Oil and Petrochemical Industry

Comprehensive Products and Solutions in Utility and Process Control Management
Forbes Marshall is a leader in energy conservation and efficiency improvement for the oil and petrochemical industry. Our unique complementary expertise enables us to engineer customised systems that combine our comprehensive range of services, products and solutions for utilities and process companies. Our extensive and global presence make us a trusted partner.

### Our Work in the Oil and Petrochemical Industry

<table>
<thead>
<tr>
<th>Supply of Products in New Refineries</th>
<th>Trap Population (%) in Indian Refineries</th>
</tr>
</thead>
<tbody>
<tr>
<td>75,000+</td>
<td>80%+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Installed Base of Traps in The World’s Single Largest Refinery</th>
<th>Large Size Strainer with Special Material of Construction</th>
</tr>
</thead>
<tbody>
<tr>
<td>60,000+</td>
<td>72&quot;</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of Steam Traps Audited in Refineries</th>
<th>Steam Trap Dynamic Analysis and Optimisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,200,000+</td>
<td>1,00,000+ traps</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Condensate Savings Achieved Through Condensate Recovery System</th>
<th>Steam Savings Achieved Through Steam Trap Analysis and Optimisation</th>
</tr>
</thead>
<tbody>
<tr>
<td>250+ Million Tons</td>
<td>1,150,000+</td>
</tr>
</tbody>
</table>

Everyday vast quantities of oil and gas are refined and transported across the globe. When the stakes are high, any amount of unaccounted hydrocarbon or poor quality hits the bottom line. With our expertise in steam generation, distribution, trapping and flash condensate recovery, we help the oil and petrochemical industry identify and reduce losses and improve profit margins.

Our innovative products save steam and recover condensate at the maximum which results in less fuel being burnt. This reduces the carbon footprint while enhancing the life of the plant and helps maintain higher efficiency levels.

This dossier gives a brief overview of our work in the Industry, savings achieved so far and further potential.
The oil and petrochemical industry backed by seven decades of experience building steam engineering and control.

We develop and deliver systems that improve manufacturing processes and conserve energy, and are environmentally sustainable. We offer our customers a comprehensive range of valve and control solutions across a variety of industries. Our knowledge, innovative solutions, reliable products, and support team are all backed by seven decades of experience.

### Product Installed Base

<table>
<thead>
<tr>
<th></th>
<th>Oil &amp; Gas Fired Boilers</th>
<th>Steam Traps</th>
<th>Piston Valves</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3000</td>
<td>3 Million+</td>
<td>400,000+</td>
</tr>
<tr>
<td>Bio, Waste, and</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial Waste</td>
<td>500</td>
<td>80,000+</td>
<td>130,000+</td>
</tr>
<tr>
<td>Energy Plants</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pressure Reducing</td>
<td>35,000</td>
<td>10,500+</td>
<td>1500+</td>
</tr>
<tr>
<td>Systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Condensate Pumps</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Steam Operated)</td>
<td>10,500+</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Steam and Water</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analysis Systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boiler Monitoring</td>
<td>2,500+</td>
<td>4000+</td>
<td>3,500+</td>
</tr>
<tr>
<td>Systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dust and Gas Monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vibration Monitoring</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systems</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Areas of Expertise

We provide a vast range of products, systems, packages and services primarily in the following three areas:

<table>
<thead>
<tr>
<th>Energy Conservation</th>
<th>Utility Management</th>
<th>Process Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam systems</td>
<td>Air efficiency solutions</td>
<td>Metering solutions for the petroleum industry</td>
</tr>
<tr>
<td>Energy services</td>
<td>Remote online pollution monitoring</td>
<td>Mechanical valves</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Control valves and stations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Machine condition monitoring systems</td>
</tr>
</tbody>
</table>
Energy Conservation

Steam Systems

- Knowledge, service and products for the efficient use of steam
- Steam distribution and metering
- Steam trapping solutions
- Condensate and flash steam recovery
- Boiler blow down controls
- Pressure reduction and temperature control
- Debottlenecking of distribution
- Debottlenecking of steam tracing systems

Steam Savings (%) in Different Industries

Source: Performance certificates from customers

Steam Savings in MT v/s Co₂ Reduction in MT

Forbes Marshall's Presence in Encon Initiatives

<table>
<thead>
<tr>
<th>Activity</th>
<th>Number of Refineries</th>
<th>Trap population</th>
<th>Uptime</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audits of steam traps system</td>
<td>18 out of 21 in India</td>
<td>2,20,000</td>
<td></td>
</tr>
<tr>
<td>Steam trap system management</td>
<td>18 out of 21 in India</td>
<td>1,10,000</td>
<td>Uptime &gt; 95%</td>
</tr>
<tr>
<td>Condensate and flash steam recovery</td>
<td>11 out of 21 in India</td>
<td>60,000</td>
<td></td>
</tr>
</tbody>
</table>
Performance Certificates from Customers

Indian Oil Corporation Limited
Vadodara Refinery

Order Value
₹ 2.38 Cr

Initial Traps Working
66%

Final Traps Working
95%

No. of Steam Traps
20000

Steam Savings
15 TPH

Indian Oil Corporation Limited
Guwahati Refinery

Order Value
₹ 65.39 L

Initial Traps Working
62%

Final Traps Working
98%

No. of Steam Traps
2500

Steam Savings
2.9 TPH
Completion Certificate

Indian Oil Corporation Limited
Digboi Refinery

Order Value
₹ 98.26 L

Initial Traps Working
69%

Final Traps Working
99%

No. of Steam Traps
3300

Steam Savings
3.68 TPH

Completion Certificate

Numaligarh Refinery Limited
Assam Refinery

Order Value
₹ 21.59 L

Initial Traps Working
49%

Final Traps Working
98%

No. of Steam Traps
4100

Steam Savings
8.4 TPH
<table>
<thead>
<tr>
<th>Sr No</th>
<th>Refineries</th>
<th>Capacity</th>
<th>Steam traps</th>
<th>Steam savings Achieved (TPH)</th>
<th>Initial Trap % Working Status</th>
<th>Final Trap % Working Status</th>
<th>Contract Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>IOCL, Vadodara</td>
<td>13.7 MMTPA</td>
<td>20000</td>
<td>15</td>
<td>66</td>
<td>95</td>
<td>2 year</td>
</tr>
<tr>
<td>2</td>
<td>IOCL, Panipat</td>
<td>15 MMTPA</td>
<td>3600</td>
<td>5.19</td>
<td>37</td>
<td>81</td>
<td>1 year</td>
</tr>
<tr>
<td>3</td>
<td>IOCL, Guwahati</td>
<td>1 MMTPA</td>
<td>2500</td>
<td>2.9</td>
<td>62</td>
<td>98</td>
<td>2 year</td>
</tr>
<tr>
<td>4</td>
<td>IOCL, Digboi 1st Contract</td>
<td>0.65 MMTPA</td>
<td>3300</td>
<td>3.68</td>
<td>69</td>
<td>99</td>
<td>6 months</td>
</tr>
<tr>
<td>5</td>
<td>IOCL, Digboi 2nd Contract</td>
<td>0.65 MMTPA</td>
<td>3300</td>
<td>5.07</td>
<td>69</td>
<td>99</td>
<td>2 year</td>
</tr>
<tr>
<td>6</td>
<td>IOCL, BGR 1st Contract</td>
<td>2.3 MMTPA</td>
<td>4400</td>
<td>3.30</td>
<td>70</td>
<td>99</td>
<td>18 months</td>
</tr>
<tr>
<td>7</td>
<td>IOCL, BGR 2nd Contract</td>
<td>2.3 MMTPA</td>
<td>5500</td>
<td>5.70</td>
<td>80</td>
<td>99</td>
<td>21 months</td>
</tr>
<tr>
<td>8</td>
<td>IOCL, BGR 3rd Contract</td>
<td>2.3 MMTPA</td>
<td>5700</td>
<td>2.10</td>
<td>81</td>
<td>97</td>
<td>18 months</td>
</tr>
<tr>
<td>9</td>
<td>HPCL Mumbai</td>
<td>6.5 MMTPA</td>
<td>1500</td>
<td>2.99</td>
<td>55</td>
<td>98</td>
<td>1 year</td>
</tr>
<tr>
<td>10</td>
<td>HPCL, Vizag</td>
<td>8.3 MMTPA</td>
<td>6000</td>
<td>2.33</td>
<td>64</td>
<td>98</td>
<td>1 year</td>
</tr>
<tr>
<td>11</td>
<td>BPCL, Mumbai 1st Contract</td>
<td>12 MMTPA</td>
<td>1550</td>
<td>4.42</td>
<td>45</td>
<td>97</td>
<td>1 year</td>
</tr>
<tr>
<td>12</td>
<td>BPCL, Mumbai 2nd Contract</td>
<td>12 MMTPA</td>
<td>3000</td>
<td>2.50</td>
<td>45</td>
<td>97</td>
<td>1 year</td>
</tr>
<tr>
<td>13</td>
<td>BPCL, Kochi 1st Contract</td>
<td>9.5 MMTPA</td>
<td>2000</td>
<td>11.81</td>
<td>52</td>
<td>99</td>
<td>1 year</td>
</tr>
<tr>
<td>14</td>
<td>BPCL, Kochi 2nd Contract</td>
<td>9.5 MMTPA</td>
<td>1500</td>
<td>4.10</td>
<td>38</td>
<td>97</td>
<td>18 months</td>
</tr>
<tr>
<td>15</td>
<td>NRL, Assam</td>
<td>3 MMTPA</td>
<td>4100</td>
<td>8.4</td>
<td>50.5</td>
<td>97</td>
<td>1 year</td>
</tr>
<tr>
<td>16</td>
<td>CPCL, Chennai</td>
<td>10.5 MMTPA</td>
<td>4000</td>
<td>9.40</td>
<td>40</td>
<td>96</td>
<td>1 year</td>
</tr>
</tbody>
</table>
Integrated Solutions for Refineries and Allied Industries

Forbes Marshall Thermodynamic Steam Traps (IBR/NIBR)

The Forbes Marshall thermodynamic trap is a mainline trap with compact design. It features a mirror-polished, differentially hardened disc and seat for a long life, with a tight seal. It also provides excellent resistance. These traps are used for draining main steam distribution lines, where prompt removal of condensate is essential.

**FMTD65, FMTD65-A, FMTD65-B**

MOC : ASTM A 743 Gr. CA 40  
Sizes : DN 15/20  
Ends : SW, Screwed  
      : Flgd. #150/ #300/#600  
PMO : SW 55.0 bar(g), Scr.31.5 bar (g)  
TMO : FMTD65 A - 255 °C  
      : FMTD65 B - 425 °C

**FMTD76-M**

(with replaceable seat and disc)  
MOC : ASTM A 217 Gr. WC 6  
Sizes : DN 15, 20  
Ends : Screwed BSPT/NPT and SW ends  
PMO : 62 bar (g)  
TMO : 482 °C

**FMTD722-M**

(with replaceable seat and disc)  
MOC : ASTM A 182 Gr. F 22  
Sizes : DN 15, 20  
Ends : SW, BW,  
      : Flgd. #600 / #1500  
PMO : 220 bar (g)  
TMO : 550 °C


The Forbes Marshall tracer / instrument tracer line trap maximises the use of steam enthalpy, discharging subcooled condensate. The trap mechanism discharges condensate only after it has cooled below saturation temperature, making it ideally suited for all tracer lines and jacketed pipes. In addition, these traps can act as trouble-free air venting devices.

**FMTLT53 / FMAV53**

MOC : Forged Carbon Steel  
      : ASTM A 105  
Sizes : DN 15 to 20  
Ends : Scr. BSPT / NPT / SW  
PMO : 32.0 bar (g)  
TMO : 287 °C  

*Note: Also available in full assembly containing dial thermometer / without air collector pipe*

**FMTLT53-Y**

MOC : Forged Carbon Steel  
      : ASTM A 105  
Sizes : DN 15 ANSI 150, 300  
& Ends : DN 20 ANSI 150  
PMO : 32 bar (g)  
TMO : 287 °C

**FMMST63**

MOC : ASTM A276 SS316  
Sizes : DN 06, 15  
Ends : Scr BSPT/NPT  
PMO : 21 bar(g)  
TMO : 287 °C
Single Orifice Float Traps (TV/SLR Venting/IBR/NIBR)

The Forbes Marshall single orifice float trap includes a self aligning main valve, water hammer-proof float assembly and corrosion resistant air vent. Equipped with all these and the option of a steam lock release (SLR) mechanism, the Forbes Marshall single orifice float trap is the most preferred ball float trap in process industry.

**SOFT53**
MOC : CS, ASTM A216 Gr. WCB
Sizes : DN 15 - 50
Ends : Scr, BSPT/NPT, SW to ANSI B 16.11, Flanged to ANSI B 16.5
PMO : 32.0 bar (g)
TMO : 300 °C

**SOFT53-X**
MOC : CS, ASTM A216 Gr. WCB
Sizes : DN 100
Ends : Flanged to ANSI B 16.5
PMO : 32.0 bar (g)
TMO : 300 °C
Capacity : Condensate load upto 40,000 kg/hr

**SOFT54**
MOC : CS, ASTM A216 Gr. WCB
Sizes : DN 25
Ends : Flanged to ANSI B 16.5
PMO : 42.0 bar (g)
TMO : 425 °C

**SOFT50**
MOC : ASTM 510
Sizes : DN 15, 20, 25, 40
Ends : Butt weld, flanged to ANSI B 16.5, class 600
PMO : 98.6 bar (g)
TMO : 425 °C
Capacity : Condensate load upto 1200 kg/hr

Forbes Marshall Bucket Traps (IBR/NIBR)
Forbes Marshall bucket traps are the ideal solution for high pressure process condensate recovery.

**FMBT50**
MOC : CS, ASTM A216 WCB
Sizes : DN 15 to 25
Ends : SW, Scr BSPT / NPT
PMA : 32 bar (g)
TMA : 300 °C

Forbes Marshall Bimetallic Traps
Forbes Marshall bimetallic traps are a robust solution for high pressure mainline trapping.

**FMBM Series**
MOC : Forged Alloy Steel
ASTM A182 F22 / F91,
ASTM A105 F22 / F91
Sizes : DN 15 to 25
Ends : SW / Butt weld / Flanged (#600, 900, 1500, 2500)
PMO : 210 bar (g)
TMO : 525 °C
Forbes Marshall Air Eliminator

The Forbes Marshall air eliminator is a ball float type air or gas eliminator used for liquid systems, with cast steel cover and stainless steel internals. The complete unit is easy to maintain.

FMAE53
MOC: CS, ASTM A 216 Gr. WCB
Sizes: DN 15 to 25
Ends: Screwed BSPT / NPT / socket weldable to ANSI B 16.11 / Flanged ANSI B 16.5 class 150,300,600, BS Table H, J, K, R, DIN PN 10,16,25 and 40
PMA: 32,0 bar(g)
TMA: 425 °C

Forbes Marshall Liquid Drain Traps

The Forbes Marshall liquid drain trap is a condensate drain trap of cast iron body and cover for compressed air and other pressurised gases. The trap body is equalised with the pressure in the system through the balancing connection on top of the trap body.

FMLDT53
MOC: CS, ASTM A216 Gr.WCB
Sizes: DN 15 to 25
Ends: Screwed: BSPT / NPT, Socket weldable ANSI 150, 300, 600 Flanged: BS table H, J, K, R DIN ND 10,16,25,40
PMA: 32 bar (g)
TMA: 425 °C

Two Orifice Float Traps

The Forbes Marshall two orifice float trap (patented) is our latest innovation in steam trapping solutions. It comes with two orifices operated by a single float and is designed to meet the need of high discharge capacity at startup and adequate discharge during continuous operation. It offers high turndown for varying loads. This trap comes with horizontal screwed BSPT / flanged connections and can be maintained without disturbing the pipework.

TOFT
MOC: SG Iron, ENJS 1025
Sizes: DN 15 to 50
Ends: Scr. BSPT
PMO: 17.0 bar (g)
TMO: 232 °C

CMTOFT
MOC: SG Iron, ENJS 1025
Sizes: DN 15, 20
Ends: Flanged ASA 300
PMO: 15.0 bar(g)
TMO: 220 °C
Mainline and Tracer Line Compact Modules

The Forbes Marshall pipeline connectors are designed for use with swivel connector steam traps. These pipeline connectors are equipped with integral piston type stop valves which isolate upstream of the steam traps.

**FMPC50, FMPC51, FMPC52**
- **MOC**: Carbon steel, ASTM A 105 N
- **Sizes**: 15, 20 DN
- **Ends**: Screwed BSPT / Socket weld ends to ANSI B 16.11 Class 3000
- **PMO**: 42 bar g
- **TMO**: 425 °C

**FMPC53**
- **MOC**: Forged carbon steel, ASTM A 105 N
- **Sizes**: DN 15, 20
- **Ends**: Inlet Female SWE, Outlet Male SWE
- **PMO**: 42 bar (g)
- **TMO**: 425 °C

Compact Steam Trap Assembly Thermodynamic Type for Mainline (IBR/NIBR)

Forbes Marshall compact steam trap assembly thermodynamic type, coupled with the world’s leading steam trap technology, reduces plant downtime and maintenance costs and ensures zero emissions, while conforming to prevalent environment and pollution norms.

It consists of inbuilt piston valve for upstream, downstream, bypass, vent and testing.

**CMTD42M-F**
- **MOC**: Forged body - no welded joints
  - ASTM A 105
- **Sizes**: DN15, 20
- **Ends**: Socket weldable
- **PMO**: 42 bar g
- **TMO**: 425 °C
- **Body design condition**: ANSI 600

**CMTD62M-F**
- **MOC**: Cast alloy steel body - no welded joints
  - ASTM A 217 Gr. WC6
- **Sizes**: DN15, 20
- **Ends**: Socket weldable
- **PMO**: 62.5 bar g @ 482 °C
- **TMO**: 525 °C @ 42.7 bar g
- **Body design condition**: ANSI 600

**CMTD250M**
- **MOC**: Forged body - no welded joints
  - ASTM A 182 Gr F22 Cl3
- **Sizes**: 25 DN (optional 20 and 15 DN)
- **Ends**: Butt welded
- **PMO**: 220 bar g @ 374 °C
- **TMO**: 550 °C @ 80 bar g
- **Body design condition**: ANSI 2500
**Forbes Marshall Universal Thermodynamic Traps**

The Forbes Marshall universal thermodynamic trap, FMTD64-U, is a stainless steel thermodynamic steam trap with integral strainer. These traps are fitted with two screws to a pipeline connector with universal flange connection. This ensures ease of maintenance with minimum system downtime.

<table>
<thead>
<tr>
<th><strong>FMTD64-U</strong></th>
<th><strong>FMTLT63-U</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MOC</strong></td>
<td>CF8 ASTM A351</td>
</tr>
<tr>
<td><strong>Ends</strong></td>
<td>Fitted to pipeline connector with universal flange connection</td>
</tr>
<tr>
<td><strong>PMO</strong></td>
<td>42 bar (g)</td>
</tr>
<tr>
<td><strong>TMO</strong></td>
<td>425 °C</td>
</tr>
<tr>
<td><strong>Sizes</strong></td>
<td>32 bar (g)</td>
</tr>
<tr>
<td><strong>TMA</strong></td>
<td>287 °C</td>
</tr>
</tbody>
</table>

**View Glass (IBR / NIBR)**

The Forbes Marshall view glass is a simple yet novel product that enables visualising the flow of steam, water or oil, inside pipelines. The visualisation of flow helps diagnose problems occurring in equipment upstream or downstream of the view glass.

<table>
<thead>
<tr>
<th><strong>VU10</strong></th>
<th><strong>VU30</strong></th>
<th><strong>VU50</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>MOC</strong></td>
<td>CI, IS 210 Gr. FG 260</td>
<td>CI, IS 210 Gr. FG 260</td>
</tr>
<tr>
<td><strong>Sizes</strong></td>
<td>DN 15 to 25 (single window), DN 40, 50 (double window)</td>
<td>DN 15 to 25</td>
</tr>
<tr>
<td><strong>Ends</strong></td>
<td>Scrd BSPT / NPT</td>
<td>Scrd BSPT / NPT / SW / Flanged</td>
</tr>
<tr>
<td><strong>PMO</strong></td>
<td>13 bar (g)</td>
<td>13 bar (g)</td>
</tr>
<tr>
<td><strong>TMO</strong></td>
<td>220 °C</td>
<td>220 °C</td>
</tr>
</tbody>
</table>
Steam Operated Pump Trap (SOPT)
The SOPT is a steam operating pump trap with flanged connections. The product automatically traps steam while discharging condensate, under both positive as well as negative differential pressures including vacuum, depending on the pipe line conditions.

SOPT
MOC: Carbon Steel / SG Iron ASTM A 395
Sizes: DN15 x DN50
Ends: Flanged PN16
PMO: 14 bar (g) @ 198 °C
TMO: 320 °C @ 12.8 bar (g)

Flash Vessel
The Forbes Marshall flash vessel is particularly suited to boiler blowdown heat recovery systems where efficient separation of flash steam from blowdown is essential to prevent contamination of the boiler feedtank and/or heat transfer surfaces.

FMFV
MOC: Carbon Steel IS 3589
Sizes: DN 150, 200, 300, 375
Ends: Flgd. #150
PMO: 10.5 bar (g)
TMO: 180 °C

Multi Valve Pressure Powered Pump Package Unit
The Forbes Marshall multi valve pressure powered pump package unit is a positive displacement pump unit operated by steam, compressed air or pressurised gas. The unit is specifically designed to pump hot condensate and liquids of specific gravity 1.0 down to 0.9.

MV55
MOC: Carbon Steel - IS2062
Sizes: DN80
Ends: Condensate Inlet: DN80 Flange Class 150
Condensate Outlet: DN80 Flange
(provided with mating flange)
Vent outlet: DN150 Flange Class 150
PMA: 7 bar (g)
TMA: 180 °C

MV110
MOC: ASTM A671 CB60 Class 22
ASTM A516 Gr.70
Sizes: DN 125
Ends: Condensate Inlet: DN 150 Flange Class 150/300
Condensate Outlet: DN 150 Flange Class 150/300
PMO: 21.1 bar (g) | TMO: 288 °C
Maximum Motive Inlet Pressure: 14 bar (g)
Forbes Marshall Steam and Condensate Manifolds (IBR / NIBR)

Forbes Marshall steam and condensate manifold is a single forged component. It is compact, weld free, light weight and uniform in design, which eliminates the need for on-site fabrication and testing. These manifolds come with optional insulation jackets which make the assembly more efficient and safe.

**FMSCM4X, FMSCM8X, FMSCM12X**

- **MOC**: Forged carbon steel, ASTM A105
- **Sizes**: FMSCM manifolds are available with 4, 8 or 12 connections
- **Ends**: Flanged to BS 1560 (ANSI) class 150/300 or Socket weld to ANSI B 16,11 Class 3000
- **PMO**: Class150 - 14 bar (g)
  - Class 300 - 41.5 bar (g)
- **TMO**: Class150 - 425 °C @ 5.5 bar(g)
  - Class 300 - 425 °C @ 28bar(g)

Sample Coolers

A compact, space saving, shell-in-shell design ensures quick and safe sampling of high purity media. A counter current flow is utilised to maximise cooler efficiency. Applications include clean steam, pure steam and hot WFI sampling.

**Size**: DN 50,100, 200
**Inlet Temperature**: 35 °C (max.)
**Inlet Pressure**: 3.5 bar (g)
**Outlet Pressure**: Open to atmosphere
**Quality / Chloride Content**: Less than 25 ppm

Thermocompressors

The Forbes Marshall thermocompressor directly impacts the bottomline by compressing low pressure flash steam or exhaust steam to a higher pressure / temperature, reclaiming energy which would otherwise have been vented.
Piston Valves

The Forbes Marshall piston valve is a seatless and glandless valve. At the heart of the piston valve are piston and sealing rings to achieve a leak proof shutoff. This unique design ensures a long life even at high temperatures of up to 425 °C.

**PSVAL (DN15, 20, 25, 32, 40)**

Forged carbon steel piston valves provide perfect tightness and durable stability on different media such as steam, superheated steam, heat transfer fluid, etc.

- **MOC**: ASTM A 105
- **Sizes**: 15 to 40 DN
- **Ends**: Scr. BSPT / NPT / SW

**For 15, 20, 25 and 40 DN - Socket weld ends**

- **PMO**: 78 bar g
- **TMO**: 425 °C

**For 15, 20, 25 - Screwed ends**

- **PMO**: 78 bar g
- **TMO**: 425 °C

**For 32 and 40 DN - Screwed ends**

- **PMO**: 41.5 bar g
- **TMO**: 425 °C

**For 16, 20, 25, 32, 40 DN - Flanged ends**

Class rating: #150, #300, #600

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**PSVAL (DN50, DN65, DN80, DN100, DN125, DN150, DN200, DN300)**

Cast carbon steel piston valves provide perfect tightness and durable stability on different media such as steam, superheated steam, heat transfer fluid, etc. DN250 and DN300 can be supplied with electrical actuators.

- **MOC**: CS, ASTM A216 Gr.WCB
- **Ends**: Flange rating: ANSI 300, ANSI 150

**Body design condition: ANSI 300 flanged ends**

- **PMO**: 41.5 bar g @ 253 °C
- **TMO**: 425 °C @ 28.8 bar g

**Body design condition: ANSI 150 flanged ends**

- **PMO**: 14 bar g @ 197 °C
- **TMO**: 425 °C @ 5.5 bar g
Valves

Safety is synonymous with the valves that are manufactured by Forbes Marshall. These are of the highest quality standards.

**Gate Valves**
MOC : A216 Gr WCB, A352 Gr LCB, A217 Gr WC6, A217 Gr WC9, A217 Gr C5, A217 Gr C12, A351 Gr CF8, A351 Gr CF8M
Sizes : ½” - 42”, Class 150-2500
Ends : Flanged / butt weld

**Ball Valves**
MOC : A216 Gr WCB, A352 Gr LCB, A217 Gr WC6, A217 Gr WC9, A217 Gr C5, A217 Gr C12, A351 Gr CF8, A351 Gr CF8M
Sizes : ½” - 24” Class 1500
upto 16” Class 2500
upto 2” Class 4500
Ends : Flanged / butt weld

**Globe Valves**
MOC : A216 Gr WCB, A352 Gr LCB, A217 Gr WC6, A217 Gr WC9, A217 Gr C5, A217 Gr C12, A351 Gr CF8, A351 Gr CF8M
Sizes : 2” - 20” Class 150
2” - 12” Class 600
2” - 10” upto class 2500
Ends : Flanged / butt weld

**Non-return Valve**
MOC : WCB - alloy steel, duplex steel, inconel
Sizes : ½” - 24”
Ends : Socket weld / Butt weld / Flanged#600
Type : Lift check upto 2” Swing check above 2”

**Forbes Marshall Disc Check Valves**
The Forbes Marshall disc check valve, FMDCV, is of the wafer pattern designed to be sandwiched between flanges. They are ideal for all types of fluids and provide tight sealing in both vertical and horizontal positions. Quick and rapid open-close mechanism delivers high response levels.

**FMDCV**
MOC : Austenitic SS ASTM A 351 CF8M
Sizes : DN 15 to 100
PMO : 40 bar (g)
TMO : 300 °C and 400 °C

**FMDCV ANSI**
MOC : ASTM A 351 CF3M
Sizes : DN 15 to 100
PMO : 40 bar (g)
TMO : 300 / 400 °C
Mechanical Valves
Valves for all reasons*

- High pressure stop valves
- API range of gate, check and ball valves
- Globe valves
- Blowdown valves
- Safety relief valves
- Turbine bypass system
- Throttle valves
- Drain valves

*Available in NACE MR0175

Control Valves
Complete control solutions for critical service conditions*

- 2 way control and on/off valves
- 3 way control valves
- Pressure reducing valves
- Desuperheating valves
- Pressure reducing cum desuperheating valves

*from our joint venture company Forbes Marshall Arca

Stations and Accessories
Fully customised and fabricated to ASME standards and IBR III C and II A regulations

- Combined pressure reducing and desuperheating valves
- PRDS / PRS / Desuperheating stations
- Pneumatic diaphragm actuators
- Pneumatic / electro pneumatic positioners

Sampling Systems for Process (Liquids and Gases)
Safe and reliable sampling of fluids
For samples extracted from the inlet and outlet of various distillation columns, vessels and pipelines
For liquids like diesel, naphtha, kerosene, oil and gases like, LPG, propylene etc.
For sample cooling (if required), isolation from process, venting and safe disposal of sample
Strainers (NIBR / IBR)

Strainers arrest pipeline debris such as rust, jointing compound and weld metal in pipelines, protecting equipment and processes. Our strainers are customised to suit individual space and performance requirements. The range includes Y-type, conical, T-type, basket and duplex strainers.

Y-Type Strainer
Size : ½" to 24"
MOC :
1. Cast-WCB, WC6, WC9, CF8M, LCB
2. Forged - A105, F22
Gr. TP304 TP316
Design : ASME SecVIII Div.
End Connections : SW / Screwed / Flanged
Rating : Up to class 2500

T-Type Strainer
Size : 2" to 72"
Material :
1. Carbon Steel, A234 WPB; Low temperature carbon steel (A420-WPL6);
2. Stainless steel (A403-WP)
End connections :
RF / RTJ flanged (ASME B16.5), butt weld (ASME B16.25)

Basket Type Strainer
Size : 2" to 24"
Material :
1. Carbon Steel (A53 E/B A106-B);
2. Low temperature carbon steel (A333-6);
3. Stainless steel (A312)
End connections :
RF / RTJ flanged (ASME B16.5), butt weld (ASME B16.25)

Duplex Strainer
Size : DN 500
Material : A216 WCB with epoxy lining
Rating : Class 900
End : Flanged connections

Forbes Marshall Moisture Separators (IBR / NIBR)

Forbes Marshall moisture separators effectively remove moisture from steam flow. They help reduce process and maintenance problems like lower productivity, erosion and corrosion that can be caused due to wet steam.

FMSEP54
MOC : CS, A216 Gr. WCB
Size : DN 25 TO 200
Ends : Flanged Table (F, H, J, K) /
Flanged #150, #300
PMA : 32 bar (g)
TMA : 425 °C

FMSEPFB
MOC : ASTM A106 Gr.B
Sizes : DN 15 to 300
Ends : Flanged : Table H, J, K, ASA 150, 300, 600, PN 16, 25, 40
PMA : 34 bar (g)
TMA : 425 °C

Forbes Marshall Moisture Separators (Fabricated)

The fabricated Forbes Marshall moisture separator is used for the removal of entrained liquids in steam, so that they can be drained away as condensate.
Forbes Marshall Safety Relief Valves (IBR / NIBR)
The Forbes Marshall safety relief valve is a high lift safety valve with gun metal seat, valve and brass internals suitable for use on steam, air and water.

FMSRV
MOC : Gun Metal
Sizes : DN15, 20, 25, 40, 50
Ends : Scr. BSPT
PMA : 0.34 to 17.5 bar (g)
TMA : 224 °C

Full Lift Safety Valve
MOC : ASTM A210 WCB
    ASTM A217 WC6 / Wc9
    ASTM A351 CF8 / 8M
Sizes : DN 15, 20, 25, 40, 50
Ends : Flanged class 150/300
Design : ASME SEC VIII DIV Standard

Temperature Control Systems (IBR / NIBR)
Our temperature control systems offer cost effective temperature control for steam or water. Hydraulic actuators control quick opening valves for fast response to system demands. Packless glands eliminate the need for periodic repacking or retightening to avoid leaks. Liquid expansion is uniform over the entire temperature range to ensure accurate calibration.

MOC : ASTM A 216 WCB / ASTM A351 CF8M
Sizes : ½” to 16”
Pressure : ANSI 150 - 1500
Rating

Forbes Marshall Vent Head
The Forbes Marshall vent head is designed to fit vertical open-ended steam vent pipes. The vent head discharges dry steam safely to atmosphere, at low velocity, thereby protecting personnel from injury and buildings from material damage.

FMVH
MOC : SS304 ASTM A240
Sizes: DN 50 - 500
Rating : Class 150, 300, 600
**Diffuser (NIBR)**
The Forbes Marshall diffuser is a compact unit designed to fit the outlet of a steam or air trap discharging to atmosphere. It reduces the problems of noise and erosion by dampening high velocity discharge. It can be fitted to any trap where conditions promote blast discharge, similar to that associated with balanced pressure, inverted bucket or thermodynamic traps.

**DIFF**
- MOC : ASTM A213 TYPE 304
- Sizes : DN15
- Ends : Scr. BSPT
- PMA : 44.0 bar (g)

**Vacuum Breaker**
The Forbes Marshall vacuum breaker, FMVB, is a vacuum breaker, designed as per standards ASME Section VIII Division 1 to fit on steam or liquid systems.

**FMVB**
- MOC : ASTMA 276 Type 431
- Sizes : DN15
- Ends : Scr. BSPT / NPT
- PMO : 21 bar (g)
- TMO : 400 °C at 13 bar (g)

**Pilot Operated Pressure Reducing Valves (IBR / NIBR)**
Our pressure reducing valves cover the entire spectrum of pilot valves. They are maintenance friendly, easy to operate and best suited to handle fluctuating small to heavy loads in steam/compressed air applications.

**FMPRV41**
- MOC : SG Iron
- Size : DN 15 to 50
- Ends : Screwed : BSPT / NPT for DN15, 20, 25
  Flanged : BS 10 Table “F” / “H” for DN40 and DN50
- PMO : 17 bar (g)
- TMO : 232 °C

**Double Seated Pressure Reducing Valve**
**DSPRV41**
- MOC : SG Iron
- Size : DN 40, 50
- Ends : Flanged : BS 10 Table “F” / “H”
- PMO : 17 bar (g)
- TMO : 232 °C
Remote Online Pollution Monitoring

Meet the stringent guidelines of pollution control boards

- On line multi-parameter analyser
  (For monitoring of COD, BOD, pH and TSS)
- Nitrate analyser
- COD analyser
- Ammonia analyser
- 2 wire transmitter
  (for pH / Conductivity / DO / ORP / TDS)
- Suspended solids analyser (for TSS monitoring)
- Chromium VI : Colorimetric online analyser
- BioSens : The revolutionary BOD analyser
  (measures BOD in 40 minutes)

We do cater to other water applications such as RO,
  desalination, raw water, DM water, boiler feed water and
  cooling water.
**Process Efficiency**

**Metering Solutions for the Petroleum Industry**
Achieve more

**Petroleum Refining**
With the steady rise in the consumption of petroleum products and the demand for higher grade refined products, refineries are innovating and upgrading their process to meet the market demands.
Refineries today have complex processes and number of blending stream to produce the high end value added refined products. This calls for accurate, reliable, versatile and cost effective metering solutions that cover the entire oil refining process. KROHNE flowmeters can be found in virtually every refining applications such as:
- Crude oil inlet to refinery
- Crude oil blending
- Feed to various refining stages
- Metering of intermediates
- Metering of high temperature residues
- VR / VGO metering
- Coker feed / pass metering
- Refined product blending
- Ethanol blending
- Lube oil blending
- Metering high temperature fuel oil to furnaces
- Molten sulphur metering
- Bitumen metering
- Liquid paraffin metering
- Refined product metering in tank farms
- Oil movement metering
- LPG metering
- LNG metering
- Sea water metering
- Desalination water metering
- Cooling water metering
- DM water metering
- Sour water metering (NACE compliant)
- VA meters for compressor seal systems
- VA meters for sampling systems
- Level metering
- Bio-diesel metering

**Single Source Commitment for Flow Metering Systems**
Custody transfer metering for liquids and gases
Loading / off-loading systems for ships, trucks and railcars
Provers
Sampling systems
Analyser management system
Supervisory metering systems
Pipeline leak detection and localisation

(*from our joint venture company KROHNE Marshall)
Recovery of Flash Steam and Condensate in SRU Payback in 3 Months

Before
- Design - 6500 kg/hr
- Operating 3700 kg/hr
- Tracing condensate locally drained 8000 kg/hr
- Jacketing condensate locally drained 5000 kg/hr
- Fin Fan Condenser
- To Deaerator
- To Electric Pump
- To Refinery Condensate Header

After
- Design - 6500 kg/hr
- Operating 3700 kg/hr
- Tracing condensate locally drained 8000 kg/hr
- Jacketing condensate locally drained 5000 kg/hr
- Fin Fan Condenser
- To Deaerator
- To Electric Pump
- To Refinery Condensate Header

Benefits
- Improve energy performance (MBN)
- Reduce wastage of steam and condensate
- Increase gross refinery margin
- Reduce utility cost

Monetary Savings per Annum
- Flash Steam – ₹ 675 lacs
- Condensate – ₹ 29 lacs
- Payback in 3 Months

Improved Stripping Steam Quality through Improved Dryness Fraction

Before
- STRIPPER
- 6" Control Valve
- 4" Steam Trap
- 4" Steam Trap
- 4" Steam
- 4" Steam Trap
- 4" Orifice Flow Meter
- 4" Steam Trap

After
- STRIPPER
- 5" Control Valve
- 4" Steam Trap with Drain module
- 3/4" Steam Trap
- 4" Steam Trap
- 4" Orifice Flow Meter
- 4" Steam Trap
- 4" Steam

Before
- Wet steam affects the quality of the final product
- Higher steam consumption

After
- Quality of final product improved
- Reduced steam consumption
Flash Steam and Condensate Recovery in Tank Farm Area

**Before**
- Condensate getting drained
- Group trapping with one trap
- Uneven heating of product
- Wrong selection of traps

**After**
- Flash steam and condensate recovered
- Individual trapping leading to uniform heating of product at required temperature with optimum steam consumption
- Application wise correct selection of traps
Objective – To reduce pump seal failure by controlling pressure and removing condensate to ensure dry steam reaches the pump seal.

Piping plan 62 of API 682/ISO21049 specifies that environment on the atmospheric side of single seals can be improved by quenching with steam. The average number of pumps under plan 62 in a 6 MMTPA is in the range of 40 to 50.

Steam quenching is essential for long seal life and as a safety measure for a number of high temperature and heavy hydrocarbon duties. Most common pump problems include seal failures associated with inadequate or the lack of a steam quench, which is used to prevent coke formation and to cool the seal at high temperatures or to heat the seal faces on some medium temperature hydrocarbon residue duties.

The provision of dry steam flow at pressure below 1 barg is not a simple task. Over pressurisation will cause early seal failure. Steam traps and insulation are essential. Site surveys often find a flow of tepid water to the seal, which on hot duties flash off into steam in a dramatic fashion causing pressure pulsation at seal.

Initial Problems

Failure of pump seal

Root Cause

All pumps encounter condensate carry over with steam at the pump seal because of wrong installation of the trap and routing which causes the pump seal to fail.

Solution

Steam should be dry saturated before it is utilised. We recommend the installation of a single module comprising of a self-acting pressure reducing valve and a moisture separator in the supply line of quenching steam.

This will ensure that the steam supply is dry saturated and pressure is controlled precisely as per API norms. Also, all the condensate deposited in the drain pocket can be easily removed through the trap. Refer figure below.
**Problem**

Steam traps are passive devices, which means they need positive differential pressure to evacuate the condensate.

In a lean amine heater, the process parameters are such that the differential pressure across the trap is usually negative. This causes stalling which in turn forces the bypass valve of the steam trap to remain open at all times and results in the passing of live steam along with condensate.

**Solution**

The installation of a pump and trap combination system will ensure that the heat exchanger is always free from condensate while allowing 100% space to be used for heat transfer using steam.

**Benefits of the System**

The steam operated pump trap maintains uniform heat transfer rate under all conditions

Increased productivity and reduced batch timing due to elimination of moisture which is a barrier to heat transfer

The bypass valve does not need to be opened, thus avoiding steam wastage

The steam operated pump trap saves condensate by returning it to the local condensate collection tank, which was earlier being drained due to negative differential pressure

Safety – no water hammering, no steam leaks or condensate spillage

Reduction in corrosion of heat exchanger by avoiding sub-cooled condensate
Perfect Fuel Atomisation to Stop Wastage and Improve Efficiency

Problem
Dribbling of fuel oil from the furnace burner
Low burner efficiency
Cumbersome to maintain the trap under the furnace due to oil spillage

Root Cause
Lack of proper atomisation of fuel oil due to wrong selection of trap in atomisation steam header drain i.e. balance pressure trap is installed instead of thermodynamic trap
Improper heat transfer between tracing and fuel oil because of group trapping in fuel oil tracing line which leads to water logging in the tracing line

Advantages of the Modified System
Proper atomisation of fuel oil in the burner
Thermodynamic trap removes the condensate as soon as it forms in the header
Permissible required temperature of fuel oil maintained resulting in perfect atomisation and hence increased burner efficiency
Dribbling of fuel oil at the burner nozzle reduced, leading to reduction in fuel oil wastage
Correct atomising temperature of fuel oil leads to complete combustion and thereby reduced fuel loss
Piston valve provides positive isolation to the trap with tight shut off bypass valve, vent valve and test valve
Ease of maintenance
**Effective Condensate Evacuation for Large Condensate Loads Against High Back Pressure**

### Conventional Approach

![Conventional Approach Diagram](image1)

### Modern Approach

![Modern Approach Diagram](image2)

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**Condensate Pump Trap Combination System**

![Condensate Pump Trap Combination System Diagram](image3)

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### System Range Details

- **Condensate Load**: 1 to 130 TPH
- **Outlet Pressure**: Upto 8 bar
- **Motive Pressure Required**: Upto 13 bar

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### Limitations of a Conventional Approach

- Allows condensate to back up and flood the heat exchanger, causing:
  - Loss of thermal performance
  - Corrosion of tubes
  - Water hammer

- Electrical centrifugal pumps are used to pump the condensate.

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### Benefits of a Modern Approach

- Smooth condensate evacuation and pumping against the system back pressure thereby avoiding flooding and water hammering.
- No electrical/external power required to drive the steam operated condensate pump.
- Compact and robust mechanical design.
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World Class Technology from World Class Facilities