Balancing & Flow Measurement Valves

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General Information

Importance of a Balanced System

Heating, cooling and water distribution systems must be accurately adjusted and balanced to achieve optimum system performance. Unbalanced systems can produce wide temperature variations among rooms and can raise building energy costs. The installation of balancing valves in combination with pre-determined accurate pressure drop calculations provides indoor comfort and energy efficiency to the end user.

Accurately balanced systems provide the following benefits:
- A comfortable indoor climate
- Desired flow distribution throughout the building
- Substantial energy and cost savings
- Trouble-free operation and ease of maintenance

Role of Balancing Valves

The role of the balancing valve is to control the gallon per minute (gpm) flow rate in each building main, riser and branch to deliver the designed gpm flow in chilled and/or hot water applications. At each heat transfer coil the balancing valve is set to provide the precise flow rate specified by the design engineer to provide indoor comfort and energy efficiency within a building.

Figure 1 shows a typical hydronic system and illustrates the locations where balancing valves are usually installed.

The example below describes how Watts balancing valves would be applied to a system like that shown in Figure 1.

In Figure 1, Riser B has 12 coils that each require a 2 gpm flow rate to meet design requirements. The total design flow rate is (12 coils x 2 gpm) or 24 gpm per riser. Balancing valves will be applied on the main supply line, the coil return, the branch return and the riser return as follows:
- A Series CSM-91 shall be applied on the main supply line to control the flow rate to 48 gpm. (2 risers per header at 24gpm per riser)
- A Series CSM-81-F shall be applied on each riser return line to control the flow rate to 24 gpm (4 branches per riser at 6 gpm per branch).
- A Series CSM-61 shall be applied on each branch return line to control the flow rate to 6 gpm (3 coils at 2 gpm per branch).
- A Series CSM-61 shall be applied on each coil return line to control the flow rate through the coil to 2 gpm.

Each return riser flows into the return header sending 24 gpm to the boiler or chiller.

Figure 2 is a typical heat transfer coil used in chilled or hot water hydronic systems. This illustration shows the products commonly included.

Figure 1
installed on the coil including an air vent, test plugs, a balancing valve, ball valves, a strainer and a gauge. Installations will vary due to specification preference.
**Series CSM-61**

**Flow Measurement Valves**

Sizes: ½” – 3” (15 – 80mm)

Series CSM-61 Flow Measurement Valves are designed for application on low or medium flow rate HVAC units. Their compact size allows for easy installation and use in crowded piping compartments. The CSM-61’s ball-type design, extended throttling range, and large indicator plate, make for highly accurate flow measurement, even in very low flow ranges.

The CSM-61’s positive memory feature is easy to see, access, and operate, facilitating system balancing and flow measurement. These valves are also bi-directional, so there is no chance of installing the valve in the incorrect flow direction.

Series CSM-61 valves provide positive shutoff, eliminating the need for a separate service valve. The solder style CSM’s may be installed without disassembly, saving costly installation time. These valves are also provided with blowout proof stems. Use, misuse, corrosion, or wear will not allow the stem to “blowout,” releasing pressurized hot or chilled water.

**Features**

- Accurate flow measurement
- Easy to use memory
- Bi-directional flow
- Positive shutoff
- Safe “blowout” proof design
- Available with threaded and soldered end connections
- Integral drain port

**Specifications**

A flow measurement valve shall be installed on each hot/chilled water unit or as otherwise shown on plans. The valve shall be of the bi-directional, blow-out resistant, tight shutoff, ball design, with position indicator, memory device, checked metering ports with drip caps and integral drain ports opposite the metering ports type. The valve shall be a Watts Regulator Company Series CSM-61.

**Applications**

- Fan coil units
- Water source heat pumps
- Reheat coils
- Panel coils
- Small branch lines
- Unit heaters
- Unit ventilators
- Finned radiation
- Small domestic hot water lines
- Convecators
- Small pumps

**Installations**

Fan Coil Unit

Pump, Riser, and Branches
### Materials of Construction

| Housing/Body | Bronze |
| Packing Material | 1/4" - 2" (15 – 50mm) Viton®<sup>®</sup>  
2 1/2" - 3" (65 – 80mm) Neoprene |
| Pressure Taps | 1/4" Brass SAE 45° Flare |
| Seats | 1/4" – 1", 3" (15 – 25, 80mm) Carbon/Glass filled PTFE  
1 1/4" – 2" (32–50mm) Virgin PTFE. |
| Drain Plug | Brass |

### Pressure-Temperature

<table>
<thead>
<tr>
<th>Pattern</th>
<th>Size</th>
<th>Working Temp °F</th>
<th>°C</th>
<th>Max. Working Pres. psi</th>
<th>bar</th>
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<tbody>
<tr>
<td>Solder</td>
<td>1/2&quot; – 1&quot; (15 – 25mm)</td>
<td>250</td>
<td>93</td>
<td>100</td>
<td>7</td>
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<tr>
<td></td>
<td>1 1/4&quot; – 2&quot; (32 – 50mm)</td>
<td>250</td>
<td>93</td>
<td>90</td>
<td>6</td>
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<tr>
<td>Thread</td>
<td>1/2&quot; – 3&quot; (15 – 80mm)</td>
<td>250</td>
<td>121</td>
<td>175</td>
<td>12</td>
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*Note 1: Solder used in joints: 50-50 Tin Lead (ASTM B32 Alloy Grade 50A)*  
**Note 2: Solder used in joints: 95-5 Tin Antimony*

### Dimensions-Weights

<table>
<thead>
<tr>
<th>Model</th>
<th>Size (DN)</th>
<th>Dimensions (approx.)</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>in.</td>
<td>mm</td>
<td>C</td>
</tr>
<tr>
<td>CSM-61-M1-S</td>
<td>1/2</td>
<td>15</td>
<td>2 1/8</td>
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<td>2 1/8</td>
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<td>6 1/8</td>
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<td>3</td>
<td>80</td>
<td>6 1/8</td>
</tr>
</tbody>
</table>

Suffix: S = Solder Ends, T = Threaded Ends
Series CSM-81-F
Flow Measurement Valves
Sizes: 2½" – 8" (65 – 200mm)

Series CSM-81-F Flow Measurement Valves are designed for application on medium to high volume flow rate HVAC units. The CSM-81-F’s lubricated plug design, extended throttling range and large indicator plate provide accurate flow measurement and long service life.

CSM-81-F’s unique cylindrical plug design provides full flow with minimal pressure drops and low operating torque. Large wrench flats on the external plug surface make setting or closing the valve simple.

Series CSM-81-F valves feature easily accessible checked metering ports with drip caps to facilitate system balancing and flow measurement. These valves also provide positive shutoff, eliminating the need for a separate service valve.

Features
- Accurate flow measurement
- Flanged end connections
- Positive shutoff
- Checked metering ports
- Low torque
- Face to face dimensions to ANSI B16.10

Specifications
A flow measurement valve shall be installed on each hot/chilled water unit or as otherwise shown on the plans. The valve shall be of flanged end connections, provide positive shutoff, low torque cylindrical plug design, with position indicator plate and checked metering ports. The valve shall be a Watts Regulator Company Series CSM-81-F.

Applications
- Fan coil units
- Water source heat pumps
- Reheat coils
- Panel coils
- Branch lines
- Pumps

Typical Installations
## Pressure-Temperature

Maximum Working Temperature: 250°F (121°C)
Maximum Working Pressure: 175psi (12 bar)

## Materials of Construction

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<thead>
<tr>
<th>Component</th>
<th>Material</th>
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<tr>
<td>Body</td>
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<tr>
<td>Plug</td>
<td>ASTM-A-126 Class B semi-steel</td>
</tr>
<tr>
<td>Stem Seal</td>
<td>PTFE</td>
</tr>
<tr>
<td>Pressure Taps</td>
<td>Brass ¼&quot; SAE 45° Flare</td>
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## Dimensions-Weights

<table>
<thead>
<tr>
<th>Model</th>
<th>Size (DN)</th>
<th>Dimensions (approx.)</th>
<th>Weight</th>
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</thead>
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<td>in.</td>
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</tr>
<tr>
<td>CSM-81-F</td>
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<td>80</td>
<td>8</td>
</tr>
<tr>
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<td>9</td>
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<td>11½</td>
</tr>
<tr>
<td>CSM-81-F</td>
<td>8</td>
<td>200</td>
<td>12½</td>
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</tbody>
</table>

Suffix: F = Flanged Ends.

For additional information, request literature ES-CSM-81.
Series CSM-91

Flow Measurement/Balancing Valves

Sizes 2½" – 12" (65 – 300mm)

Series CSM-91 Flow Measurement/Balancing Valves are designed for application on medium or large flow rate HVAC systems, pump packages, and cooling towers. They feature a multi-turn adjustment range for maximum control, pressure differential readout ports on both sides of the valve to allow for easier installation and positive shutoff for servicing equipment. In addition, these valves also incorporate a micrometer type handwheel adjustment, visually readable settings and a tamper-proof memory stop.

The CSM-91's field-convertible design allows the valve to be changed from the factory-standard straight pattern to an optional angle pattern with standard tools and no additional parts. This allows the valve to be used as a replacement for angles or elbows, and will not affect the valve’s accuracy.

Maximum flow requires a one-foot pressure drop across the valve to obtain an accurate meter reading with the valve set point from 50% to 100% open for greatest accuracy.

The valve should be installed with flow in the direction of the arrow on the valve body, and installed at least five pipe diameters downstream from any fitting, and at least ten pipe diameters downstream from any pump. Two pipe diameters downstream from the CSM-91 should be free of any fittings. When installed, easy and unobstructed access to the valve handwheel and metering ports for adjustment should be provided. Mounting of the valve in piping must prevent sediment buildup in metering ports.

Features

- Multi-turn adjustment
- Interchangeable metering and drain ports on both sides of valve
- Positive shutoff
- Tamper-proof memory stop
- Micrometer type handwheel adjustment - visually readable from a distance
- Field convertible for straight or angle pattern
- Grooved end connections with optional flange adapters

Specifications

A flow measurement valve shall be installed as shown on plans. Each valve shall have two ¼" (6mm) NPT brass metering ports with Nordel® check valves and gasketted caps located on both sides of valve seat. Two additional ¼" (6mm) NPT connections with brass plugs are to be provided on the opposite side of the metering ports for use as drain connections. Drain connections and metering ports are to be interchangeable for measurement flexibility when valves are installed in tight locations. The valve body shall be ductile iron with industrial standard grooved ends. Valve stem and plug disc shall be bronze with ergonomically designed handwheel with multi-turn handwheel adjustments.

Sizes 2½" and 3" (65 and 80mm) - five turns, 4" – 6" (100 – 150mm) - six turns, 8" and 10" (200 and 250mm) - twelve turns, and 12" (300mm) - fourteen turns. Flange adapters shall be supplied to prevent rotation. The valve shall be a Watts Regulator Company Series CSM-91.
**Pressure-Temperature**

**Grooved Ends Only**

Maximum Working Pressure: 375psi (26.25 bar)

Maximum Temperature: 230°F (110°C)

**Flange**

Maximum Working Pressure:

Class 125: 175psi (12 bar)

Maximum Temperature: 230°F (110°C)

**Materials of Construction**

Body: Ductile Iron ASTM A536 GR65-45-12

Disc: Bronze ASTM B884 C-84400

Seat: 2½” – 6” (65 – 150mm) Engineered Resin

8” – 12” (200 – 300mm) EPDM

Stem: 2½” – 6” (65 – 150mm) Brass ASTM B-16,

8” – 12” (200 – 300mm) Stainless Steel

O-ring: Buna-N

Memory Lock: Brass ASTM B-16

Meter Ports: NPT Brass Body with Schrader Valve

Drain Tappings (2) 1/4” Brass plug

*Note: Series CSM-91 valves are shipped with grooved ends standard. For companion flanges, please specify size when ordering. Insulation blocks are also ordered separately from valve. Please specify size when ordering.*

**Dimensions-Weights**

**Straight Pattern (Standard)**

<table>
<thead>
<tr>
<th>Size (DN)</th>
<th>A in.</th>
<th>B in. mm</th>
<th>C in. mm</th>
<th>D in. mm</th>
<th>F in. in.</th>
<th>Flange Dia. 125# in. mm</th>
<th>Spacing E in. mm</th>
<th>Weight in. lbs</th>
<th>Weight in. kgs</th>
</tr>
</thead>
<tbody>
<tr>
<td>2½</td>
<td>65</td>
<td>12</td>
<td>305</td>
<td>9½</td>
<td>245</td>
<td>2¼</td>
<td>70</td>
<td>2¾</td>
<td>65</td>
</tr>
<tr>
<td>3</td>
<td>80</td>
<td>12</td>
<td>305</td>
<td>10½</td>
<td>267</td>
<td>2½</td>
<td>62</td>
<td>3</td>
<td>76</td>
</tr>
<tr>
<td>4</td>
<td>100</td>
<td>14</td>
<td>356</td>
<td>10¾</td>
<td>268</td>
<td>3</td>
<td>76</td>
<td>3½</td>
<td>87</td>
</tr>
<tr>
<td>5</td>
<td>125</td>
<td>17½</td>
<td>445</td>
<td>13½</td>
<td>332</td>
<td>3½</td>
<td>92</td>
<td>4½</td>
<td>125</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
<td>20¼½5</td>
<td>525</td>
<td>13¼</td>
<td>349</td>
<td>4½</td>
<td>113</td>
<td>5½</td>
<td>149</td>
</tr>
<tr>
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<td>24½</td>
<td>625</td>
<td>5½</td>
<td>144</td>
<td>7½</td>
<td>200</td>
</tr>
<tr>
<td>10</td>
<td>250</td>
<td>30</td>
<td>762</td>
<td>26½</td>
<td>673</td>
<td>6½</td>
<td>167</td>
<td>9½</td>
<td>241</td>
</tr>
<tr>
<td>12</td>
<td>300</td>
<td>38½½8</td>
<td>964</td>
<td>28½½6</td>
<td>722</td>
<td>7½</td>
<td>194</td>
<td>12½</td>
<td>321</td>
</tr>
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</table>

**Angle Pattern (Convertible)**

**For additional information, request literature ES-CSM-91.**
Series TDV

Triple Duty Valves
Sizes: 2½" – 12" (65 – 300mm)

Series TDV Triple Duty Valves are designed for use on single, double, and vertical in-line pump applications. The TDV combines the functions of a positive hand-tight shutoff valve, check valve, and flow control valve into one versatile package, and eliminates the need to utilize three separate valves on the pump system. By using the Series TDV, fewer components and fewer connections are required. Therefore, installation time is reduced, less space is needed, and the potential for leaks is reduced: adding up to significant cost savings.

The field-convertible design allows the TDV to be changed from the factory-standard, straight pattern to an optional angle pattern by using standard tools, and no additional parts. This allows the TDV to be used as a replacement for angles and elbows, and generates even greater savings on space and connections.

The TDV is also designed for easy field serviceability with bonnet O-rings that can be replaced under pressure by backseating the valve, and seats that can be changed without the use of special tools.

Features

- Reduced field installation and material cost
- Eliminates requirement of three valves on pump discharge
- Soft seat to ensure tight shutoff
- Spring closure design, non-slam silent check valve feature
- Valve Cv designed to ASHRAE flow recommendations for quiet system operation
- Grooved end connections with optional flange adapters

Specifications

A triple duty valve shall be installed on the discharge side of each pump as indicated on the plans. The valve body shall be ductile iron with grooved ends and anti-rotation lugs on the inlet and outlet of the body. The valve shall have two ¼" (6mm) NPT connections on each side of the valve seat. Two connections to have brass pressure metering ports with check valve and gasketed caps. Two other connections to be supplied with brass drain plugs. Metering ports are to be inter-changeable with brass drain plugs. The valve disc shall be bronze plug type with engineered resin seat 2½" – 6" (65 – 150mm) and EPDM for 8” – 12” (200 – 300mm).

Valve stem shall be stainless steel with wrench flats. Flange adapters, where necessary, shall be Class 125) ductile iron flanges with anti-rotation lugs and EPDM gaskets. Valve shall be a Watts Regulator Company Series TDV.

Applications

- Single, double and vertical in-line pumps
**Pressure-Temperature**

**Grooved Ends Only**
- Maximum Working Pressure: 375psi (26.25 bar)
- Maximum Temperature: 230°F (110°C)

**Flange**
- Maximum Working Pressure:
  - Class 125: 175psi (12 bar)
  - Maximum Temperature: 230°F (110°C)

**Materials of Construction**
- Body: Ductile Iron ASTM A536 GR65-45-12
- Disc: Bronze ASTM B584 C-84400
- Seat: Stainless Steel ASTM A582 Type 416
- Spring: Stainless Steel ASTM S302
- O-ring: Buna-N
- Meter Ports: NPT Brass Body with cap
- Drain Tappings (2): ¼" Brass plug

Note: Series TDV valves are shipped with grooved ends standard. For companion flanges, please specify size and class rating when ordering. Insulation blocks are also ordered separately from valve. Please specify size when ordering.

**Dimensions-Weights**

**Straight Pattern (Standard)**

<table>
<thead>
<tr>
<th>Size (DN)</th>
<th>A (in.)</th>
<th>C (in.)</th>
<th>D (in.)</th>
<th>Flange dia. 125# (in.)</th>
<th>Spacer (in.)</th>
<th>Weight (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2½</td>
<td>65</td>
<td>12</td>
<td>305</td>
<td>7 178 2½ 70 2½ 65 7 178</td>
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<td>19 9</td>
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<td>3</td>
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<td>305</td>
<td>7 178 2½ 61 3 76 7½ 191</td>
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**Angle Pattern (Convertible)**

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<th>C (in.)</th>
<th>D (in.)</th>
<th>E (in.)</th>
<th>F₁ (in.)</th>
<th>F₂ (in.)</th>
<th>Flange dia. 125# (in.)</th>
<th>Spacer (in.)</th>
<th>Weight (lbs.)</th>
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<td>295</td>
<td>7½ 187</td>
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<td>10 150</td>
<td>1 1/4 32</td>
<td>81 37</td>
</tr>
<tr>
<td>6</td>
<td>150</td>
<td>17½</td>
<td>432</td>
<td>14½ 359</td>
<td>4½ 111 6½ 168</td>
<td>5½ 149 10½ 264</td>
<td>11 279</td>
<td>2 50</td>
<td>120 54</td>
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<tr>
<td>8</td>
<td>200</td>
<td>18½</td>
<td>513</td>
<td>16½ 415</td>
<td>5½ 234 7½ 200</td>
<td>22½ 580</td>
<td>13½ 343</td>
<td>2½ 57</td>
<td>310 141</td>
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<tr>
<td>10</td>
<td>250</td>
<td>19½</td>
<td>576</td>
<td>18½ 481</td>
<td>5½ 243 9½ 240</td>
<td>8½ 727</td>
<td>16 406</td>
<td>2½ 57</td>
<td>460 209</td>
</tr>
<tr>
<td>12</td>
<td>300</td>
<td>21½</td>
<td>612</td>
<td>20½ 516</td>
<td>6½ 161 9½ 248</td>
<td>9½ 727</td>
<td>16 406</td>
<td>2½ 57</td>
<td>870 395</td>
</tr>
</tbody>
</table>

*Note: Series TDV valves are shipped as straight pattern from factory. To convert to angle pattern refer to instruction sheet shipped with valve.*

For additional information, request literature ES-TDV.
Series CSM-91-IK

Insulation Kits
Sizes: 2½" – 4" (65 – 100mm)

Series CSM-91-IK Insulation Kits are available in sizes 2½" – 6" (65 – 150mm) to suit Watts Series CSM-91 balancing valves and Series TDV triple duty valves. The outside shell is a preformed, removable PVC jacket with a flame spread rating of 50 or less. These systems provide sufficient mineral fiberglass insulation to meet ASHRAE 90.1 specifications in operating conditions with maximum fluid design operating temperature range of 141°F – 200°F (61°C – 93°C) and mean rating temperature of 125°F (52°C).

For additional information, request literature ES-CSM-91-INS.

Series PG

Pressure Differential Gauges

Series PG Pressure Differential Gauges are designed for use with all Watts flow measurement valves and flow measurement orifices. This Series may also be used to check differential pressures across other system components including pumps, strainers, coils, etc. All readout kits feature overrange protection and are equipped with hoses, carrying case and instructions.

Features
- Portable
- For use with Watts flow measurement valves & orifices
- Overrange protection
- Equipped with hoses, carrying case and instructions

Ranges:

<table>
<thead>
<tr>
<th>Model</th>
<th>Pressure Range</th>
<th>Temp. Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>PG-2</td>
<td>0 – 16 ft. (0 – 4876 kg/m²)</td>
<td>235°F (113°C)</td>
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<tr>
<td>PG-3</td>
<td>0 – 35 ft. (0 – 10668 kg/m²)</td>
<td>235°F (113°C)</td>
</tr>
<tr>
<td>PG-4</td>
<td>0 – 100 in. (0 – 2540 kg/m²)</td>
<td>235°F (113°C)</td>
</tr>
<tr>
<td>PG-5</td>
<td>0 – 200 in. (0 – 5080 kg/m²)</td>
<td>235°F (113°C)</td>
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<tr>
<td>PG-6</td>
<td>0 – 50 in. (0 – 1270 kg/m²)</td>
<td>235°F (113°C)</td>
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<tr>
<td>PG-8</td>
<td>0 – 135 in. (0 – 3429 kg/m²)</td>
<td>235°F (113°C)</td>
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</tbody>
</table>

For additional information, request literature ES-PG-2-6 or ES-PG-8.

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