IN-LINE PNEUMATIC FLOW METER INSTALLATION & MAINTENANCE INSTRUCTIONS

HEDLAND®
DIVISION OF RACINE FEDERATED INC.

FORM # HLIT208-2G

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⚠ CAUTION

This product should be installed and serviced by technically qualified personnel trained in maintaining industrial class flow instrumentation and processing equipment.

⚠ CAUTION

Read instructions thoroughly before installing the flow meter. If you have any questions regarding product installation or maintenance call your local supplier for more information.

I. Introduction

The Pneumatic Flow Meter is an industrial class in-line flow rate indicator, offered in seven port sizes (from 1/4" to 3") to monitor pressurized air lines and/or a wide range of other compressed gases, in flow ranges from 0.5-5 SCFM up to 200-2200 SCFM.

SCFM = Standard Cubic Feet per Minute [1 cu ft of Air (1.0 SG) @ 100 PSIG @ 70 °F]

This direct reading piston-type variable area flow meter is simple to install. However, a few precautions are recommended to assure maximum operational reliability with minimum maintenance.

Compressibility of Gases

Since gases are significantly compressible, the density of any compressed gas will vary according to changes in operating pressure levels. In other words, volumetric flow rates will vary significantly with changes in line pressure. Therefore, pneumatic flow meters should be installed with a pressure gauge located as close as possible to the inlet port. The PSIG range capacity of this pressure gauge should be at least 125% of the anticipated pressure in the system, or be suitable for the maximum expected line pressure (if higher). For example, if you are anticipating an operating pressure of 100 PSIG, you should use a pressure gauge with a capacity of at least 125 PSIG.

Materials of Construction

The standard Pneumatic Flow Meter is offered in a variety of construction materials to provide the flexibility and chemical compatibility to fit the widest possible range of flow monitoring applications.

Aluminum is offered as a rugged, low cost flow meter for monitoring non-corrosive pneumatic systems (or other compressed gases) under operating pressures up to 1000 PSIG (250 PSIG for 3" models) with a 10:1 safety factor for direct reading models and 600 PSIG for test kits.

Brass is recommended for monitoring compressed gases under operating pressures up to 1000 PSIG, in applications where corrosion inhibitors are ***not*** present. It is also recommended for applications in which galvanic corrosion could become a problem, such as systems using copper or brass components in the presence of an electrolyte, such as water. The brass test kit is rated to 600 PSIG; pressure rating is limited by the valve.

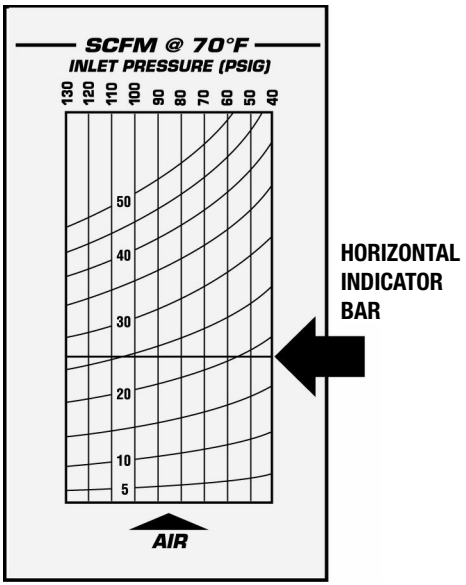
Stainless Steel flow meter models are offered for monitoring air flow or other compressed gases under pressures up to 1500 PSIG with a 10:1 safety factor. The all stainless steel models (with hostile environment components) are recommended for monitoring caustic or corrosive gases, such as hydrogen chloride or sulfur dioxide, or similar aggressive gases that would attack most materials of construction. The stainless test kit is rated to 600 PSIG; pressure rating is limited by the valve.

Four Pneumatic Meter Models

The standard Pneumatic Flow Meter is offered with the exclusive Multi-pressure Flow Scale (See Figure 1). Suitable for use with Air (1.0 s.g.).

1. The basic model is offered with a standard flow meter body, calibrated to indicate flow using the exclusive Multi-pressure Flow Scale.
2. A second (extended) flow meter design model is also offered. In addition to featuring the exclusive Multi-pressure Flow Scale, this second model option features a modified flow meter body with an extended inlet cap. This extended inlet cap contains a (plugged) ¼" NPT port for quick, easy field installation of a customer supplied pressure gauge.
3. The third model option is similar to the second with a Multi-pressure Flow Scale and a factory installed pressure gauge already mounted in the extended inlet cap of the meter body.
4. The Pneumatic Flow Meter is also offered in a test kit configuration which includes an extended cap with factory installed pressure gauge and ball valve.

Figure 1 Multi-pressure Flow Scale



Multi-pressure Flow Scale

The In-line Pneumatic Flow Meter is offered with a Multi-pressure Flow Scale to visually indicate air flow rates (1.0 s.g.) in SCFM (standard cubic feet/minute) at various pressure levels from 40 PSI to 130 PSI.

How to Read

To use, the operator reads the inlet gauge pressure and selects the appropriate vertical line or interpolated value closest to the gauge reading and follows the line until it intersects the brightly colored horizontal indicator bar. The flow rate in scfm/lps is read by taking the intersection points and following the slope of the closest diagonal line to a scale value and interpolating the scfm/lps flow rate. No further calculations are required. See Figure 1, Multi-pressure Scale.

Single Pressure Flow Scale

A special Single Pressure Flow Scale is available in U.S. or metric units for an additional charge. See “Price and Availability Digest”, Form 141 on CD-ROM. This is a graduated scale, calibrated for air in standard cubic feet per minute (scfm) at 1.0 s.g. (70 °F at 100 psi), or liters per second (lps) at 1.0 s.g. (21 °C at 6.9 bar), see Figure 2 on page 3, Single Pressure Flow Scale. A standard cubic foot of air is defined as a cubic foot of air at 70 °F at atmospheric pressure 14.7 psia at sea level. Since it is impossible to flow air at “standard” conditions, the scale is calibrated for an inlet condition of 100 psi (6.9 bar) at 70 °F (21 °C). A correction factor must be calculated to determine the actual air volume. Each meter is supplied with the Conversion Chart shown in Figure 3 on page 3.

Conversion Chart

The Conversion Chart provides a series of simplified mathematical formulas to "correct" the graduated scale for changes in pressure (Table 1), temperature (Table 2), and/or specific gravity (Table 3). *Special scales can be made to accommodate other pressures, temperatures and specific gravity.*

The Conversion Chart can also be used to "correct" (adjust) the Multi-pressure Flow Scale to indicate flow rates in applications beyond the parameters stated on the scale.

*To adjust for **Pressures** beyond (above or below) scale limits:*

Step 1. Locate point at which the brightly colored indicator line intersects the vertical 100 PSIG pressure line.

Step 2. Divide this reading by the Pressure Correction Factor (f_1) indicated in the Conversion Chart.

*To adjust for changes in **Temperature**:*

Step 1. Divide the 100 PSIG flow rate reading by Temperature Correction Factor (f_2).

*To adjust for changes in **Specific Gravity**:*

Step 1. Establish the square root of the new specific gravity.

Step 2. Divide the 100 PSIG flow rate reading by the Specific Gravity Correction Factor (f_3).

Figure 2 Single Pressure Flow Scale

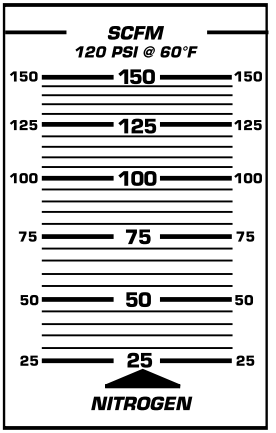


Figure 3 Conversion Chart

DETERMINE FLOW RATES USING DIFFERENT PRESSURES & TEMPERATURES

$$\text{scfm (actual)} = \frac{\text{scfm (indicated)}}{f_1 \times f_2 \times f_3}$$

Where f_1 = Conversion factor for inlet pressure
f_2 = Conversion factor for temperature
f_3 = Conversion factor for specific gravity

TABLE 1 PRESSURE CORRECTION FACTOR (f_1) Operating Pressure

psig	25	50	75	100	125	150	175	200	225	250
BAR	1.7	3.5	5.2	6.9	8.6	10.4	12.1	13.8	15.5	17.2
kPa	172	345	517	689	862	1034	1207	1379	1551	1724
f_1	1.700	1.331	1.131	1.00	.902	.835	.778	.731	.692	.658

$$f_1 = \sqrt{\frac{114.7}{14.7 + \text{psig}}} \qquad f_1 = \sqrt{\frac{7.914}{1.014 + \text{BAR}}} \qquad f_1 = \sqrt{\frac{790.857}{101.357 + \text{kPa}}}$$

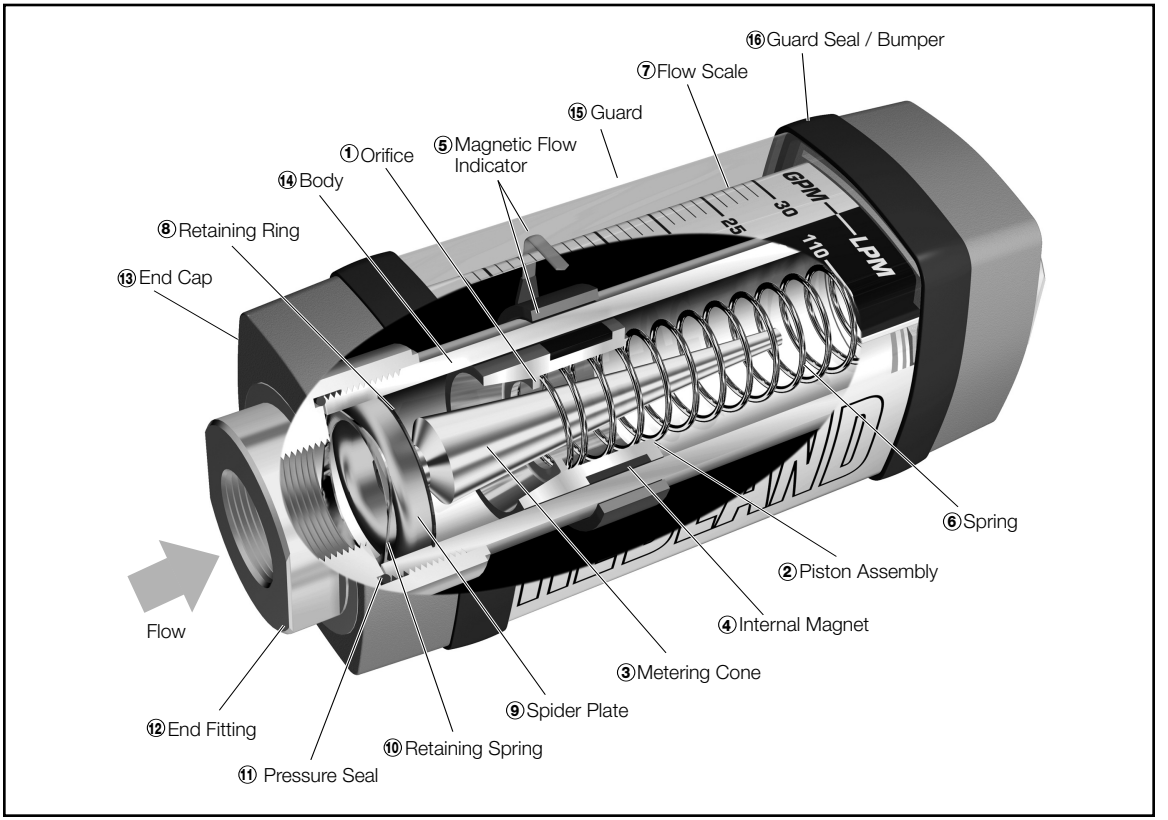
TABLE 2 TEMPERATURE CORRECTION FACTOR (f_2)

°F	+10	+30	+50	+70	+90	+110	+130	+150	+170	+190
°C	-12.2	-1.1	+9.9	+21.0	+32.1	+43	+54	+65	+76	+88
f_2	.942	.962	.981	1.00	1.018	1.037	1.055	1.072	1.090	1.107

$$f_2 = \sqrt{\frac{460 + °F}{530}} \qquad f_2 = \sqrt{\frac{273 + °C}{293}}$$

TABLE 3 SPECIFIC GRAVITY CORRECTION FACTOR (f_3)

$$f_3 = \sqrt{\text{Sp. Gr.}}$$



⚠ CAUTION

This meter may contain residual amounts of test fluid at the time of shipment. This fluid should be removed prior to installation as the fluid may be incompatible or hazardous with some liquids or gases. Failure to follow these instructions could result in damage to the equipment.

II. Operating Principle:

The Flow Meter is a variable area instrument. A precision machined, sharp-edged Orifice ① located within the Piston Assembly ②, forms an annular opening with the contoured Metering Cone ③. The piston assembly carries a cylindrical PPS/Ceramic Magnet ④ that is magnetically coupled to an external Indicating Magnet ⑤ that moves precisely in direct response to movement of the piston. A calibrated Spring ⑥ opposes flow in the forward direction. This spring decreases viscosity sensitivity and allows the flow meter to be used in any position, including inverted.

Bi-directional flow capability: If required, a reverse flow by-pass option is available and is depicted on individual product pages of Hedland catalog Form No. 140-2G. Note that flow is measured in the forward direction only.

Operates in any position: The in-line flow meter's unique spring loaded variable area design allows meters to be installed in any position without affecting accuracy. An optional inverted flow scale is also available.

Easier to read linear scale: This flow meter is the most readable product in its class. Brightly colored indicators move over the graduated, linear Flow Scale ⑦ which contains bold, easy to read numerals and gauge marks. This enhanced resolution virtually eliminates parallax problems associated with competitive, direct reading flow meters.

360° Rotatable guard/scale: This unique design allows the meter to be installed in any orientation without regard to scale direction. Once the meter is permanently installed, the guard/scale can be rotated 360° to optimize readability.

Operating Pressure

The standard Pneumatic Flow Meter (Aluminum and/or Brass) operates under normal industrial class conditions at pressures up to 1000 PSIG (250 PSIG for 3" meters) with a 10:1 safety factor. Stainless Steel models are rated up to 1500 PSIG with a 10:1 safety factor.

⚠ CAUTION

For rigorous cyclical applications, consult factory for specific fatigue life estimates.

Operating Temperature

The operating temperature for standard Pneumatic Flow Meters is 240 °F maximum.

III. Installation

The In-line Flow Meter is a simple device to install. However, the following tips are recommended for reliable, trouble-free operation.

⚠ CAUTION

Do NOT install this unit within 2 ft of electrical transformers, high powered electric motors or other electromagnetic devices that could adversely affect the magnetic coupling between the flow indicator ring and the piston magnet.

A. Piping (plumbing)

1. The standard In-line Flow Meters are offered in SAE (Society of Automotive Engineers), NPTF (National Pipe Thread - Dry Seal), and BSPP (British Standard Pipe Parallel) ports and available in the following sizes: 1/4" (SAE #6), 1/2" (SAE #10), 3/4" (SAE #12), 1" (SAE #16), 1-1/4" (SAE #20), 1-1/2" (SAE #24), 1-1/2" Code 62 4-bolt flange, 3" (SAE #28) and 3" Code 61 4-bolt flange. Note: Use pipe threaded within commercial tolerances.

⚠ CAUTION

Do NOT use aromatic hydrocarbons, halogenated hydrocarbons, ketones or ester-based fluids on (or near) polycarbonate guard. Do NOT use Loctite® thread locker or liquid Teflon® as thread sealant.

2. Piping should be accurately aligned and of correct length. The high pressure body of the flow meter can withstand shock and flow/pressure pulsation. However, the piping should be firmly supported by external mounting brackets, both upstream and downstream of the meter, to avoid any pipe flexing action that could reduce the life of the meter.
3. If the flow meter inlet or outlet are to be rigidly mounted and the opposing port is to be connected to flexible hose, the end connected to flexible hose ***must*** be rigidly mounted.
4. Install a union near the inlet or outlet of the meter. This will facilitate quick, easy meter removal and inspection during periodic maintenance procedures.

⚠ CAUTION

Do not use pipe wrenches on the flow meter body. To avoid scarring or otherwise damaging the external surface, use an open end wrench for securing the inlet and for tightening the flow meter outlet connection port.

5. The In-line Flow Meter does not require flow straighteners or special lengths of straight inlet/outlet piping to stabilize turbulent flow patterns. However, to assure maximum operational reliability, avoid installation of elbows, valves and/or reducers immediately adjacent to the meter inlet, if possible.

B. Flow Direction

Caution should be taken to align the flow arrow, located on the meter scale, in the same direction as the anticipated line flow.

⚠ CAUTION

The standard flow meter is a unidirectional flow meter. The piston acts as a check valve to block flow in the reverse direction. This causes an excessive pressure differential, which can result in damage to internal meter components. The Flow Meter is also available in a modified design, which offers a reverse flow by-pass feature to accommodate bi-directional flow. Consult factory for details.

C. Mounting Orientation

The design of the In-Line Flow Meter provides the designer/installer the flexibility to mount the product in any plane, without sacrificing (hindering) flow rate accuracy. (It is calibrated in the horizontal axis, and will provide the highest degree of accuracy in that orientation.)

D. Filtration

The meter will allow particulate to pass that would jam most valves and flow controls. Systems which do not have filtration should be equipped with at least a 200 mesh sieve or 74 micron filter. Most pneumatic systems would already have a much finer filtration.

Within the flow meter body, dirt, ferrous metal or sealing agents, such as Teflon® tape may lodge and cause malfunction. If the meter is jammed at a fixed position, follow cleaning instructions.

⚠ CAUTION

Before attempting to remove the meter from the line, check the system to confirm that line pressure has been reduced to zero PSI.

⚠ CAUTION

Review precautions listed under "A. Piping" prior to removing meter from line.

E. Cleaning and Maintenance

1. Remove flow meter from line. Remove excess piping from meter. NOTE: It is ***NOT*** necessary to remove the transparent dust guard from the meter to remove the meter from the line.

⚠ CAUTION

Do NOT use cleaning solvent on the transparent guard!

2. Thoroughly wipe off the entire flow meter surface, removing all foreign matter.
3. *If* you choose to remove the dust guard assembly, see Procedure A below.
4. Remove the inlet cap from the flow meter body, noting the sequence of disassembly for later reference (during reassembly). **The internal parts are held in place by a retaining ring. Remove the retaining ring.** The wetted parts ***should*** slide out when the meter is tilted. If they ***DO NOT*** slide out freely, read Procedure B before proceeding.
5. Place all meter components on a clean work surface in order of disassembly.
6. Clean and dry the spring and meter body, checking outlet port threads for foreign particles.
7. Inspect piston and ring magnet assembly. Check magnet for hairline cracks. Clean, dry and reassemble.
8. Clean inlet spider plate and metering cone assembly.
9. Reassemble the flow meter, checking the inlet cap O-ring for nicks and cuts. If nicks and cuts are present, the O-ring should be replaced.

Procedure A – Removal of Dust Guard

To remove the dust guard for cleaning or replacement, simply loosen the end fitting located at the bottom of the meter and slide the end cap, dust bumper, and dust guard off the bottom of the meter, taking care to avoid damaging the O-ring seal between the end cap and the dust gland.

Procedure B – Service Inspection/Replacement

1. If internal wetted parts do not slide freely out of the flow meter body, they may be pushed out by inserting a wooden dowel into the outlet port of the meter. (Make sure the retaining ring has been removed.)
2. After disassembly, check for foreign matter on the wetted parts and on the inner surface of the flow meter body.
   a. Isolate and identify the source of the foreign matter.
   b. Take corrective action to resolve the problem (install finer filtration unit, etc.)
3. Check for scored or worn parts, especially the outer diameter of the piston assembly. Also check the inner surface of the flow meter body.
   a. Replace any badly worn parts.
   b. Return the flow meter to the factory for detailed inspection and repair, if necessary.

⚠ CAUTION

A line snubber is recommended for applications in which rapid valve actuation or pulsation is anticipated. This not only reduces the risk of decoupling the flow meter's magnetic piston, it also reduces excessive wear on other components in the system.

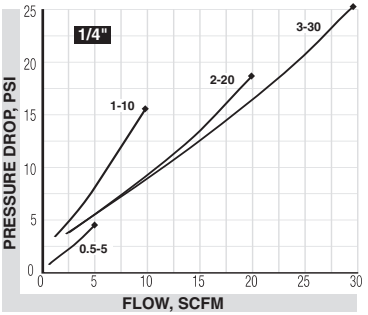
Procedure C – Quick Recoupling

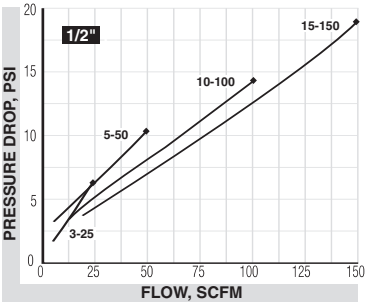
This piston-type variable area flow meter is inherently less sensitive to shock and vibration than other variable area designs. The unique magnetic coupling also eliminates the need for mechanical linkages that can wear or loosen over the functional life of the meter.

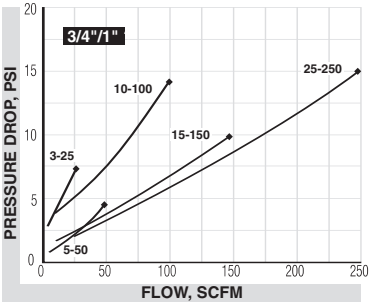
However, on occasion, a pressure spike or extreme flow surge can cause the piston to move in reverse motion at such rapid speed that it disconnects the piston (magnetic coupling) from the external indicator ring. If this occurs, we suggest the following procedures to recouple the piston magnet and the external magnetic indicator ring.

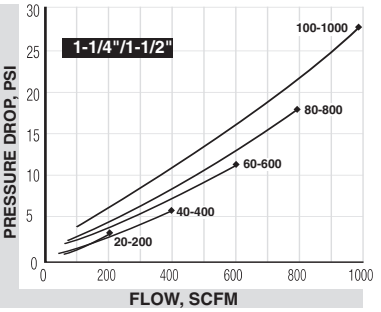
1. If the system permits, simply fluctuate flow rate from "no flow" to "full flow" allowing the moving piston to magnetically recouple to the magnetic indicator ring.
2. For rigorous cyclical applications where this decoupling may occur frequently, consult the technical services staff for further recommendations.

Air / Compressed Gases

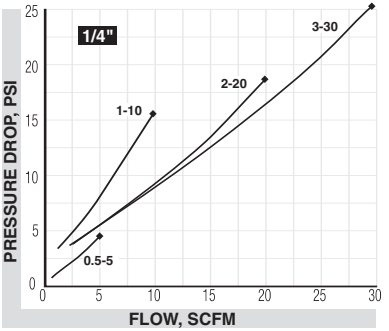


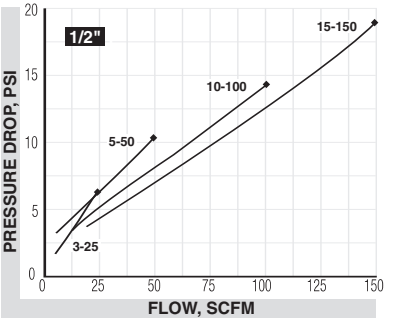


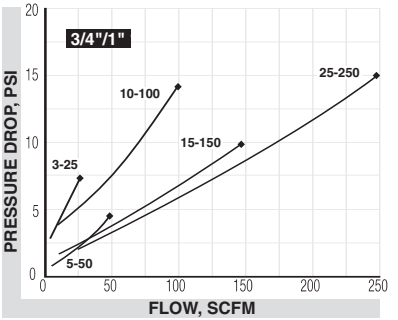


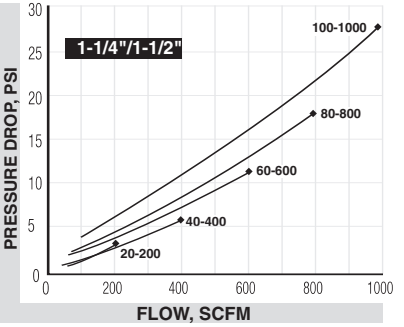


Air / Compressed Gas Test Kits

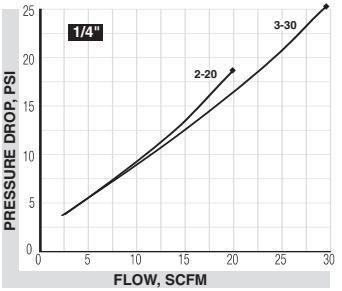


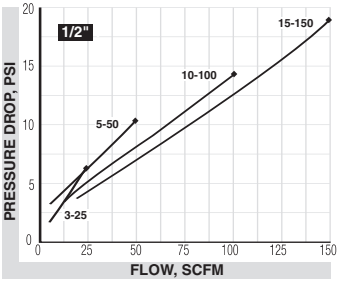


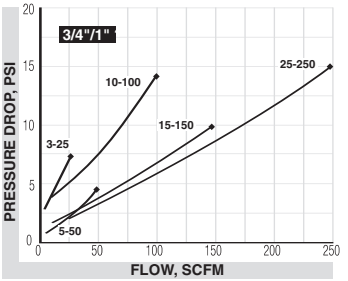


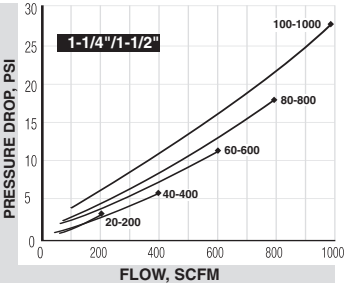


Air / Caustic and Corrosive Gases

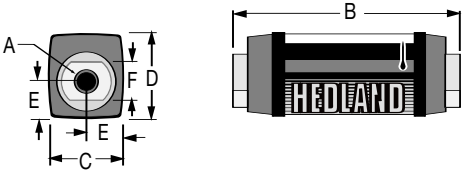




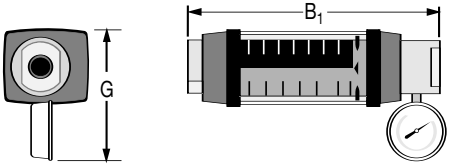




STANDARD PRODUCT



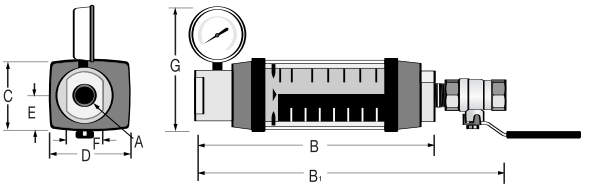
EP & EG OPTION



DIMENSIONS: (1/4 to 1-1/2 Series)

A	B	B_1	C	D	E	F	G
NOMINAL PORT SIZE	**LENGTH in (mm)**	**LENGTH in (mm)**	**WIDTH in (mm)**	**DEPTH in (mm)**	**OFFSET in (mm)**	**FLATS in (mm)**	**HEIGHT in (mm)**
1/4 (SAE 6)	4.8 (122)	6.12 (155)	1.68 (43)	1.90 (48)	.84 (21)	.88 (22)	5.0 (127)
1/2 (SAE10)	6.6 (168)	8.00 (203)	2.07 (53)	2.40 (61)	1.04 (26)	1.25 (32)	5.4 (137)
3/4 (SAE 12)	7.2 (183)	8.9 (226)	2.48 (63)	2.85 (72)	1.24 (32)	1.50 (38)	5.9 (150)
1 (SAE 16)	7.2 (183)	8.9 (226)	2.48 (63)	2.85 (72)	1.24 (32)	1.75 (44)	5.9 (150)
1-1/4 (SAE 20)	12.2 (310)	13.8 (351)	4.12 (105)	4.72 (120)	2.06 (52)	2.75 (70)	7.2 (183)
1-1/2 (SAE 24)	12.2 (310)	13.8 (351)	4.12 (105)	4.72 (120)	2.06 (52)	2.75 (70)	7.2 (183)

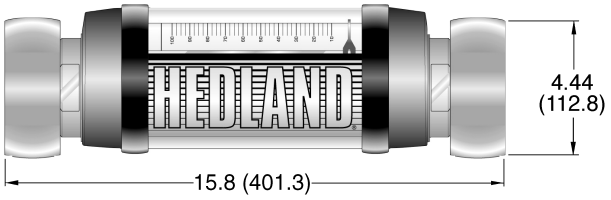
AIR & COMPRESSED GAS TEST KIT

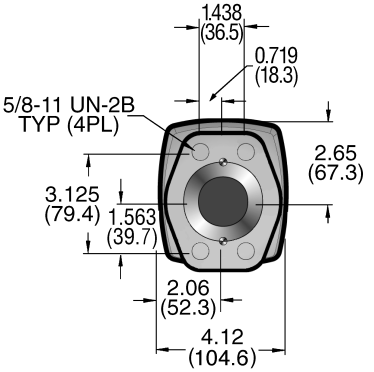


DIMENSIONS: (1/4 to 1-1/2 Series)

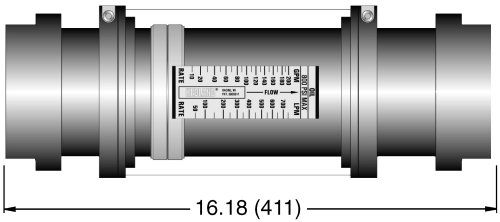
A	B	B_1	C	D	E	F	G
NOMINAL PORT SIZE	**LENGTH in (mm)**	**LENGTH in (mm)**	**WIDTH in (mm)**	**DEPTH in (mm)**	**OFFSET in (mm)**	**FLATS in (mm)**	**HEIGHT in (mm)**
1/4	6.12 (155)	8.38 (213)	1.68 (43)	1.90 (48)	.84 (21)	.88 (22)	5.0 (127)
1/2	8.00 (203)	11.0 (279)	2.07 (53)	2.40 (61)	1.04 (26)	1.25 (32)	5.4 (137)
3/4	8.90 (226)	12.38 (315)	2.48 (63)	2.85 (72)	1.24 (32)	1.50 (38)	5.9 (150)
1	8.90 (226)	12.38 (315)	2.48 (63)	2.85 (72)	1.24 (32)	1.75 (44)	5.9 (150)
1-1/4	13.80 (351)	18.39 (465)	4.12 (105)	4.72 (120)	2.06 (52)	2.75 (70)	7.2 (183)
1-1/2	13.80 (351)	18.39 (465)	4.12 (105)	4.72 (120)	2.06 (52)	2.75 (70)	7.2 (183)

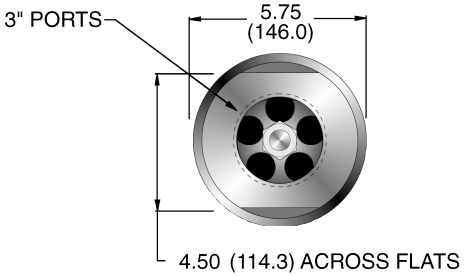
1-1/2 INCH CODE 62, 4-BOLT FLANGE



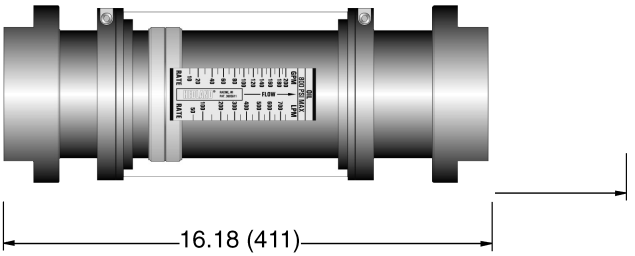


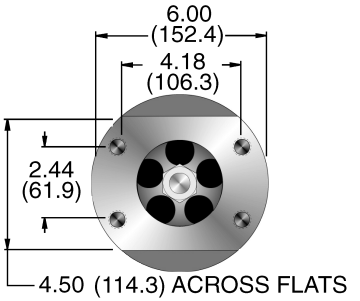
3 INCH SAE, NPTF, BSPP





3 INCH CODE 61, 4-BOLT FLANGE





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Division of Racine Federated Inc.

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