 1</td>
<td>15-50NB</td>
<td>SPARE-1550CSPRV-1T5SPKIT</td>
</tr>
<tr>
<td>SPRING 0.8 TO 2.5 BAR G PACK OF 1</td>
<td>15-50NB</td>
<td>SPARE-1550CSPRV-0.8T2.5SPKIT</td>
</tr>
<tr>
<td>PRESSURE ADJUSTMENT BOLT PACK OF 1</td>
<td>15-50NB</td>
<td>SPARE-1550CSPRV-BKIT</td>
</tr>
</tbody>
</table>

How to order spares:

Always order spares by using the description given in the column headed 'Available spares' and state the size, model and pressure range.

Example: 1 nos -Diaphragm for a DN25 CSPRV direct acting clean steam pressure reducing valve have a pressure range of 0.8 - 2.5 bar g, PN10 rating an FPM diaphragm

9. Warranty Period:

As per the ordering information and agreement in the contract.
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