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).

PI Series, with standard scale and pointer (control box A).

PI 070720
**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**

**HOUSING MATERIAL 500PSI WHERE USED**

- Aluminum
  - Lube oil = A
- Brass
  - Water = B

**HOUSING MATERIAL 1500PSI WHERE USED**

- Stainless steel (316)
  - Chemicals, corrosives, oil = 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**

**SCALES**

- GPH: 5, 10, 15, 20, 25, 30, 40, 50, 60, 75, 80, 90, 100, 120, 150, 200, 250 & 300 = GH
- GPM: 0.25, 0.5, 0.75, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20 & 30 = GM
- LPH: 20, 30, 40, 50, 60, 70, 80, 90, 100, 200, 300, 400, 500, 600, 700, 800, 900 & 1000 = LH
- LPM: 5, 10, 15, 20, 25, 30, 35, 40, 50, 60, 70, 75, 80, 90, 100 = LM
- CMH: 1, 2, 3, 4, 5, 6
- GLM: Dual scale - gallons & liters per minute

**THREADED ATTACHMENT**

<table>
<thead>
<tr>
<th>Pipe Size and Attachment Method</th>
<th>NPT</th>
<th>SAE</th>
<th>BSPP</th>
<th>BSPT</th>
<th>Max Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/4 In Inches</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 In Inches</td>
<td>2</td>
<td>4T</td>
<td>4BP</td>
<td>4BT</td>
<td>5</td>
</tr>
<tr>
<td>3/8 In Inches</td>
<td>3</td>
<td>6T</td>
<td>6BP</td>
<td>6BT</td>
<td>10</td>
</tr>
<tr>
<td>1/2 In Inches</td>
<td>3</td>
<td>8T</td>
<td>8BP</td>
<td>8BT</td>
<td>15</td>
</tr>
<tr>
<td>5/8 In Inches</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/4 In Inches</td>
<td>6</td>
<td>12T</td>
<td>12BP</td>
<td>12BT</td>
<td>30</td>
</tr>
<tr>
<td>1 In Inches</td>
<td>8</td>
<td>16T</td>
<td>16BP</td>
<td>16BT</td>
<td>30</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>1/4&quot;</td>
<td>FW=Welded</td>
<td>CS=Carbon Steel</td>
<td>150</td>
</tr>
<tr>
<td>3</td>
<td>3/8&quot;</td>
<td>FT=Threaded</td>
<td>S=316 Stainless</td>
<td>300</td>
</tr>
<tr>
<td>4</td>
<td>1/2&quot;</td>
<td>FW=Welded</td>
<td>CS=Carbon Steel</td>
<td>600</td>
</tr>
<tr>
<td>6</td>
<td>3/4&quot;</td>
<td>FW=Welded</td>
<td>CS=Carbon Steel</td>
<td>600</td>
</tr>
<tr>
<td>8</td>
<td>1&quot;</td>
<td>FW=Welded</td>
<td>CS=Carbon Steel</td>
<td>600</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

**FLOW DIRECTION**

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

**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

**No symbol** = Lowest possible setting (usually 10% of maximum flow)

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.

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**CONTROL BOX & READOUT**

**‘A’, ‘L’ and ‘Z’ Boxes**

*A*, *L* and *Z* boxes are small, simple and cost effective. Available with analog display, mechanical switches or transmitters (HART or 4-20mA).

<table>
<thead>
<tr>
<th>A Box</th>
<th>L Box</th>
<th>Z Box</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALBA</td>
<td>LBA</td>
<td>ZA</td>
</tr>
<tr>
<td>ALCA</td>
<td>LCA</td>
<td>ZB</td>
</tr>
<tr>
<td>ALDA</td>
<td>LDA</td>
<td>ZC</td>
</tr>
<tr>
<td>ALFA</td>
<td>LFA</td>
<td>ZD</td>
</tr>
</tbody>
</table>

4-20 mA transmitter (Intrinsically safe with approved barriers)

- AX0
- LX0
- ZX0
- A0
- L0
- Z0
- A1
- L1
- Z1
- A2
- L2
- Z2
- A3
- L3
- Z3
- A4
- L4
- Z4
- A51
- L51
- Z51
- A52
- L52
- Z52
- A53
- L53
- Z53
- A54
- L54
- Z54

HART with programmable switch points

- AXH
- LXH
- ZXH
- A0H
- L0H
- Z0H
- A1B
- L1B
- Z1B
- A2B
- L2B
- Z2B
- A3
- L3
- Z3
- A4
- L4
- Z4
- A51
- L51
- Z51
- A52
- L52
- Z52
- A53
- L53
- Z53
- A54
- L54
- Z54

Display only

- A0
- L0
- Z0

One SPDT (3 wire)

- A1
- L1
- Z1

One high vibration SPDT (3 wire)

- A1B
- L1B
- Z1B

Two SPDT (3 wire)

- A2
- L2
- Z2

Two high vibration SPDT (3 wire)

- A2B
- L2B
- Z2B

One SPDT (4 wire)

- A3
- L3
- Z3

Two SPDT (4 wire)

- A4
- L4
- Z4

One SPDT (3 wire) high temperature

- A61
- L61
- Z61

Two SPDT (3 wire) high temperature

- A62
- L62
- Z62

One SPDT (3 wire) gold contact

- A71
- L71
- Z71

Two SPDT (3 wire) gold contact

- A72
- L72
- Z72

One SPDT (3 wire) hermetically sealed

- A53
- L53
- Z53

Two SPDT (3 wire) hermetically sealed

- A54
- L54
- Z54

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**T 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.*

**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

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**‘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) = R1B
- Two SPDT (3 wire) = R2
- Two high vibration SPDT (3 wire) = R2B
- 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*

- One SPDT hazardous location = R7
- One DPDT hazardous location = R17
- Two SPDT hazardous location = R18
- Two DPDT hazardous location = R19

*For > 5 amp circuits*

- One SPDT hazardous location = R20
- One DPDT hazardous location = R21
- Two SPDT hazardous location = R22
- Two DPDT hazardous location = R23
- One SPDT hazardous location proximity = R30
- Two SPDT hazardous location proximity = R31

**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
**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.

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CONTROL BOX SELECTION GUIDE

“A”, “L” and “Z” Boxes

3/4” NPT Conduit Connection

“T” Box

500-NPT Conduit Connection
(2) PLACES

“R” Box

SECONDARY JUNCTION BOX LOCATION

PRIMARY JUNCTION BOX LOCATION

ROUND ENCLOSURE JUNCTION BOX OPTIONS

| No Junction Box | Pointer Only, No Electrical Components |
| 1 Junction Box | One Type of Electrical Item Only – 1 or 2 Switches or Transmitter, but NOT both. |
| 2 Junction Boxes | Transmitter AND 1 or 2 Switches. |

R5.72 [145 mm] APPROXIMATE SWING RADIUS

R7.29 [R185 mm] [185 mm] APPROXIMATE SWING RADIUS

5.25 [133 mm] PORT-TO-PORT

5.25 [133 mm] PORT-TO-PORT

5.25 [133 mm] PORT-TO-PORT

5.25 [133 mm] PORT-TO-PORT

APPROXIMATE SWING RADIUS

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APPROXIMATE SWING RADIUS

PORT-TO-PORT

PORT-TO-PORT

PORT-TO-PORT

PORT-TO-PORT

5.25 [133 mm]

5.25 [133 mm]

5.25 [133 mm]

5.25 [133 mm]
A-Box for PI Series w Flanges

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

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>

“Flow Up” or “Flow Down” dimensions are the same.