Cox
Turbine Flow Meters

# Turbine Flow Meters

## Precision Series


Badger Meter

TUR-UM-00477-EN-04 (August 2019)

# User Manual

# CONTENTS

# DESCRIPTION

Cox Precision Turbine Flow Meters are precisely manufactured and calibrated instruments used in accurate rate-of-flow and total-flow measurement of all types of fluids, whether liquid or gas. They also have many applications as sensors in process flow control.

The flow meter mounts directly in the flow line and consists of a cylindrically bored housing, a flow straightener and turbine assembly, and magnetic or carrier frequency pickups, as shown in *Figure 2 on page 7*.

On all Precision Flow Meters, the magnetic or carrier frequency pickup is located directly above the turbine, near the downstream end of the flow meter. The flow straightener and turbine assembly is retained in the housing by a snap ring and can be easily removed for cleaning and further disassembly.

Cox Precision Turbine Flow Meters are provided with flow straighteners at the downstream and upstream ends. The flow straighteners diminish any turbulence created by the turbine. Other physical differences are illustrated in exploded views. See *Figure 1 on page 7* and *Figure 2 on page 7*.

# SAFETY INFORMATION

The installation of the Cox Precision Turbine Flow Meters must comply with all applicable federal, state, and local rules, regulations, and codes.

Failures to read and follow these instructions can lead to misapplication or misuse of the Cox Precision Turbine Flow Meters, resulting in personal injury and damage to equipment.

## Safety Symbol Explanations

| | |
|---|---|
| ⚠ DANGER | Indicates a hazardous situation, which, if not avoided, *will* result in death or serious personal injury. |
| ⚠ WARNING | Indicates a hazardous situation, which, if not avoided, *could* result in death or severe personal injury |
| ⚠ CAUTION | Indicates a hazardous situation, which, if not avoided, *could* result in minor or moderate personal injury or damage to property. |

# UNPACKING & INSPECTION

Upon opening the shipping container, visually inspect the product and applicable accessories for any physical damage such as scratches, loose or broken parts, or any other sign of damage that may have occurred during shipment.

**NOTE:** If damage is found, request an inspection by the carrier's agent within 48 hours of delivery and file a claim with the carrier. A claim for equipment damage in transit is the sole responsibility of the purchaser.

# PRINCIPLE OF OPERATION

Fluid passing through the meter causes the rotor and bearing to revolve at a speed directly proportional to fluid velocity. As each rotor blade passes the pickup, it varies the pickup's reluctance, producing an output signal. Since turbine speed is directly proportional to fluid velocity, signal frequency is similarly proportional to the volumetric rate-of-flow. The output signal can be fed into various types of instruments to indicate the rate-of-flow, such as indicators, frequency converters, counters, recorders and controllers.

Cox uses two pickup technologies, magnetic and carrier frequency (RF). The magnetic pickup has a self-generating mV frequency output. The RF carrier pickup senses eddy current losses as the rotor blade passes the pickup. It does not use an internal permanent magnet and therefore eliminates magnetic drag on the rotor. This results in linear flow ranges up to 100:1 and repeatable operating flow ranges up to 150:1. The RF carrier pickup requires a signal conditioner to generate an output. A high level signal offers the advantage of high output signal to noise ratio over the entire range of the flow meter and permits long distance signal transmission.

All Cox Precision Turbine Flow Meters are designed to provide a high frequency output voltage at the maximum of their flow range. This high frequency signal improves resolution and standardized output permits several overlapping range flow meters to be connected in series to one indicating instrument. Data concerning extended ranges, specific output voltage and other frequency ranges is available from the Badger Meter Sales Department. As with any precision instrument, the full capabilities of the Cox Precision Turbine flow meter can be realized only through close adherence to the installation and maintenance instructions discussed in this manual.

# INSTALLATION

1. Check the flow meter internally for foreign material and make sure the turbine rotor spins freely prior to installation.
2. Install a minimum of 10 pipe diameters of straight pipe or tube in the same size as the flow meter on the upstream side, and 5 diameters on the downstream side to avoid creating turbulence in the liquid, which can cause incorrect flow meter output. If space prohibits the use of these straight sections, install the piping to produce as straight and smooth a flow as possible. Available Cox Flow Straighteners are listed at *www.badgermeter.com.*
3. Install the flow meter with the flow arrow, etched on the exterior of the meter body, pointing in the direction of fluid flow.
4. Do not use any sealing compound or Teflon tape on the 37-degree flared tube connections of Cox Precision Turbine flow meters. The use of these on adjacent piping should be held to a minimum in order to avoid coating the bearings and rotor blades with compound, causing premature rotor failure and erratic performance

**NOTE:** Copper conical seals or crush rings may be used, if necessary.

5. Install a mesh strainer upstream before operation of the flow meter if particles are present.

**CAUTION**

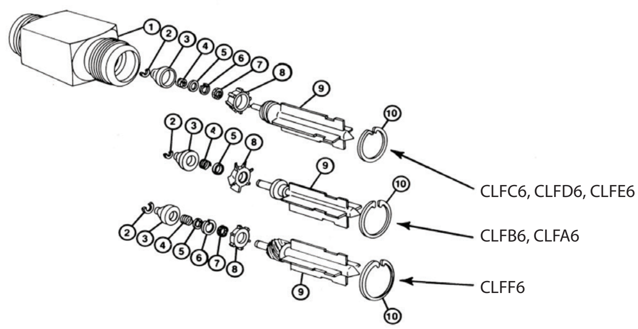
***BLEED ALL AIR AND VAPOR FROM THE LIQUID AFTER INSTALLING OR REINSTALLING A FLOW METER.***

6. Start flow slowly to avoid sending a "slug" of high velocity air or vapor through the flow meter and causing it to overspeed. Start required flow after flow meter is full of liquid. Aerated liquids flowing through a flow meter will result in incorrect flow rates.

# DISASSEMBLY

1. Firmly hold flow meter and, using tweezers, carefully remove internal snap ring from the upstream end.
2. Use long nose pliers and grasp one vane of flow straightener and gently pull flow straightener and rotor assembly from the body. Use slight twisting motion. Snug fit at transition.
3. Press down on the hub to relieve spring pressure on C-washer and remove with tweezers or thin nosed pliers. Remove hub, spring and spacer.
4. Carefully remove rotor from shaft.
5. Remove a snap ring from side of bearing and push bearing out of rotor.

**NOTE:** Models CLFA6 and CLFB6 must be returned to factory for bearing change.




**CLFC6, CLFD6, CLFE6, CLFF6**

1. Body *
2. C-washer
3. Hub *
4. Spring *
5. Spacer
6. Bearing retainer ring *
7. Bearing
8. Rotor *
9. Straightener assembly *
10. Body retaining ring

* Replaceable at factory level only.

**CLFB6, CLFA6**

1. Body *
2. C-washer
3. Hub *
4. Spring *
5. Spacer
8. Rotor *
9. Straightener assembly *
10. Body retaining ring

**NOTE:** Order parts by name and basic number shown, followed by flow meter size designation. For example, order a bearing for a CLFF6 flow meter as bearing #1400-63. Flow meter serial number must be provided when ordering parts.

*Figure 1: Cox Precision LoFlo turbine flow meter*

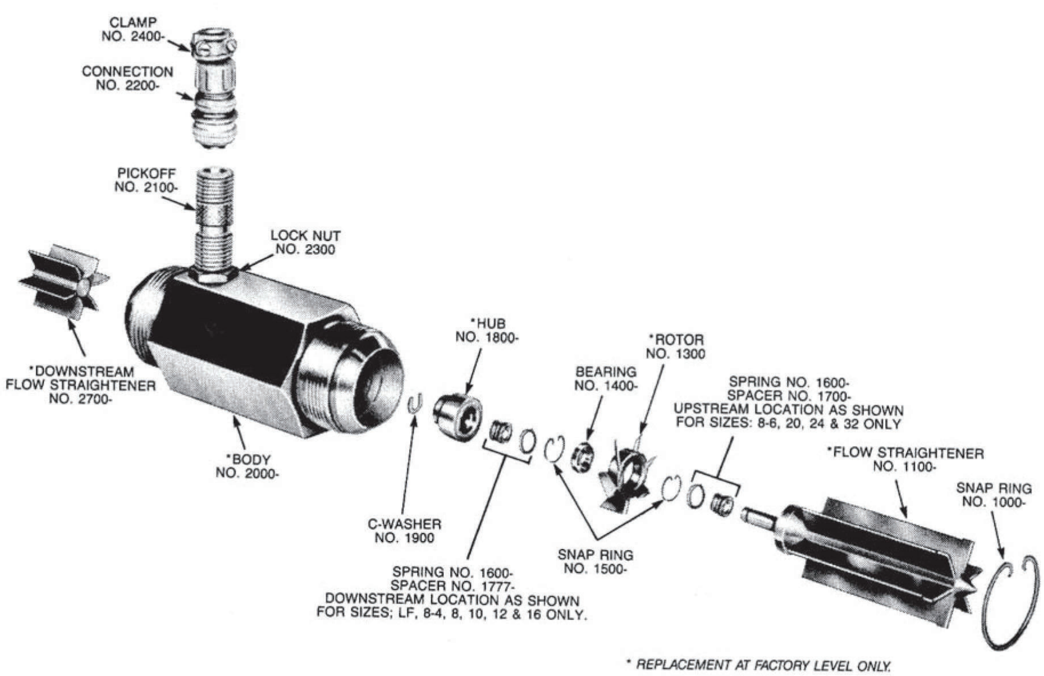



*Figure 2: Cox precision turbine flow meter*

# CLEANING

Immerse all parts, except pickup, in a clean, filtered solvent suitable for removing residue from the liquid the flow meter has been used with. If necessary, use a soft bristle brush.

If there is foreign matter in the ball bearings, allow them to soak in the solvent for approximately 10 minutes and then dry with filtered compressed air. Do not use excessive air pressure.

**NOTE:** Do not sonic clean bearings!

**⚠CAUTION**

***EXERCISE EXTREME CARE DURING THE CLEANING PROCESS SO THAT NONE OF THE PARTS ARE DROPPED, SCRATCHED OR DAMAGED IN ANY WAY. NO ATTEMPT SHOULD BE MADE TO FURTHER POLISH ANY OF THE PARTS, ESPECIALLY THE ROTOR.***

## Cleaning a Turbine Meter after Water Calibration and/or Service

**NOTE:** When cleaning flow meters, keep the body, sleeve and pickup together. Sleeve is fitted to body and pickup has a protruding pin. Replacement pickups are supplied with a nut and have no protruding pin.

1. Remove the meter from the line and let all excess water drip out.
2. Fill the meter with alcohol, at least 50% Isopropyl, Ethyl or Methyl, and let it stand for 5 minutes.
3. Discard the alcohol and let the meter dry for 2 minutes.
4. Fill the meter with MIL-C-7024 Type 2 calibration fluid, or similar solvent, and let it stand for 1 minute.
5. Discard the calibration fluid and flush the meter with an approved fluorocarbon solvent, such as Isotron.

**NOTE:** If this procedure is not possible, the turbine meter should always remain filled with water when not in use, to prevent internal wetted parts from being exposed to air.

**⚠CAUTION**

***DO NOT INTERCHANGE FLOW METER PARTS OTHER THAN BEARINGS AND RETAINING RINGS. THIS PRECAUTION IS NECESSARY TO PRESERVE LINEARITY AND REPEATABILITY.***

# REASSEMBLY

Reassembly is the reverse of disassembly except for the following:

- Always install with the retainer flange facing upstream on Precision Turbine flow meters where shaft bearings are provided with a retainer.
- Inspect rotor for markings as shown in *Figure 4* to indicate flow direction before assembly.
- Flow meters having broached slots in the body for flow straightener vanes should be carefully assembled.
- Align straightener vanes with the slots and push gently until the assembly is seated.

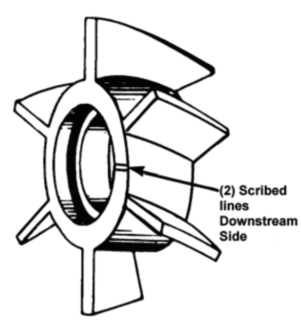



*Figure 3: Scribed lines*

# TROUBLESHOOTING

| Issue | Possible Cause | Remedy |
|---|---|---|
| Meter indicates higher flow than actual. | Cavitation. | Increase back pressure. |
| Meter indicates high flow. | Dirt blocking flow area rotor. | Clean meter; add filter. |
| Meter indicates low flow. | Dirt dragging rotor. | Clean meter; add filter. |
| Meter indicates low flow. | Worn bearing. | Replace bearing; recalibrate when required. |
| Meter indicates low flow. | Viscosity higher than calibrated. | Change temperature; change fluid; recalibrate meter. |
| Erratic system indication; meter alone works well. | Ground loop is shielding. | Ground shield one place only. Watch for internal electronic instrument grounds. |
| Indicator shows flow when shut off. Mechanical vibration causes rotor to oscillate without turning. | Mechanical vibration. | Isolate meter; use potted pickup. |
| No flow indication. Full flow of fluid opened into dry meter. Impact of fluid on rotor causes bearing separation. | Fluid shock. New bearing failed. | Move meter to position where it is full of fluid at start-up. |
| Erratic indication at low flow; good indication at high flow. | Low instrument sensitivity. 10 mV rms turbine signal is being lowered by loading of electronics or instrumentation cannot sense low level signals. | Amplify signal. |
| No flow indication. | Faulty pickup. | Replace pickup; recalibrate as necessary. |
| System works perfectly, except indicates lower flow over entire range. | Bypass flow, leak. | Eliminate bypass valves, leak. Faulty solenoid valves. |
| Meter indicating high flow. Upstream piping at meter smaller than meter. | Fluid jet impingement on rotor. Critical in gas. | Change piping. |
| Opposite effects as above. | Viscosity lower than calibrated. | Change temperature; change fluid; recalibrate meter. |
| Mass flow indication wrong. Turbine meter is volumetric; density correction is electronic; must change with temperature. | Wrong fluid density. Critical in gas. | Check fluid, electronics. |
| Erratic or wrong indication of flow. | Loose pickup. | Tighten pickup. |
| Indicates high flow two hours after installing new bearing. | Bearing wear-in; small meters critical. | Recalibrate. 20…30 min. run-in is required to stabilize friction. |
| Cannot reach maximum flow rate; meter selection was with Delta-P at 0.75 sp. gr., now using on 1.0 sp. gr. Delta-P is proportional to specific gravity. | High pressure drop. | Install larger meter. |
| Does not repeat at low flows. Repeats at high flows. | System resolution readability. | Increase resolution, for example:<br>1 out of 100 = 1%<br>1 out of 1000 = 0.1% |

# CALIBRATION DATA

## K-Factor

The calibration data supplied with a Cox Precision Turbine Flow Meter is shown in *Figure 5 on page 11*. Correct application of a Cox Precision Turbine Flow Meter requires consideration of many important factors. Because of the wide variation of possible applications, detailed data for liquid flow models only is given in this manual. For special requirements—such as those outside the range of –300…350° F, those with extremely corrosive liquids, gases and other unusual conditions—consult the factory.

## 20-Point Calibration

Calibration at twenty flow rates (10 up-scale and 10 down) between minimum and maximum flow range, is available for application where ± 0.25% accuracy or better is required. With this calibration complete data on signal output, pressure drop, K-factor and deviation from linearity is supplied.

## 30-Point Calibration

This is the same as the 20-point, with 10 extra points to cover the longer range of the carrier type meters.

## UVC-Universal Viscosity Curve

A 10-point calibration is made at each of four viscosities if curves of "K" versus Hertz were made. In between, viscosities cannot be determined, see *Figure 4*. Replot as "K" versus Hertz divided by centistokes. A single curve is drawn through all data points. Other viscosity curves can now be determined. Use only over 10:1 range for viscosity effects.

## Gas Calibrations

When performed at the Flow Dynamics facility, a curve of ACFM vs. Hertz is supplied.

## Pressure Rating

The standard LoFlo and Precision Flow Meters are rated 2500…5000 psi operating pressure. They have a 4:1 pressure safety factor. Flange flow meters are rated for service pressure according to ANSI ratings for the flanges used.

Operation at temperatures above 200° F will decrease the connection rating because of lowered stress capabilities of the metal.

**Liquid Formula**

$$GPM = (Hertz \times 60) \div K$$

$$\frac{PPH = Hertz \times 3600 \times 8.328 \times S.G.}{K}$$

$$Time\ Base\ in\ Seconds = \frac{Engrg.Units\ GPM - PPH}{Hertz}$$

**Gas Formula**

$$\rho = \frac{144 \times PSIA}{R \times °Rankine} = \#/ft^3$$

$$SCFM = ACFM \times \frac{\rho\ \text{Act}}{\rho\ \text{Std}}$$

$$PPM = ACFM \times \rho\ Act$$

*Figure 4: Calculating flow rates in different units*

# Certificate of Calibration

Badger Meter — Flow Dynamics (Calibrators | Calibration Services)

8635 Washington Avenue • Racine, Wis. 53406-1580 • Phone: 877-243-1010 • indorders@badgermeter.com

| | | | |
|---|---|---|---|
| **Customer Name:** | BADGER METER EUROPE GMBH | **Report #** | 430343 - 16120000111 |
| **Customer Address:** | 1440 FRANCISCO STREET TORRANCE CA UNITED STATES 90501 | | |
| **Customer PO #** | 70095 | | |
| **Model #** | EFM16SR-W-W-AN-H-3 | **Cal Date:** | 5/28/2019 |
| **Serial #** | 16120000111 | **Customer Re-Cal Date:** | |
| **Signal:** | Hz | **Lab Temp:** | 73.2 Deg F |
| **Calibration Procedure:** | QAP-035 | **Lab Relative Humidity:** | 60.5% |
| **Calibration Tech:** | Bryan R | | |
| **Fluid Specifications:** | MIL-PRF-7024-II | **Specific Gravity:** | 0.762 |
| **Temperature (F):** | 80.0 | **Viscosity (CSTKS):** | 1.12 |

**Notes, Adjustments & Repairs**

**Calibration Results (As Found = As Left)**

| Test Point # | Frequency Hz | Flow Rate GPM | Freq./ Visc Hz/cstk | K Factor pul/gal | Flow Rate LPM | Mass Flow PPH |
|---|---|---|---|---|---|---|
| 1 | 66.636 | 1.9345 | 59.496 | 2066.7 | 7.3229 | 737.39 |
| 2 | 66.613 | 1.9342 | 59.476 | 2066.3 | 7.3219 | 737.28 |
| 3 | 94.307 | 2.7497 | 84.203 | 2057.8 | 10.409 | 1048.1 |
| 4 | 94.596 | 2.7585 | 84.461 | 2057.5 | 10.442 | 1051.5 |
| 5 | 162.56 | 4.7698 | 145.14 | 2044.8 | 18.056 | 1818.1 |
| 6 | 162.98 | 4.7826 | 145.52 | 2044.7 | 18.104 | 1823.0 |
| 7 | 225.66 | 6.6462 | 201.48 | 2037.2 | 25.159 | 2533.4 |
| 8 | 225.68 | 6.6465 | 201.50 | 2037.3 | 25.160 | 2533.5 |
| 9 | 328.97 | 9.7350 | 293.72 | 2027.5 | 36.851 | 3710.7 |
| 10 | 330.01 | 9.7661 | 294.66 | 2027.5 | 36.969 | 3722.6 |
| 11 | 458.37 | 13.635 | 409.26 | 2017.1 | 51.613 | 5197.2 |
| 12 | 459.29 | 13.661 | 410.08 | 2017.2 | 51.712 | 5207.2 |
| 13 | 682.86 | 20.445 | 609.70 | 2004.0 | 77.391 | 7792.9 |
| 14 | 682.94 | 20.445 | 609.76 | 2004.2 | 77.394 | 7793.2 |
| 15 | 985.49 | 29.687 | 879.90 | 1991.7 | 112.38 | 11316.0 |
| 16 | 985.98 | 29.706 | 880.34 | 1991.4 | 112.45 | 11323.3 |
| 17 | 1456.3 | 44.113 | 1300.3 | 1980.8 | 166.98 | 16814.6 |
| 18 | 1456.6 | 44.127 | 1300.5 | 1980.5 | 167.04 | 16820.1 |
| 19 | 2202.1 | 67.028 | 1966.1 | 1971.2 | 253.73 | 25549.3 |
| 20 | 2204.8 | 67.118 | 1968.5 | 1970.9 | 254.07 | 25583.7 |

**Standards Used in Calibration**

| Standard # | Description | Serial # | ReCal Date |
|---|---|---|---|
| FDI-220 | 400 GPM Liquid Prover | N/A | 12/14/2021 |
| FDI-220 Cart | 400 GPM Liquid Prover Cart (mA, Vdc, Temp, Freq) | N/A | 11/8/2019 |

The instrument referenced above was calibrated using standards traceable to the National Institute of Standards and Technology. Calibration reports for references maintained by Badger Meter, Inc. are available upon request to the customer of this calibration report. The volumetric flow rates reported are within a best uncertainty of +/- .035% of reading (Represents an expanded uncertainty using a coverage factor, k = 2, at an approximate level of confidence of 95%) and applies to calibration equipment only and +/- 0.02% reading uncertainty of the UUT(Unit Under Test).
Badger Meter, Inc. calibration services are accredited by NVLAP (NVLAP Lab Code 200668) to ISO/IEC 17025:2005 (NIST Handbook 150) and are compliant to ANSI/NCSLZ540-1-1994; Part 1. This certificate is not used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.
**The results reported relate only to the item(s) calibrated as described above. This report may not be reproduced, except in full, without the written approval of Badger Meter, Inc.**

NVLAP® CALIBRATION NVLAP LAB CODE 200668-0

| I certify the accuracy of this Calibration Report: | Ralph Buckridge | Calibration Engineer | Ralph Buckridge (Digitally signed by Ralph Buckridge DN: cn=Ralph Buckridge, o=Badger Meter, ou=Manufacturing Engineer, email=rbuckridge@badgermeter.com, c=US Date: 2019.06.06 10:16:06 -05'00') |
|---|---|---|---|
| | Name | Title | Signature |

***End of Report***

**Doc Nbr: CRF-002 Rev: K**
**Report #:430343 - 16120000111-L Page 1 of 1**

*Figure 5: Calibration certification*

**NOTE:** NVLAP accreditation applies only to the Badger Meter Flow Dynamics calibration lab, located in Racine, Wisconsin.

# METER SPECIFICATIONS

| | | |
|---|---|---|
| **Repeatability** | Liquid | ± 0.02% of reading |
| | Gas | 0.25% (of reading) |
| | LoFlo | ± 0.25% of reading |
| **Linearity** | ± 0.50% (± 0.1% with flow processor) | |
| **Calibrator Uncertainty** | Liquid | ± 0.05% of reading |
| | Gas | ± 0.20% of reading |
| | LoFlo | ± 0.05% of reading |
| **Frequency Output** | Liquid | 1200…1500 Hz |
| | Gas | 1500…1800 Hz (Maximum) |
| | LoFlo | 1500…1800 Hz (Maximum) |
| **Response Time** | Liquid | 2…3 ms (at 1.2 cSt) |
| | Gas | 20…30 ms or better (at 1.2 cSt) |
| | LoFlo | 20…30 ms or better (at 1.2 cSt) |
| **Materials of Construction** | Body | 316 stainless steel |
| | Shafts | 316 stainless steel |
| | Rotors | 17-4 PH stainless steel |
| | Bearing | Ceramic |

## Torque Rating

When using Precision Flow Meters with AN end fittings at high pressure, tighten the fittings to the torque values listed below.

| Size | Minimum Torque (Dry) |
|---|---|
| All CLF Meters | 270 in-lb |
| 8-4, 8-6, 08 | 450 in-lb |
| 10 | 650 in-lb |
| 12 | 900 in-lb |
| 16 | 1200 in-lb |
| 20 | 1400 in-lb |
| 24 | 1600 in-lb |
| 32 | 1800 in-lb |

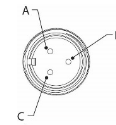
## Filtration

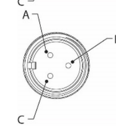
Filtration is recommended as follows:

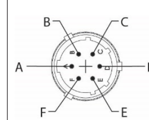
- LoFlo meters, meter sizes 84…08, and flange sizes 84, 86, 8 and 10 flow meters should have filters with a rating of 25…40 microns.
- Size 10…32 and flange sizes 12…48 flow meters should have filters with a rating of 40…75 microns.

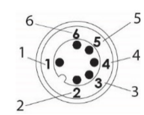
# PICKUP SPECIFICATIONS

| PN | Type | Std or Special | Body Thread | Termination Type | Mounting Thread Electrical | Supply Voltage | Output | Resist-ance | Gauss | Temp. Range ° F (° C) | Internal Temp. Sensor? | Certs. | Internal Amp? | Pinouts |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C01 | RF | Std | 5/8-18 | 2-Pin MS | MS3106-10SL-4S | — | RF | 4.3 Ω max. | — | -250…400 (-157…204) | No | CE | No | — |
| C02 | RF | Std | 5/8-18 | 2-FL Teflon | 1/2-14 NPT | — | RF | 3…5 Ω | — | -250…400 (-157…204) | No | CE | No | — |
| C03 | RF | Std | 5/8-18 | FL | 1/2-14 NPT | — | RF | 4 Ω | — | -330…450 (-201…232) | 100 Ω RTD | CE | No | — |
| C04 | RF | Std | 5/8-18 | 3-Pin | MS3106-10SL-3S | 8…30V DC | O.C. Pulse | — | — | -40…185 (-40…85) | No | CE, IS | No | — |
| C05 | RF | Std | 5/8-18 | 3-Pin MS | MS3102A-10SL-3P | 8…30V DC | 0…10V Pulse | — | — | -40…149 (-40…65) | No | CE, ATEX | Yes | A=Vs<br>B=Common<br>C=Vo |
| C06 | RF | Std | 5/8-18 | 3-Pin | MS3102-10SL-3P | 11…30V DC | 0…10V Pulse | — | — | -40…248 (-40…120) | No | CE | Yes | A=Vs<br>B=Common<br>C=Vo |
| C07 | RF | Std | 5/8-18 | 6-Pin | MS3111, Bayonet | 11…30V DC | 0…10V Pulse | — | — | -49…284 (-45…140) | 100 Ω RTD | CE | Yes | A=Vo<br>B=Temp. Probe (tied to C)<br>C=Temp. Probe<br>D=Temp. Probe<br>E=Vs+<br>F=Common |
| C08 | RF | Std | 5/8-18 | Micro Din, 6-Pin | — | 11…30V DC | 0…10V Pulse | — | — | -49…384 (-45…196) | 100 Ω RTD | CE | Yes | 1=Vs+<br>2=Temp. Probe<br>3=Temp. Probe<br>4=Unused<br>5=Common<br>6=Vo |
| C09 | RF | Std | 5/8-18 | 3-FL | 1/2-14 NPT | 11…30V DC | 0…10V Pulse | — | — | -40…248 (-40…120) | No | CE | Yes | Black=Common<br>Red=Input V DC<br>White=Signal Out |
| M01 | MAG | Std | 5/8-18 | 2-Pin MS | MS3106-10SL-4S | — | MAG (mV Freq) | 1.8…2.2 kΩ | 45…55 | -450…450 (-268…232) | No | CE | No | — |
| M02 | MAG | Std | 5/8-18 | 2-Pin MS | MS3106-10SL-4S | — | MAG (mV Freq) | 1.35… 1.68 kΩ | 140…150 | -450…450 (-268…232) | No | CE | No | — |







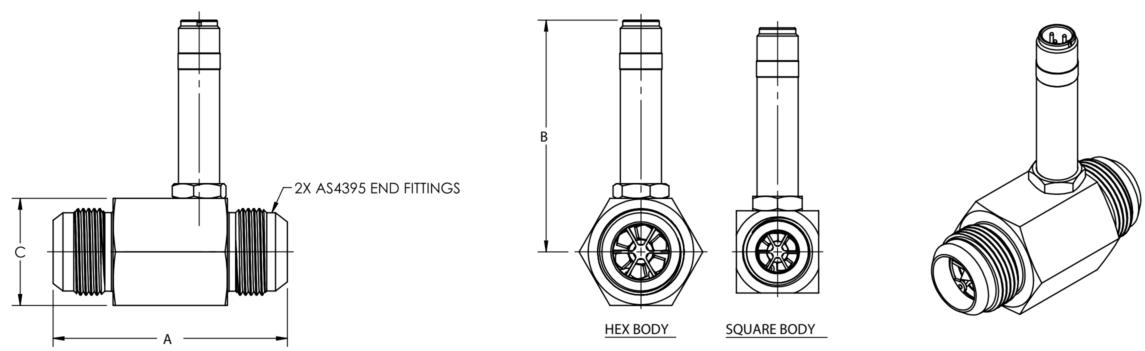


# DIMENSIONS

## Liquid Flow Meters

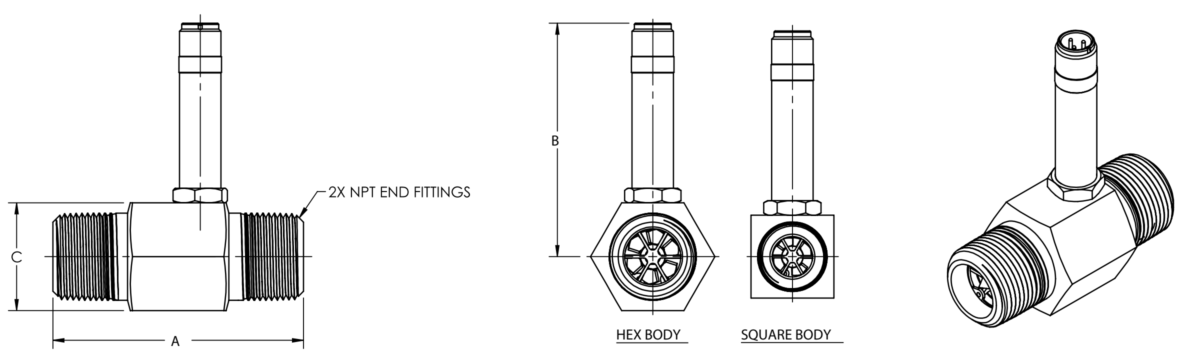
Dimension B specifies the most common pickup type. Actual size may vary depending on pickup choice. Consult factory for details.

### AN End Fitting



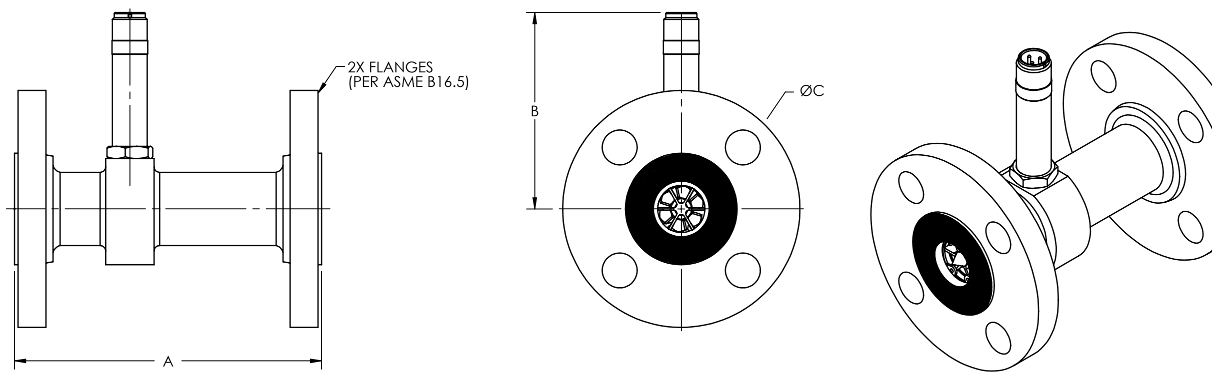

| Size | End Fitting in. (mm) | A in. (mm) | B (RF) in. (mm) | B (MAG) in. (mm) | C in. (mm) |
|---|---|---|---|---|---|
| 8-4 | 0.50 (12.70) | 2.45 (62.23) | 3.20 (81.28) | 2.70 (68.58) | 1.12 (28.45) Square Body |
| 8-6 | 0.50 (12.70) | 2.45 (62.23) | 3.20 (81.28) | 2.70 (68.58) | 1.12 (28.45) Square Body |
| 8 | 0.50 (12.70) | 2.45 (62.23) | 3.30 (83.82) | 2.80 (71.12) | 1.12 (28.45) Square Body |
| 10 | 0.625 (15.88) | 2.72 (69.08) | 3.30 (83.82) | 2.80 (71.12) | 1.25 (31.75) Square Body |
| 12 | 0.75 (19.05) | 3.25 (82.55) | 3.40 (86.36) | 2.90 (73.66) | 1.25 (31.75) Square Body |
| 16 | 1.00 (25.40) | 3.56 (90.42) | 3.50 (88.90) | 3.00 (76.20) | 1.63 (41.40) Hex Body |
| 20 | 1.25 (31.75) | 4.06 (103.1) | 3.60 (91.44) | 3.10 (78.74) | 1.88 (47.75) Hex Body |
| 24 | 1.50 (38.10) | 4.59 (116.6) | 3.80 (96.52) | 3.30 (83.82) | 2.25 (57.15) Hex Body |
| 32 | 2.00 (50.80) | 6.06 (153.9) | 4.00 (101.6) | 3.50 (88.90) | 2.75 (69.85) Hex Body |

### NPT End Fitting



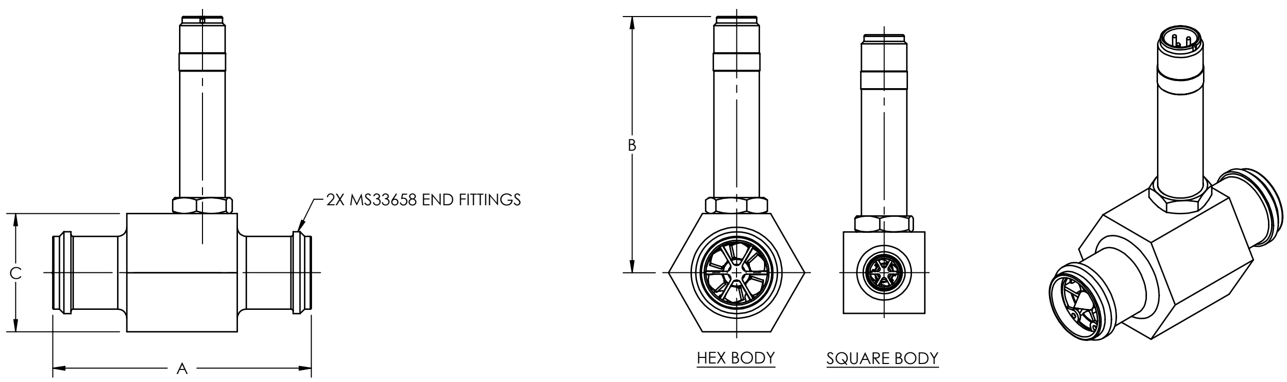

| Size | End Fitting in. (mm) | A in. (mm) | B (RF) in. (mm) | B (MAG) in. (mm) | C in. (mm) |
|---|---|---|---|---|---|
| 8-4 | 0.50 (12.70) | 2.70 (68.58) | 3.20 (81.28) | 2.70 (68.58) | 1.12 (28.45) Square Body |
| 8-6 | 0.50 (12.70) | 2.70 (68.58) | 3.20 (81.28) | 2.70 (68.58) | 1.12 (28.45) Square Body |
| 8 | 0.50 (12.70) | 2.70 (68.58) | 3.30 (83.82) | 2.80 (71.12) | 1.12 (28.45) Square Body |
| 10 | 0.75 (19.05) | 3.29 (83.57) | 3.30 (83.82) | 2.80 (71.12) | 1.25 (31.75) Square Body |
| 12 | 0.75 (19.05) | 3.29 (83.57) | 3.40 (86.36) | 2.90 (73.66) | 1.25 (31.75) Square Body |
| 16 | 1.00 (25.40) | 3.78 (96.01) | 3.50 (88.90) | 3.00 (76.20) | 1.63 (41.40) Hex Body |
| 20 | 1.25 (31.75) | 4.23 (107.4) | 3.60 (91.44) | 3.10 (78.74) | 1.88 (47.75) Hex Body |
| 24 | 1.50 (38.10) | 4.67 (118.6) | 3.80 (96.52) | 3.30 (83.82) | 2.25 (57.15) Hex Body |
| 32 | 2.00 (50.80) | 5.89 (149.6) | 4.00 (101.6) | 3.50 (88.90) | 2.75 (69.85) Hex Body |

## Flange End Fitting



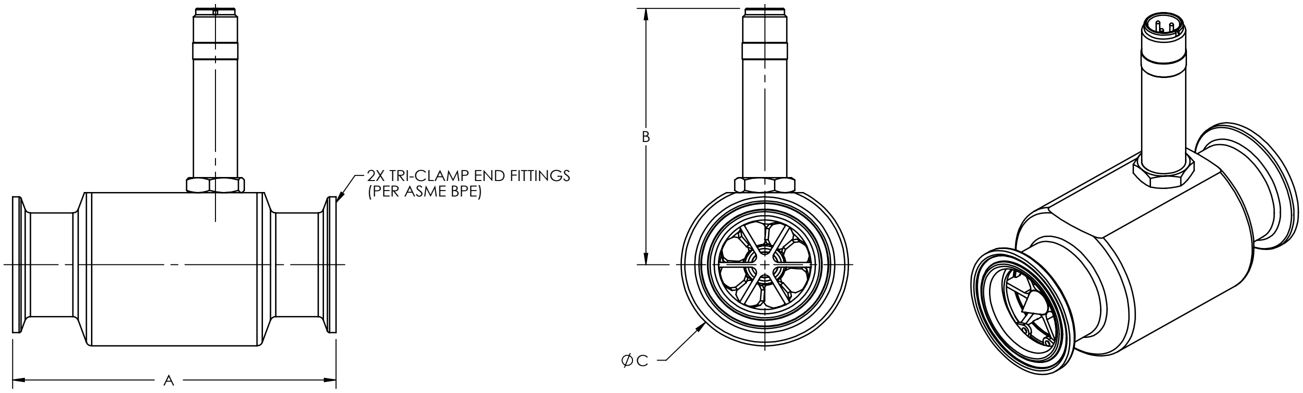

| Size | A<br>in. (mm) | B (RF)<br>in. (mm) | B (MAG)<br>in. (mm) | C—150# Flange<br>in. (mm) | C—300# Flange<br>in. (mm) | C—600# Flange<br>in. (mm) |
|---|---|---|---|---|---|---|
| 8-4 | 5.00 (127.0) | 3.20 (81.28) | 2.70 (68.58) | 3.50 (89) | 3.75 (95) | 3.75 (95) |
| 8-6 | 5.00 (127.0) | 3.20 (81.28) | 2.70 (68.58) | 3.50 (89) | 3.75 (95) | 3.75 (95) |
| 8 | 5.00 (127.0) | 3.30 (83.82) | 2.80 (71.12) | 3.50 (89) | 3.75 (95) | 3.75 (95) |
| 10 | 5.50 (139.7) | 3.30 (83.82) | 2.80 (71.12) | 3.50 (89) | 3.75 (95) | 3.75 (95) |
| 12 | 5.50 (139.7) | 3.40 (86.36) | 2.90 (73.66) | 3.88 (99) | 4.62 (117) | 4.62 (117) |
| 16 | 5.50 (139.7) | 3.50 (88.90) | 3.00 (76.20) | 4.25 (108) | 4.88 (124) | 4.88 (124) |
| 20 | 6.00 (152.4) | 3.60 (91.44) | 3.10 (78.74) | 4.62 (117) | 5.25 (133) | 5.25 (133) |
| 24 | 6.00 (152.4) | 3.80 (96.52) | 3.30 (83.82) | 5.00 (127) | 6.12 (155) | 6.12 (155) |
| 32 | 6.50 (165.1) | 4.00 (101.6) | 3.50 (88.90) | 6.00 (152) | 6.50 (165) | 6.50 (165) |

## Hose Barb End Fitting



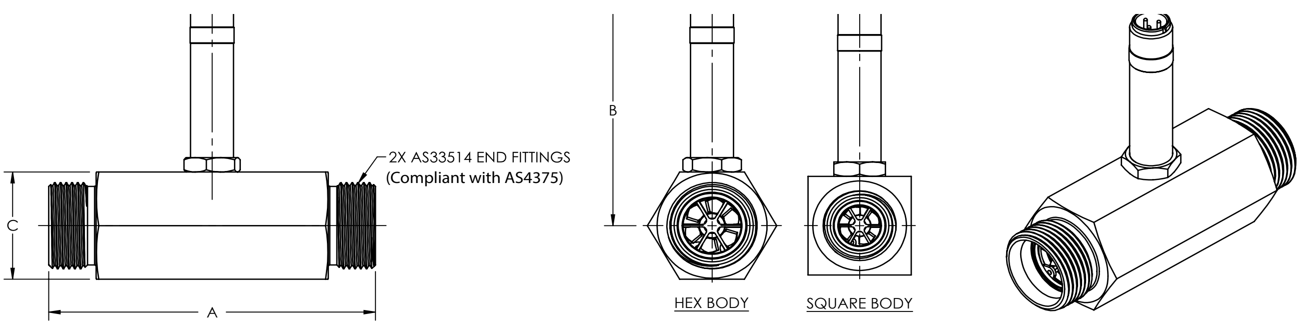

| Size | End Fitting<br>in. (mm) | A<br>in. (mm) | B (RF)<br>in. (mm) | B (MAG)<br>in. (mm) | C<br>in. (mm) |
|---|---|---|---|---|---|
| 8-4 | 0.50 (12.70) | 3.18 (80.77) | 3.20 (81.28) | 2.70 (68.58) | 1.12 (28.45) Square body |
| 8-6 | 0.50 (12.70) | 3.18 (80.77) | 3.20 (81.28) | 2.70 (68.58) | 1.12 (28.45) Square body |
| 8 | 0.50 (12.70) | 3.18 (80.77) | 3.30 (83.82) | 2.80 (71.12) | 1.12 (28.45) Square body |
| 10 | 0.625 (15.88) | 3.24 (82.30) | 3.30 (83.82) | 2.80 (71.12) | 1.25 (31.75) Hex body |
| 12 | 0.75 (19.05) | 3.25 (82.55) | 3.40 (86.36) | 2.90 (73.66) | 1.25 (31.75) Hex body |
| 16 | 1.00 (25.40) | 3.56 (90.42) | 3.50 (88.90) | 3.00 (76.20) | 1.63 (41.40) Hex body |
| 20 | 1.25 (31.75) | 4.50 (114.3) | 3.60 (91.44) | 3.10 (78.74) | 1.88 (47.75) Hex body |
| 24 | 1.50 (38.10) | 5.00 (127.0) | 3.80 (96.52) | 3.30 (83.82) | 2.25 (57.15) Hex body |
| 32 | 2.00 (50.80) | 6.50 (165.1) | 4.00 (101.6) | 3.50 (88.90) | 2.75 (69.85) Hex body |

## Tri-Clamp End Fitting




| Size | End Fitting in. (mm) | A in. (mm) | B (RF) in. (mm) | B (MAG) in. (mm) | C in. (mm) | Clamp Size in. (mm) |
|---|---|---|---|---|---|---|
| 8-4 | 0.50 (12.70) | 3.56 (90.42) | 3.20 (81.28) | 2.70 (68.58) | 1.50 (38.10) | |
| 8-6 | 0.50 (12.70) | 3.56 (90.42) | 3.20 (81.28) | 2.70 (68.58) | 1.50 (38.10) | 0.75(19.05) |
| 8 | 0.50 (12.70) | 3.56 (90.42) | 3.30 (83.82) | 2.80 (71.12) | 1.50 (38.10) | |
| 10 | 1.25 (31.75) | 3.56 (90.42) | 3.30 (83.82) | 2.80 (71.12) | 1.77 (44.96) | |
| 12 | 1.25 (31.75) | 3.56 (90.42) | 3.40 (86.36) | 2.90 (73.66) | 1.77 (44.96) | |
| 16 | 1.50 (31.80) | 3.56 (90.42) | 3.50 (88.90) | 3.00 (76.20) | 1.99 (50.55) | 1.50 (38.10) |
| 20 | 1.50 (31.80) | 4.59 (116.6) | 3.60 (91.44) | 3.10 (78.74) | 2.17 (55.12) | |
| 24 | 1.50 (31.80) | 4.59 (116.6) | 3.80 (96.52) | 3.30 (83.82) | 2.38 (60.45) | |
| 32 | 2.00 (50.80) | 6.06 (153.9) | 4.00 (101.6) | 3.50 (88.90) | 3.18 (80.77) | 2.00 (50.80) |

## High Pressure End Fitting

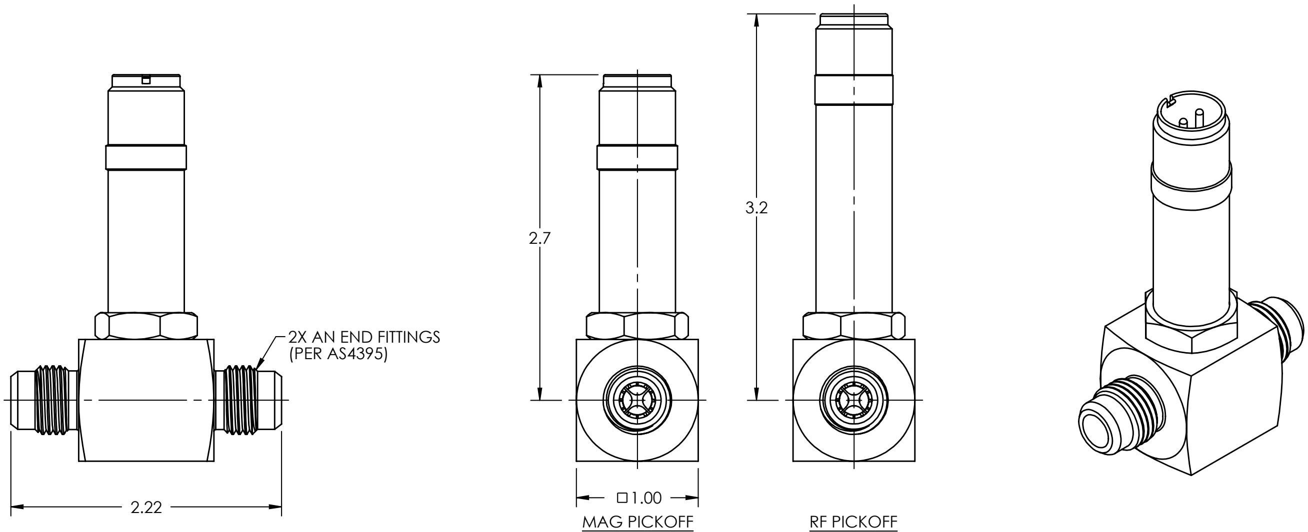



| Size | End Fitting in. (mm) | A in. (mm) | B (RF) in. (mm) | B (MAG) in. (mm) | C in. (mm) |
|---|---|---|---|---|---|
| 8-4 | 0.50 (12.70) | 3.25 (82.55) | 3.20 (81.28) | 2.70 (68.58) | 1.12 (28.45) Square body |
| 8-6 | 0.50 (12.70) | 3.25 (82.55) | 3.20 (81.28) | 2.70 (68.58) | 1.12 (28.45) Square body |
| 8 | 0.50 (12.70) | 3.50 (88.90) | 3.30 (83.82) | 2.80 (71.12) | 1.12 (28.45) Square body |
| 10 | 0.625(15.88) | 4.00 (101.6) | 3.30 (83.82) | 2.80 (71.12) | 1.25 (31.75) Square body |
| 12 | 0.75 (19.05) | 4.50 (114.3) | 3.40 (86.36) | 2.90 (73.66) | 1.50 (38.10) Square body |
| 16 | 1.00 (25.40) | 4.75 (120.7) | 3.50 (88.90) | 3.00 (76.20) | 1.63 (41.40) Hex body |
| 20 | 1.25 (31.75) | 5.50 (139.7) | 3.60 (91.44) | 3.10 (78.74) | 1.88 (47.75) Hex body |
| 24 | 1.50 (38.10) | 6.00 (152.4) | 3.80 (96.52) | 3.30 (83.82) | 2.25 (57.15) Hex body |
| 32 | 2.00 (50.80) | 7.00 (177.8) | 4.00 (101.6) | 3.50 (88.90) | 2.75 (69.85) Hex body |

### LoFlo

The dimension from the center of bore to top of pickup represents the most common pickup types. Length may vary depending on pickup choice. Consult factory for details.

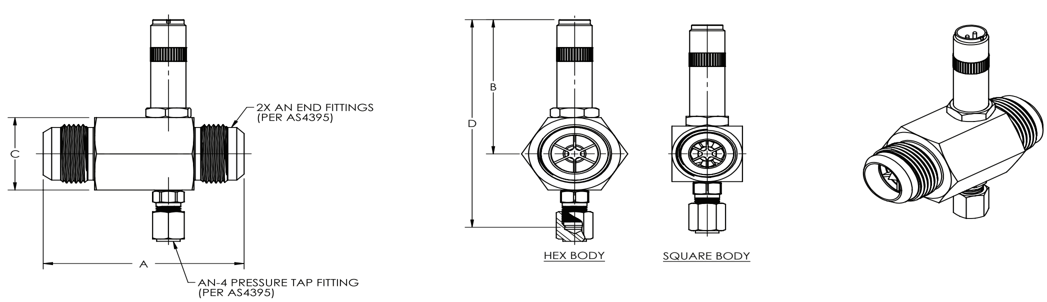
**NOTE:** Dimensions below are shown in inches.




## Gas Flow Meters

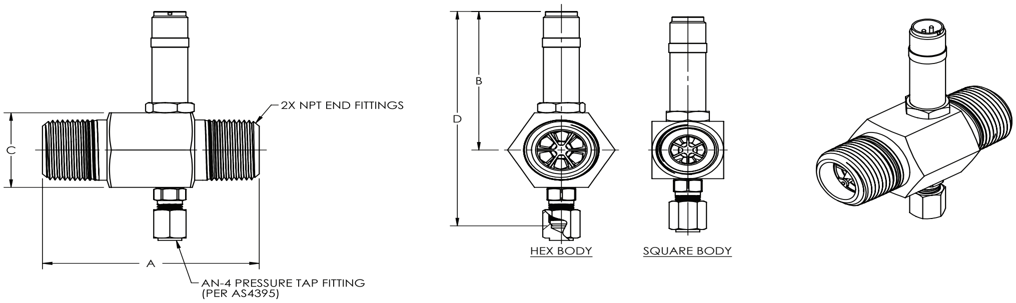
Dimension B specifies the most common pickup type. Actual size may vary depending on pickup choice. Consult factory for details.

### AN End Fitting



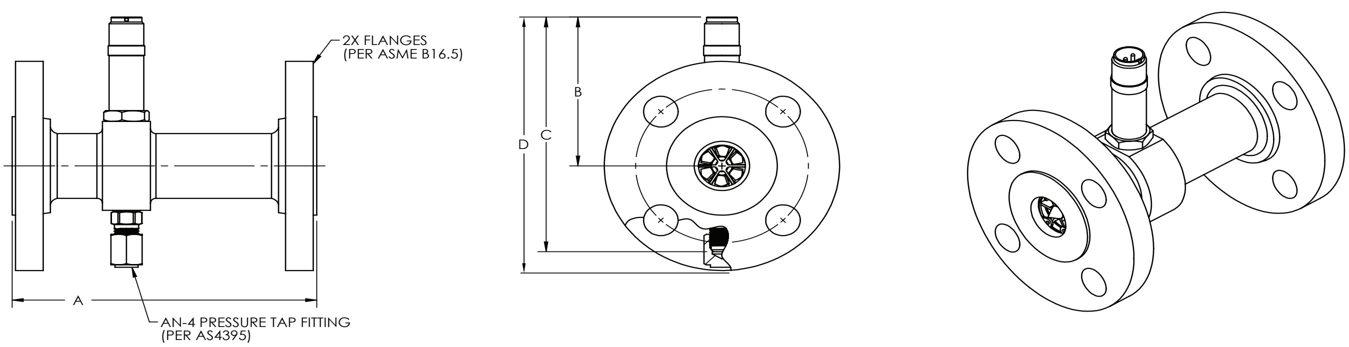

| Size | End Fitting in. (mm) | A in. (mm) | B in. (mm) | C in. (mm) | D in. (mm) |
|---|---|---|---|---|---|
| 8-4 | 0.50 (12.70) | 2.45 (62.23) | 2.80 (71.12) | 1.12 (28.44) Square Body | 4.20 (106.7) |
| 8-6 | 0.50 (12.70) | 2.45 (62.23) | 2.80 (71.12) | 1.12 (28.44) Square Body | 4.20 (106.7) |
| 8 | 0.50 (12.70) | 2.45 (62.23) | 2.80 (71.12) | 1.12 (28.44) Square Body | 4.20 (106.7) |
| 10 | 0.625 (15.88) | 2.72 (69.08) | 2.80 (72.12) | 1.25 (31.75) Square Body | 4.30 (109.2) |
| 12 | 0.75 (19.05) | 3.25 (82.55) | 2.90 (73.66) | 1.25 (31.75) Square Body | 4.40 (111.8) |
| 16 | 1.00 (25.40) | 3.56 (90.42) | 3.00 (76.20) | 1.63 (41.40) Hex Body | 4.70 (119.4) |
| 20 | 1.25 (31.75) | 4.06 (103.1) | 3.10 (78.74) | 1.88 (47.75) Hex Body | 4.90 (124.5) |
| 24 | 1.50 (38.10) | 4.59 (116.6) | 3.30 (83.82) | 2.25 (57.15) Hex Body | 5.20 (132.1) |
| 32 | 2.00 (50.80) | 6.06 (153.9) | 3.50 (88.90) | 2.75 (69.85) Hex Body | 5.70 (144.8) |

## NPT End Fitting




| Size | End Fitting in. (mm) | A in. (mm) | B in. (mm) | C in. (mm) | D in. (mm) |
|---|---|---|---|---|---|
| 8-4 | 0.50 (12.70) | 2.70 (68.58) | 2.80 (71.82) | 1.12 (28.44) Square Body | 4.20 (106.7) |
| 8-6 | 0.50 (12.70) | 2.70 (68.58) | 2.80 (71.82) | 1.12 (28.44) Square Body | 4.20 (106.7) |
| 8 | 0.50 (12.70) | 2.70 (68.58) | 2.80 (71.82) | 1.12 (28.44) Square Body | 4.20 (106.7) |
| 10 | 0.75 (19.05) | 3.29 (83.57) | 2.80 (71.82) | 1.25 (31.75) Square Body | 4.30 (109.2) |
| 12 | 0.75 (19.05) | 3.29 (83.57) | 2.90 (73.66) | 1.25 (31.75) Square Body | 4.40 (111.8) |
| 16 | 1.00 (25.40) | 3.78 (96.01) | 3.00 (76.20) | 1.63 (41.40) Hex Body | 4.70 (119.4) |
| 20 | 1.25 (31.75) | 4.23 (107.4) | 3.10 (78.74) | 1.88 (47.75) Hex Body | 4.90 (124.5) |
| 24 | 1.50 (38.10) | 4.67 (118.6) | 3.30 (83.82) | 2.25 (57.15) Hex Body | 5.20 (132.1) |
| 32 | 2.00 (50.80) | 5.89 (149.6) | 3.50 (88.90) | 2.75 (69.85) Hex Body | 5.70 (144.8) |

## Flange End Fitting




| Size | A in. (mm) | B# in. (mm) | C# in. (mm) | D 150# Flange in. (mm) | D 300# Flange in. (mm) | D 600# Flange in. (mm) |
|---|---|---|---|---|---|---|
| 8-4 | 5.00 (127.0) | 2.80 (71.12) | 4.10 (104.1) | 3.50 (89) | 3.75 (95) | 3.75 (95) |
| 8-6 | 5.00 (127.0) | 2.80 (71.12) | 4.10 (104.1) | 3.50 (89) | 3.75 (95) | 3.75 (95) |
| 8 | 5.00 (127.0) | 2.80 (71.12) | 4.30 (109.2) | 3.50 (89) | 3.75 (95) | 3.75 (95) |
| 10 | 5.50 (139.7) | 2.80 (72.12) | 4.40 (111.8) | 3.50 (89) | 3.75 (95) | 3.75 (95) |
| 12 | 5.50 (139.7) | 2.90 (73.66) | 4.50 (114.3) | 3.88 (99) | 4.62 (117) | 4.62 (117) |
| 16 | 5.50 (139.7) | 3.00 (76.20) | 4.80 (121.9) | 4.25 (108) | 4.88 (124) | 4.88 (124) |
| 20 | 6.00 (152.4) | 3.10 (78.74) | 5.00 (127.0) | 4.62 (117) | 5.25 (133) | 5.25 (133) |
| 24 | 6.00 (152.4) | 3.30 (83.82) | 5.20 (132.1) | 5.00 (127) | 6.12 (155) | 6.12 (155) |
| 32 | 6.50 (165.1) | 3.50 (88.90) | 5.70 (144.8) | 6.00 (152) | 6.50 (165) | 6.50 (165) |

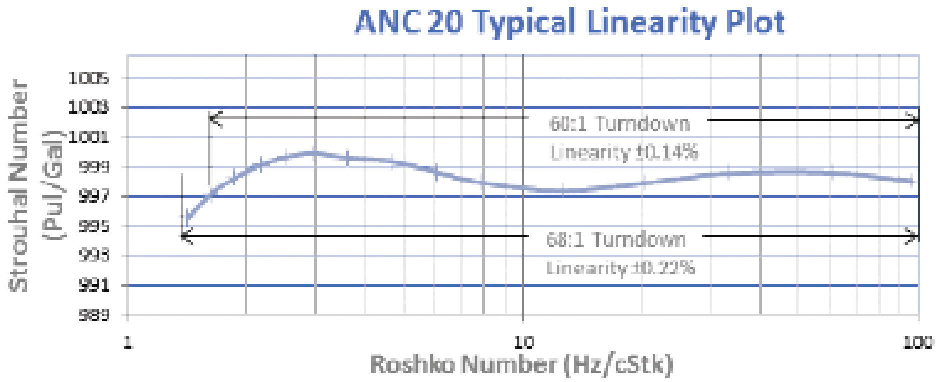



*Figure 6: Typical linearity curve for a size 20 flow meter*

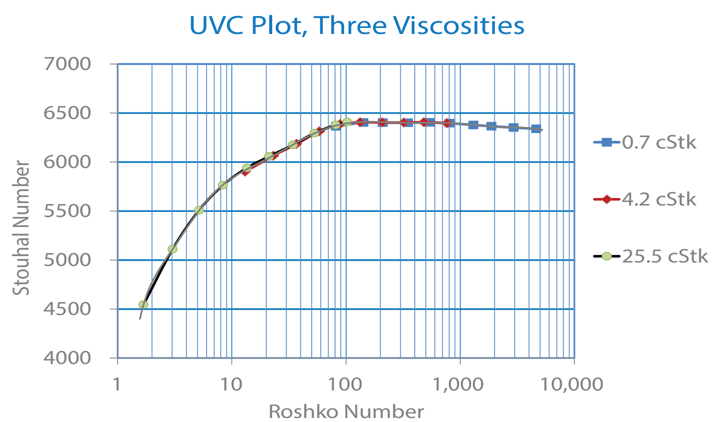



*Figure 7: UVC plot*

## RECALIBRATION

- Recalibration is not necessary following a cleaning operation or the replacement of bearings, snap rings, springs or spacers.
- Recalibrate the flow meter if the rotor hub, or rotor and flow straightener assembly is replaced.
- Flow meters may be recalibrated by the user if the facilities are available, or they may be returned to the factory. Yearly calibration is recommended.
- When the flow meter is set up for recalibration, allow the fluid to circulate for 5 minutes before beginning the calibrating runs.

## LOFLO REPLACEMENT PARTS

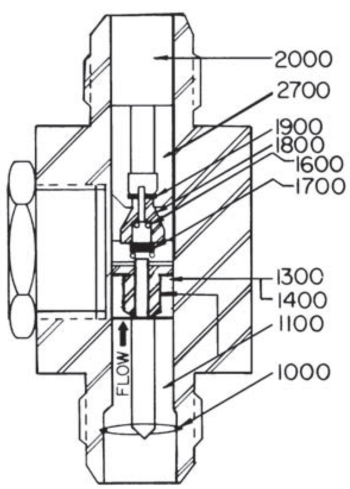



*Figure 8: Model CLFA6*

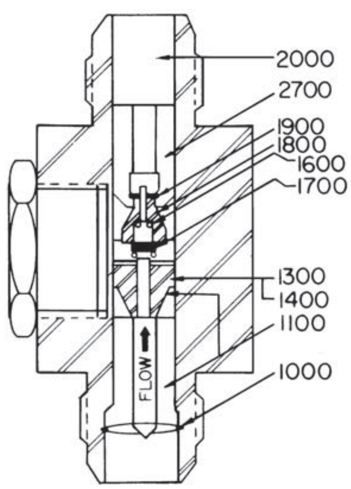



*Figure 9: Model CLFB6*

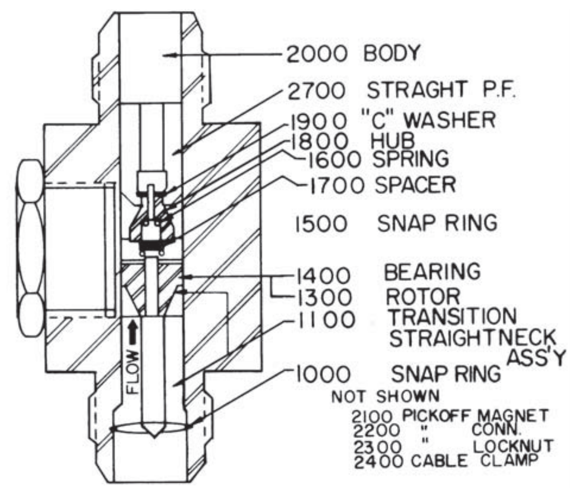



*Figure 10: Models CLFC6…CLFF6*

1100 – Flow is through 0.03

1300 – Rotor is angled blade

1400 – Bearing is staked into rotor. (Factory replace)

1100 – Flow is through swirl slot. Tube is press fit over slot.

1300 – Rotor has straight blades.

1400 – Bearing is staked into rotor. (Factory replace)

1100 – Flow is through swirl slots. No tube over slots.

1300 – Rotor has straight blades.

1400 – Bearing is held with snap rings. (Field replace)

**Control. Manage. Optimize.**

Cox Instruments is a registered trademark of Badger Meter, Inc. Other trademarks appearing in this document are the property of their respective entities. Due to continuous research, product improvements and enhancements, Badger Meter reserves the right to change product or system specifications without notice, except to the extent an outstanding contractual obligation exists. © 2018 Badger Meter, Inc. All rights reserved.

**www.badgermeter.com**

**The Americas | Badger Meter** | 4545 West Brown Deer Rd | PO Box 245036 | Milwaukee, WI 53224-9536 | 800-876-3837 | 414-355-0400
**México | Badger Meter de las Americas, S.A. de C.V.** | Pedro Luis Ogazón N°32 | Esq. Angelina N°24 | Colonia Guadalupe Inn | CP 01050 | México, DF | México | +52-55-5662-0882
**Europe, Eastern Europe Branch Office (for Poland, Latvia, Lithuania, Estonia, Ukraine, Belarus)** | Badger Meter Europe | ul. Korfantego 6 | 44-193 Knurów | Poland | +48-32-236-8787
**Europe, Middle East and Africa | Badger Meter Europa GmbH** | Nurtinger Str 76 | 72639 Neuffen | Germany | +49-7025-9208-0
**Europe, Middle East Branch Office | Badger Meter Europe** | PO Box 341442 | Dubai Silicon Oasis, Head Quarter Building, Wing C, Office #C209 | Dubai / UAE | +971-4-371 2503
**Slovakia | Badger Meter Slovakia s.r.o.** | Racianska 109/B | 831 02 Bratislava, Slovakia | +421-2-44 63 83 01
**Asia Pacific | Badger Meter** | 80 Marine Parade Rd | 19-07 Parkway Parade | Singapore 449269 | +65-63464836
**Switzerland | Badger Meter Swiss AG** | Mittelholzerstrasse 8 | 3006 Bern | Switzerland | +41-31-932 01 11

Legacy Document Number: CH 4001