UNIVERSAL® Flow Monitors

Flow meters, Flow switches and Flow transmitters

Piston - In Line

DESCRIPTION
These variable-area meters position an orifice over a tapered shaft to establish flow rate. Mounting is in-line and in any position. Straight pipe runs before or after this monitor are not required. The all-mechanical sensing system directly drives the pointer, switches and transmitters.

READOUTS
The flowmeter has outputs both visual and electronic. Visual displays are either pointer (with inscribed scale) or numeric (digital LCD). Electronic outputs can be mechanical switch closure, 4-20 mA analog, HART or some combination of switches with electronic outputs (for signal redundancy). The switches can be general purpose or rated for hazardous locations (all classes, groups and divisions).

CALIBRATION
All flow meters are individually calibrated for fluids with the viscosity you specify (up to 3000 SSU/650 Centistokes). We also compensate for your fluid’s specific gravity. For NIST Traceability please consult factory.

CONSTRUCTION MATERIALS
Housings and seals are offered in a variety of materials to suit a wide range of applications, such as: water, oil, coolants, paint, solvents and some corrosive fluids. See selections in the “How to Order” section.

LINE CONNECTION
Ports can be threaded or flanged. See selections in the “How to Order” section.

Fluid flow causes a spring-loaded piston A having a circular opening at its center B to move along the axis of a precision-tapered shaft C. This creates a variable orifice in direct proportion to the flow rate. The piston is mechanically linked to the readout pointer D and actuates switch E or a transmitter (not shown).

Viton® and Kalrez™ are registered trademarks for DuPont Performance Elastomers.
HOW TO ORDER
Select appropriate symbols and build a model code number, as in example shown:

**EXAMPLE:**  PI - B Z F 10GM - 4 32V1.0 -

### SERIES BY PRESSURE RATING
- **Piston Inline** = PI

### HOUSING MATERIAL 500PSI WHERE USED
- **Aluminum** Lube oil = A
- **Brass** Water = B

### HOUSING MATERIAL 1500PSI WHERE USED
- **Carbon steel** Oil = M
- **Stainless steel (316)** Chemicals, corrosives = Z

### INTERNAL MOVING PARTS
- **Stainless steel (316L series)** Water, oil, chemicals and corrosives = Z

### SEAL MATERIAL
- **Buna N** Water, oil = B
- **EPR** Hot water, caustics = E
- **Viton** Acids, some caustics = F
- **Kalrez** Corrosives, solvents = J
- **Kalrez (dynamic) & Buna N (static)** Specialty = A
- **Kalrez (dynamic) and EPR (static)** Specialty = H
- **Kalrez (dynamic) and Viton (static)** Specialty = K
- **Kalrez (dynamic) and Teflon (static)** Corrosives, solvents = T

### MAX FLOW RATE LIQUIDS

<table>
<thead>
<tr>
<th>SCALES</th>
<th>GPH: 5, 10, 15, 20, 25, 30, 40, 50, 60, 75, 80, 90, 100, 120, 150, 200, 250 &amp; 300 = GH</th>
<th>GPM: 0.25, 0.5, 0.75, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20 &amp; 30 = GM</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPH: 20, 30, 40, 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600, 700, 800, 900 &amp; 1000 = LH</td>
<td>LPM: 5, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100 = LM</td>
<td></td>
</tr>
<tr>
<td>CMH: 1, 2, 3, 4, 5, 6 = CMH</td>
<td>GLM: Dual scale - gallons &amp; liters per minute = GLM</td>
<td></td>
</tr>
</tbody>
</table>

### THREAD ATTACHMENT

<table>
<thead>
<tr>
<th>Pipe Size and attachment method</th>
<th>Pipe Size in inches</th>
<th>NPT</th>
<th>SAE</th>
<th>BSPP</th>
<th>BSPT</th>
<th>Max Flow in GPM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4</td>
<td>2</td>
<td>4T</td>
<td>4BP</td>
<td>4BT</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>3/8</td>
<td>3</td>
<td>6T</td>
<td>6BP</td>
<td>6BT</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>1/2</td>
<td>4</td>
<td>8T</td>
<td>8BP</td>
<td>8BT</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>5/8</td>
<td>3</td>
<td>12T</td>
<td>12BP</td>
<td>12BT</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>3/4</td>
<td>6</td>
<td>16T</td>
<td>16BP</td>
<td>16BT</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>8</td>
<td>20T</td>
<td>20BP</td>
<td>20BT</td>
<td>30</td>
<td></td>
</tr>
</tbody>
</table>

### FLANGED

Ex: 2FWCS150RF = 1/4", Welded, Carbon steel, Class 150, Raised Face flange

<table>
<thead>
<tr>
<th>Pipe Size in inches</th>
<th>Attachment</th>
<th>Material</th>
<th>Class</th>
<th>Style</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>FW=Welded</td>
<td>CS=Carbon Steel</td>
<td>15Ø</td>
<td>RF=ANSI raised face</td>
</tr>
<tr>
<td>3</td>
<td>FT=Threaded</td>
<td>S=316 Stainless</td>
<td>3ØØ</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td>6ØØ</td>
<td></td>
</tr>
</tbody>
</table>

### FLUID CHARACTERISTICS

Viscosity number followed by a ‘V’ (for SSU), ‘C’ (for centipoise), or ‘CS’ (for centistokes) followed by the specific gravity. Example: 32V1.0 would indicate a fluid with a viscosity of 32 SSU and specific gravity of 1.0
### SERVICE
- Oil and dust tight (Type 12) Available on ‘A’, ‘L’, and ‘Z’ only = N
- Weatherproof (Type 4) Available on all boxes = W
- Weatherproof, corrosion proof (Type 4X) Available on all boxes = X

### SPECIAL OPTIONS (See explanations below)
- High-temp- 400°F (300°F for transmitter options) = HT
- High accuracy (+/-1%) ref. page 4 = HA
- Stainless steel ID tag = ST
- Safety Glass window ref. page 4 = TG

### FLOW DIRECTION
- Left to right = R
- Right to left = L
- Up = U
- Down = D

### SWITCH SETTING
- No symbol = Lowest possible setting (usually 10% of maximum flow)

### CONTROL BOX & READOUT

#### A, L and Z small control box in the following configurations and materials:

<table>
<thead>
<tr>
<th>4-20 mA transmitter (Intrinsically safe with approved barriers)</th>
<th>AX0</th>
<th>LX0</th>
<th>ZX0</th>
</tr>
</thead>
<tbody>
<tr>
<td>HART with programmable switch points</td>
<td>AH0</td>
<td>LH0</td>
<td>ZH0</td>
</tr>
<tr>
<td>Display only</td>
<td>A0</td>
<td>L0</td>
<td>Z0</td>
</tr>
<tr>
<td>One SPDT (3 wire)</td>
<td>A1</td>
<td>L1</td>
<td>Z1</td>
</tr>
<tr>
<td>One high vibration SPDT (3 wire)</td>
<td>A1B</td>
<td>L1B</td>
<td>Z1B</td>
</tr>
<tr>
<td>Two SPDT (3 wire)</td>
<td>A2</td>
<td>L2</td>
<td>Z2</td>
</tr>
<tr>
<td>Two high vibration SPDT (3 wire)</td>
<td>A2B</td>
<td>L2B</td>
<td>Z2B</td>
</tr>
<tr>
<td>One SPDT (4 wire)</td>
<td>A3</td>
<td>L3</td>
<td>Z3</td>
</tr>
<tr>
<td>Two SPDT (4 wire)</td>
<td>A4</td>
<td>L4</td>
<td>Z4</td>
</tr>
<tr>
<td>One SPDT (3 wire) high temperature</td>
<td>A61</td>
<td>L61</td>
<td>Z61</td>
</tr>
<tr>
<td>Two SPDT (3 wire) high temperature</td>
<td>A62</td>
<td>L62</td>
<td>Z62</td>
</tr>
<tr>
<td>One SPDT (3 wire) gold contact</td>
<td>A71</td>
<td>L71</td>
<td>Z71</td>
</tr>
<tr>
<td>Two SPDT (3 wire) gold contact</td>
<td>A72</td>
<td>L72</td>
<td>Z72</td>
</tr>
<tr>
<td>One SPDT (3 wire) hermetically sealed</td>
<td>A83</td>
<td>L83</td>
<td>Z83</td>
</tr>
<tr>
<td>Two SPDT (3 wire) hermetically sealed</td>
<td>A84</td>
<td>L84</td>
<td>Z84</td>
</tr>
</tbody>
</table>

#### A Box  L Box  Z Box

#### T Box

- "T" box always has a transmitter (4-20 mA or HART) and can be in combination with a mechanical switch for redundancy. It has two junction boxes to separate wiring for switches and transmitters. The display can be analog or digital LCD.

#### LCD readout, 4-20mA plus option:
- No switches (Intrinsically safe with approved barriers) TX0
- One SPDT (3 wire) TX1
- Two SPDT (3 wire) TX2
- One SPDT (4 wire) TX3
- Two SPDT (4 wire) TX4
- One SPDT (3 wire) high temperature TX61

#### Pointer, scale and 4-20 mA plus option:
- No switches (Intrinsically safe with approved barriers) TX0
- One SPDT (3 wire) TX1
- Two SPDT (3 wire) TX2
- One SPDT (4 wire) TX3
- Two SPDT (4 wire) TX4
- One SPDT (3 wire) high temperature TX61

#### HART, pointer, scale plus option:
- Two programmable HART switches TH0
- One SPDT (3 wire) TH1
- Two SPDT (3 wire) TH2
- One SPDT (4 wire) TH3
- Two SPDT (4 wire) TH4
- One SPDT (3 wire) high temperature TH61

#### R Box

- "R" box is selected for greater visual resolution. It holds switches (general purpose and hazardous location all classes, groups and divisions) and transmitters (HART or 4-20 mA). Switch (standard service) and transmitter are offered in this control box together when signal redundancy is desired.

#### Flow rate display plus:
- Display only R0
- One SPDT (3 wire) R1
- One high vibration SPDT (3 wire) R18
- Two SPDT (3 wire) R2
- Two high vibration SPDT (3 wire) R28
- One SPDT (4 wire) R3
- Two SPDT (4 wire) R4
- One SPDT (3 wire) high temperature R61
- Two SPDT (3 wire) high temperature R62
- One SPDT (3 wire) gold contact R71
- Two SPDT (3 wire) gold contact R72

#### Flow rate display, Hazardous location switches as follows:
- For < 1 amp circuits R7
- One SPDT hazardous location R7
- One DPDT hazardous location R17
- Two SPDT hazardous location R18
- Two DPDT hazardous location R19

#### Flow rate display, 4-20 mA transmitter plus options as follows:
- Display and transmitter only (Intrinsically safe with approved barriers) RX0
- One SPDT (3 wire) RX1
- Two SPDT (3 wire) RX2
- One SPDT (4 wire) RX3
- Two SPDT (4 wire) RX4
- One SPDT (3 wire) high temperature RX61

#### Flow rate display, HART output plus options as follows:
- HART output only RH0
- One SPDT (3 wire) RH1
- Two SPDT (3 wire) RH2
- One SPDT (4 wire) RH3
- Two SPDT (4 wire) RH4

#### TH61

#### Down = D
#### Up = U
#### Right to left = R
#### Left to right = L

**Flow Direction**

Desired set point is assumed to be in flow units already selected (GM). Give flow rate followed by a "D" for flow going down (flow failure) or a "U" for flow going up. Example, 5D indicates a setting of 5 GPM in declining flow.
SPECIAL OPTIONS

High temperature: (option HT) requires all-metal construction with seals of Viton, EPR, Kalrez or Teflon (compatible with fluid). A thermal barrier (heat-resistant cloth) is added between the housing and the control box, which must be used with service option "W" (weatherproof) or "X" (corrosion resistant). A metal scale is provided.

High Accuracy: (option HA) Modification of full scale to +/-1%. HA not available on R7, R17, R18, R19 switch options. Requires flow rates of 1 GPM or greater.

Identification tag: (option ST) customer-supplied information is stamped on a stainless steel tag that is attached to the nameplate.

Safety Glass window: (option TG) replaces the standard window with "Laminated Safety Glass" ANSI Z97.1 and CPSC 1601 CFR 1201.

ENGINEERING DATA

Maximum fluid temperature: 200°F (93°C)

Maximum ambient temp: 150°F (65°C) CSA listed only to 105°F (41°C)

Series PI max. operating pressures: (3:1 safety factor): 500 PSI (34.48 BAR) or 1500 PSI (103.42 BAR)

Pressure drop: 5 PSI (.35 BAR) at full scale

Readout accuracy, full scale: ±2%

1% HA (high accuracy) available on 1 GPM and above.

Reference Special Options below

Switch repeatability is 1% of actual flow

INSTALLATION

Piston Inline (PI) meters mount in-line and are typically supported by rigid pipe.
CONTROL BOX SELECTION GUIDE

“A”, “L” and “Z” Boxes

3/4" NPT Conduit Connection

PORT-TO-PORT

5.25 [133 mm]

R5.72 [145 mm]
APPROXIMATE SWING RADIUS

Maximum installation dimensions

“T” Box

5.25 [133 mm] [133 mm]
PORT-TO-PORT

R7.29 [185 mm] [185 mm]
APPROXIMATE SWING RADIUS

Maximum installation dimensions

“R” Box

SECONDARY JUNCTION BOX LOCATION

1/2" NPT CONDUIT CONNECTION

PORT-TO-PORT

5.25 [133 mm]

PRIMARY JUNCTION BOX LOCATION

ROUND ENCLOSURE JUNCTION BOX OPTIONS

<table>
<thead>
<tr>
<th>No Junction Box</th>
<th>Pointer Only, No Electrical Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Junction Box</td>
<td>One Type of Electrical Item Only – 1 or 2 Switches or Transmitter, but NOT both</td>
</tr>
<tr>
<td>Primary Location</td>
<td>2 Junction Boxes: Transmitter AND 1 or 2 Switches.</td>
</tr>
</tbody>
</table>

R8.08 [205 mm]
APPROXIMATE SWING RADIUS
FOR ALL OTHER OPTIONS

R8.48 [215 mm]
APPROXIMATE SWING RADIUS
FOR 2 SWITCHES & 2 JUNCTION BOXES

Maximum installation dimensions

Approximate Swing Radius

5.25 [133 mm]
PORT-TO-PORT

1 Junction Box

500-NPT Conduit Connection
(2) Places

1/2" NPT Conduit Connection

5.25 [133 mm]
PORT-TO-PORT

1 Junction Box

Secondary Junction Box Location

Secondary Junction Box Location

Primary Junction Box Location

Secondary Junction Box Location

Primary Junction Box Location
A-Box for PI Series w Flanges

Face-to-Face Dimensions With 150# R.F. Flanges
(for other flanges consult factory)

“Flow Up” or “Flow Down” dimensions are the same.
Scale numbers are rotated 90° to read correctly.

<table>
<thead>
<tr>
<th>Port Size (Inches)</th>
<th>Dia. A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>3 1/2</td>
</tr>
<tr>
<td>3/4</td>
<td>3 7/8</td>
</tr>
<tr>
<td>1</td>
<td>4 1/4</td>
</tr>
</tbody>
</table>