COX INSTRUMENTS
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Bulletin: 82-TM Manual

82 SERIES TURBINE FLOWMETER

INSTALLATION AND MAINTENANCE MANUAL

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Figure 1. Cox Industrial Turbine Flowmeter Family

In industrial flow measurement, dependable performance and flowmeter longevity are very important. With Cox Instrument Series 82 Turbine Flowmeters, these features combine with high measurement precision over a wide range of flow rates.

I. GENERAL TECHNICAL INFORMATION

The 82 Series Turbine Flowmeter, Figure 1, produces a high resolution pulse rate output signal proportional to fluid velocity, and hence, to volumetric flow rate. As the turbine rotates, an a-c voltage is induced in a magnetic pickup coil mounted external to the fluid process. As each turbine blade passes the base of the pickup coil, the total flux density is changed, thus inducing a single voltage pulse. Each pulse represents a distinct finite volume of fluid that has been displaced through two adjacent rotor blades. The pulse rate generated becomes a very accurate measure of flow rate, and the total number of pulses in any time increment, an equally accurate measure of total volume displaced. Using digital readout devices, this accuracy is maintained within ±1 count.

The 82 Series Meter has been developed specifically for use in highly erosive and non-lubricating fluids. A unique bearing design now permits accurate, dependable flow measurement of many fluids that have, in the past, not been suitable for use with a turbine flow transmitter.

1. DESIGN FEATURES

The 82 Series Turbine Flowmeters are offered with either pipe thread, ANSI class 150/300/600 flange end connections, or flared tube end connections. All have exceptional simplicity of construction. As shown in the exploded view drawing (Figure 5), there is a minimum number of parts. The flowmeters are easily disassembled for inspection and cleaning. And reassembly or bearing replacement does not cause a shift in the calibration factor for 25 mm (1 in.) and larger units. Straightening vanes are permanently mounted in the housings and do not require removal, except in reduced bore versions having size prefix codes 1/2”-2, 1/2”-1, and 5/8"-1.

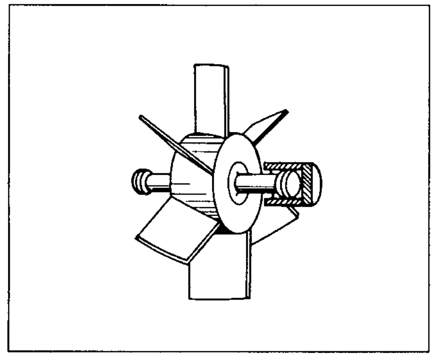


Figure 2. Ball-Sleeve Bearing Construction

A. Ball-Sleeve Bearing Construction

Tungsten carbide ball operation on aluminum oxide bearing surfaces, (Figure 2).

1. High corrosion resistance.
2. Superior water resistance exhibited in non-lubricating fluids containing severe abrasive particles.
3. Self-cleaning due to centrifugal action of rotating balls.
4. Meter performance is insensitive to bearing clearance or condition of bearing surfaces.
5. Symmetrical design of measurement element permits bidirectional flow with no degradation in performance or life.

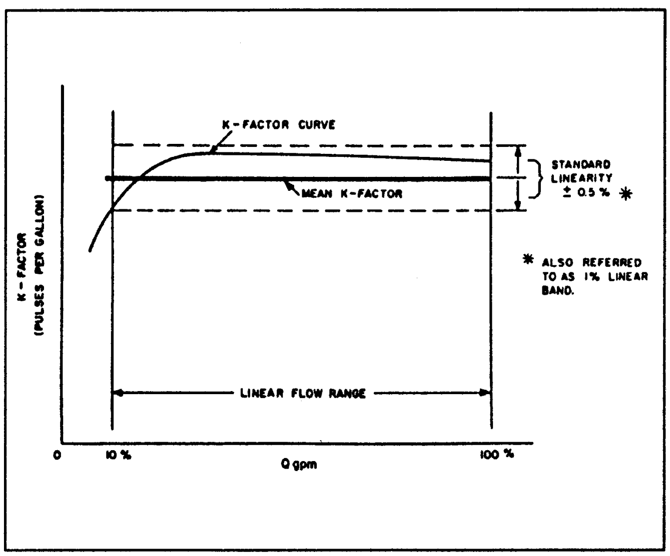


Figure 3. K-factor Curve

Table 1. Capacity Data, 82 Series Turbine Flowmeter

Size Code	**Range Limits for ±0.5% Linearity**				**Typical K-Factor**		**Typical Pulse Rate at Max. Flow Rate**	**Maximum Pressure Drop Based on Water at Maximum Flow Rate**	
	1/2”- 1” L/M Above M^3/HR		**U.S. GPM**		**1/2” –1” P/L Above P/M^3**	**P/U.S. Gal.**			
	MIN	**MAX**	**MIN**	**MAX**			**PPS**	**kPA**	**PSI**
82 Turbine Flow Meter Capacities Water at 15.6°C (60°F)									
1/2 - 1	2.27	22.7	.6	6	3036	11500	1150	70	10
1/2 and 5/8-1	4.54	45.5	1.2	12	1405	5320	1064	61	8.5
3/4 and 1-1	11.3	113	3	30	351	1328	665	50	7.0
1	23.5	235	6.2	62	218	826	855	64	8.9
1-1/2	**3.18**	**31.8**	14	140	**65000**	246	575	50	7.0
2	**5.68**	**56.8**	25	250	**27500**	104	435	60	8.5
3	**12.7**	**127**	56	560	**7920**	30	280	54	7.5
4	**22.7**	**227**	100	1000	**3380**	12.8	214	28	4.0
6	**51.1**	**511**	225	2250	**978**	3.7	140	40	5.5
8	**90.8**	**908**	400	4000	**417**	1.58	105	44	6.1
82 Turbine Flow Meter with reduced Capacities for ± 0.25% Linearity, Water at 15.6°C (60° F)									
1/2 and 5/8 –1	7.57	45.5	2	12	1405	5320	1064	61	8.5
3/4 and 1-1	18.9	113	5	30	351	1328	665	50	7.0
1	30.3	235	8	62	218	826	855	64	8.9
1- 1/2	**4.09**	**31.8**	18	140	**65000**	246	575	50	7.0
2	**7.04**	**56.8**	31	250	**27500**	104	435	60	8.5
3	**17.0**	**127**	75	560	**7920**	30	280	54	7.5
4	**36.3**	**227**	160	1000	**3380**	12.8	214	28	4.0
6	**90.8**	**511**	400	2250	**978**	3.7	140	40	5.5
8	**182**	**908**	800	4000	**417**	1.58	105	44	6.1

Notes:

1. Linear flow range is based on water at viscosity of 1cP: with liquids of other viscosities and densities, lower limit of linear range will change.
2. Precise values of K-Factor, determined by actual calibration over linear range, are listed on calibration report accompanying flowmeter.
3. Maximum pressure drop is based on water at maximum flow rate.
4. In barrels (oil) = 42 U.S. gallons.
5. Greater range can be achieved at a slight loss in linearity. Consult factory.

B. Design Simplicity:
One moving assembly.
1. Minimum number of parts.
2. Easy disassembly for inspection and cleaning without change in calibration factor.
3. Noncritical rotor alignment because of double ended ball construction. Conventional sleeve or journal bearings require precise alignment.

C. Straightening Vanes:
The rotor shaft assembly supports, integrally mounted in the meter housing both upstream and downstream of rotor, also serve as straightening vanes.

2. OPERATING CHARACTERISTICS

A. High pulse rate output signal directly proportional to flow rate, see Table 1.
B. Linear ranges also shown in Table 1.
C. High accuracy and repeatability.

(i) <u>Performance</u>

Prior to shipment, each turbine flowmeter is calibrated using water as a flow medium. Calibration in liquids other than water is available upon request.

The data is documented on a calibration data sheet and shipped with the flowmeter. Using this data, the mean calibration factor (mean K-factor), in pulses per U.S. gallon or other applicable units, is determined relative to a specific flow range. A calibration report is shipped with each flowmeter.

The factor is represented by the following expression:

$$K = \left(\frac{60f}{Q} \right)$$

where: f is pulses per second.
Q is flow rate in gallons per minute.
K is pulses per gallon.

The K-factor curve and the mean K-factor associated with a specific flow range are graphically illustrated in Figure 3.

Performance characteristics are shown in the general specification sheets.

(ii) <u>Step Response Time</u>

The 82 Series Turbine Flowmeters have a response time of 2.5 to 16 milliseconds (depending upon size) to reach 63 percent of final value after a step change in flow.

(iii) <u>Overspeed</u>

The maximum flow beyond which operation is not recommended is 150 percent of the maximum rate flow for any given meter size.

3. PROCESS PIPING AND CONNECTIONS

Installation of the flowmeter with 10 diameters upstream and 5 diameters downstream of straight pipe, the same nominal size as the flowmeter connection, is recommended as good practice.

The effect of plumbing a flowmeter into smaller line sizes is likely to cause a shift in K-factor less than .05 percent. It has been observed that pipe elbows installed immediately upstream of the meter cause a shift of less than 0.5 percent.

A strainer should be installed upstream of the flowmeter only when particles or objects in the flow stream will physically damage or block the rotor due to their bulk. Strainers are not required for protection of the bearing surfaces.

Recommended strainer sizes are shown below:

Size Code	Mesh Screen	Maximum Screen Hole Size	
		Mm	in
1/2, 3/4	100	0.13	0.005
1 to 3	80	0.18	0.007
4, 6	60	0.23	0.009
8	40	0.30	0.012

Table 2. Strainer Size

4. ELECTRICAL CONNECTIONS AND SIGNAL TRANSMISSION

Pickup Coils:
Two-pin, plug type are furnished as standard. 10SL-4P Shell, 5/8-24 NEF thread with mating connector MS 3106A-10SL-4S(c). The coil boss is externally threaded 1-1/4 NPT – for conduit use and explosion-proof requirements.

Transmission Cable:
2-conductor, Number 18 wire gauge, shielded cable, Cox Part Number R0101RM (or equal).

Signal Output:
The 82 Series Turbine Flowmeters generate an approximate sine wave a-c voltage output.

Operating Pulse Rate and Voltage:
Minimum operating pulse rates and voltages for 82 Series Turbine Flowmeters are shown in Figure 4.

Cox Industrial digital and analog devices are designed to accept these voltage and pulse rate levels.

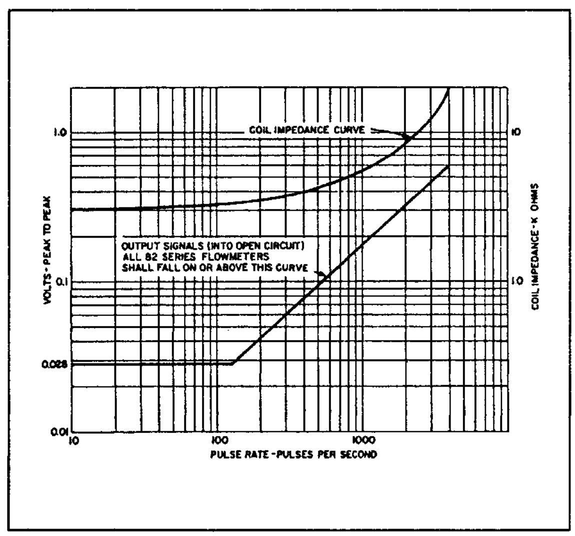


Figure 4. Operating Pulse Rate and Voltage

5. CONSTRUCTION DETAILS

Figure 5 illustrates the simplicity of design (3-inch and above shown). The moving part, rotor and shaft assembly, is symmetrical and is supported at both ends.

The ball construction affords ample running clearance, eliminating the need for precise alignment.

The rotor and shaft assembly is easily extracted from the meter housing by the removal of one retaining ring.

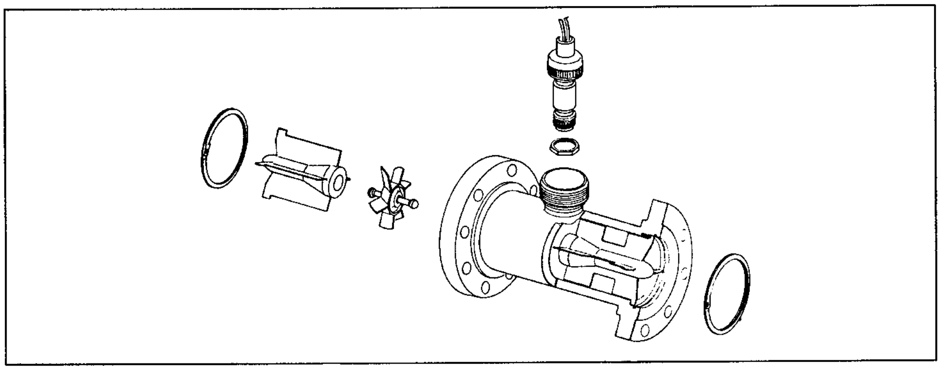


Figure 5. Flowmeter Exploded View.

Bearings:
The 82 Series Ball-Sleeve Flowmeters feature tungsten carbide on aluminum oxide (ceramic). There is a tungsten carbide ball on either end of the rotor shaft. A circumferential flat is machined on each ball. This flat effectively minimizes initial wear rate and eliminates any tendency of the meter to experience a shift in K-factor resulting from initial break-in of the bearing. Dimensional changes due to wear of the ball will be very minute, and effects on performance will be insignificant over the life of the meter. Each ball is supported by an aluminum oxide sleeve bearing surface and thrust plate which will accept both radial and axial loading. The meter is thrust compensated to minimize thrust loading with flow in either direction. This symmetrical design permits bidirectional operation. It is recommended that the flow calibration be performed in both directions for bidirectional operation to ensure best accuracy in determining the K-factor for the meter. This unique combination of materials provides optimum differential hardness for long bearing life. This permits the accurate flow measurement of nonlubricating, corrosive, and highly abrasive fluids.

Rotor:

Typical turbine type flowmeter calibration curves tend to rise as the low end of the linear range is approached. This effect is controlled by optimizing the clearance between the rotor tip and the housing wall. Generally referred to as “tip clearance.”

The 82 Series Meters feature a "conventional blade" (see Figure 2) with outstanding results. The 82 Series Meters have a friction bearing design. The frictional forces and the fluid drag forces pull the meter curve down at the low flow end, eliminating the need for the T-blade design. In addition, the tip clearance that is achieved with the 82 Series design is many times greater than is found in other designs. This is an important consideration, since this series of meters was designed to handle the toughest turbine meter applications, including those streams containing abrasive solids.

The unique choice of bearing materials and maximum tip clearance of the 82 Series Flowmeters allows installation in process lines without the usual stringent requirements for in-line strainers mounted upstream of the meter. This eliminates a normal maintenance item from the process line and also saves on pumping costs.

Materials of Construction:
All parts other than those featured above are of stainless steel construction.

6. PRESSURE DROP

Pressure drops at maximum rated flow are shown in Table 1. These values are based on water at 60 °F. To calculate the pressure drop at flow rates below maximum use:

$$\Delta P_a = \Delta P_m \left(\frac{Q_a}{Q_m} \right)^2$$

The precise equation for calculating pressure drops in liquids with specific gravities and viscosities different from the fluid in which the flowmeter is calibrated (usually water at S.G. = 1.0 centipoise) is as follows:

$$\Delta P_2 = \Delta P_1 \left(\frac{\rho_2}{\rho_1} \right)^{0.81} \left(\frac{\mu_2}{\mu_1} \right)^{0.27} \left(\frac{Q_2}{Q_1} \right)^{1.82}$$

In practice a simplified equation is used to estimate pressure drop as follows:

$$\Delta P_2 = \Delta P_1 \left(\frac{\rho_2}{\rho_1} \right) \left(\frac{\mu_2}{\mu_1} \right)^{0.25} \left(\frac{Q_2}{Q_1} \right)^2$$

Identification Of Terms

ΔP_2 = Pressure drop in process fluid (psi).
ΔP_1 = Pressure drop in calibration fluid; usually water (psi).
ΔP_2 = Pressure drop in process fluid (psi).
ΔP_a = Pressure drop at actual flow (psi).
Q_m = Maximum rated volumetric flow (gpm, bph, etc.).
Q_a = Selected volumetric flow rate (usually gpm or bph).
Q_1 = Volumetric flow rate at which P1 is known (gpm, bph, etc.).
ρ_1 = Density (Sp Gr.) of calibration fluid.
Q_2 = Volumetric flow rate at which P2 is desired (gpm, bph, etc.).
μ_1 = Absolute viscosity of calibration fluid (centipoise).
ρ_2 = Density (Sp. Gr.) of process fluid.
μ_2 = Absolute viscosity of process fluid (centipoise).

7. VISCOSITY

Figure 6 is a graphic representation of equation (1) based on a fluid with specific gravity of 1.0 and absolute viscosity of 1.0 centipoise.

The flow ranges shown in Table 1 are based on calibration in a fluid of 1 centistoke viscosity. This can be considered a "design condition" at which the driving forces on the rotor speed are linear with fluid velocity.

As the fluid viscosity increases, drag forces on the rotor blades are increased as a result of the greater fluid friction. Consequently, as the rotor speed changes, the linear relationship between fluid velocity and rotor speed will be altered.

The curves shown in Figures 7 though 15 graphically show the effect of viscosity on the 82 Series Turbine Flowmeters. These curves can be used to estimate the performance of a given line size on a specific viscous fluid. In reviewing these curves, it can be readily deduced that as the size of the turbine meter increases, the sensitivity to viscosity greatly decreases.

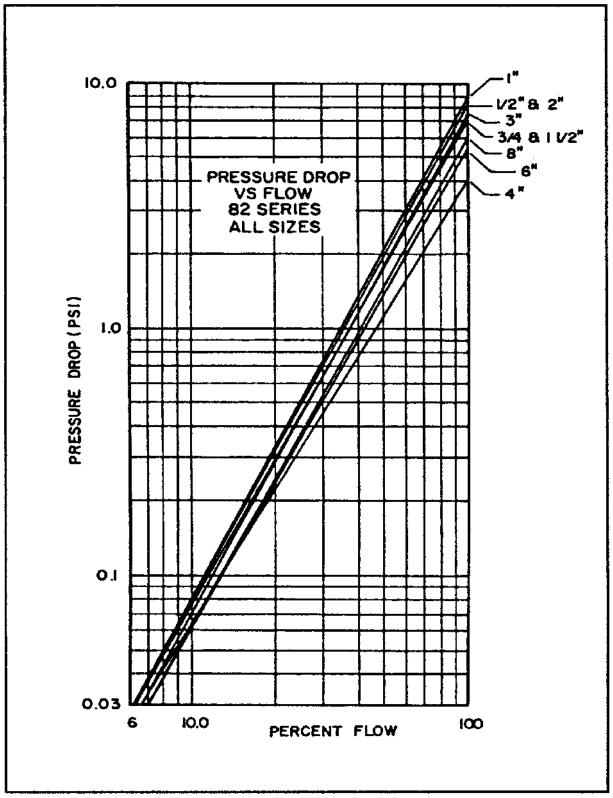


Figure 6. Pressure Drop vs Flow

The precise effect of viscosity on a given flowmeter can only be determined by performing an actual viscosity calibration. The linearity and optimum mean K-factor relative to any selected flow range within the physical operating limits of the meter can be obtained from this data.

This calibration is generally in one of two forms: (1) For application in fluids with constant viscosity. A 10-point calibration is performed in a fluid of comparable viscosity. (2) For application in fluids with varying viscosity. Two to four 10-point calibrations are performed at selected viscosities equally spaced over the required viscosity span. A universal calibration curve can then be generated over the entire range of the meter.

The most precise method would be to generate a separate curve for each specific viscosity requirement. This minimizes error in attempting to generate a smooth, continuous curve through numerous calibration points.

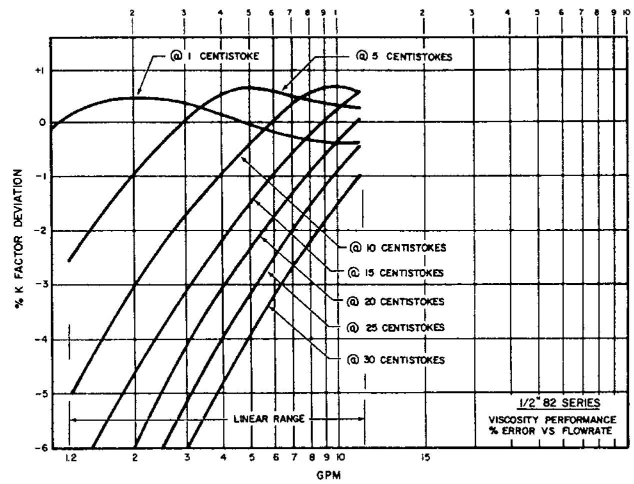


Figure 7. 1/2-inch 82 Series Turbine Flowmeter Viscosity Effects

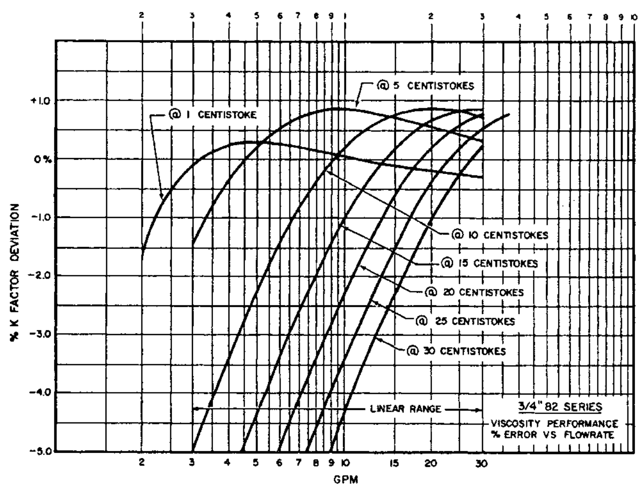


Figure 8. 3/4-inch 82 Series Turbine Flowmeter Viscosity Effects

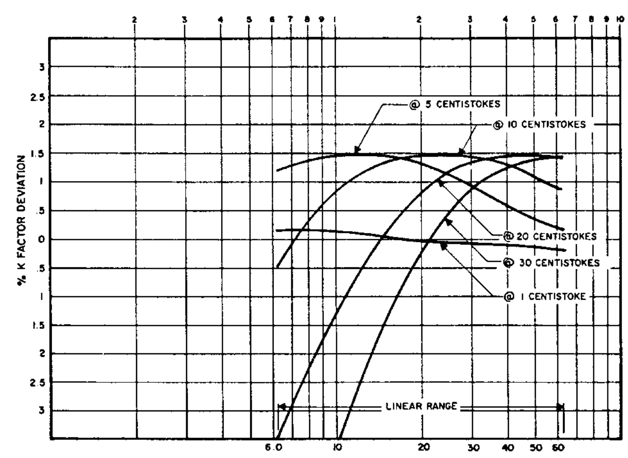


Figure 9. 1-inch 82 Series Turbine Flowmeter Viscosity Effects

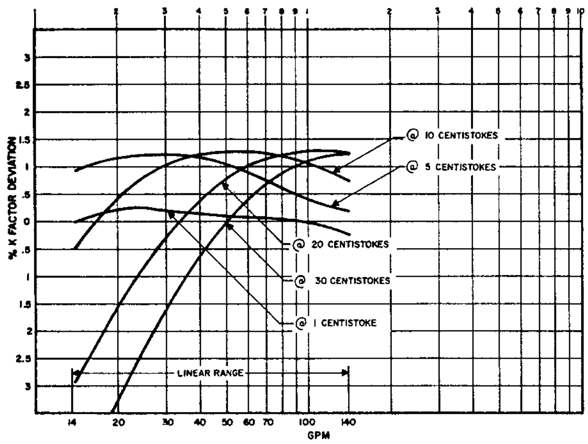


Figure 10. 1-1/2-inch 82 Series Turbine Flowmeter Viscosity Effects

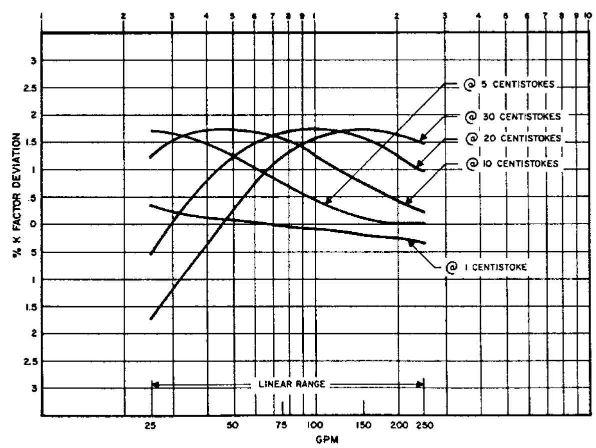


Figure 11. 2-inch 82 Series Turbine Flowmeter Viscosity Effects

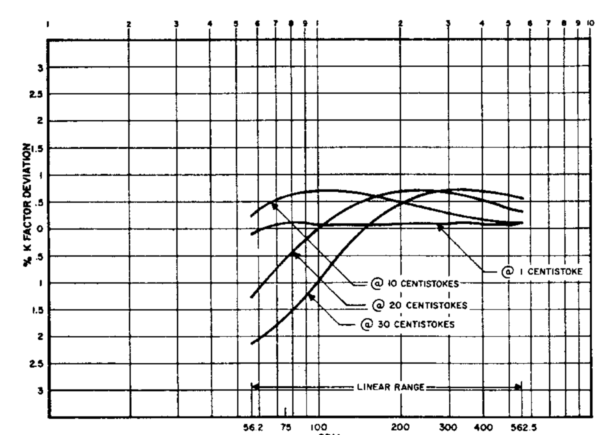


Figure 12.
3-inch 82 Series Turbine Flowmeter Viscosity Effects

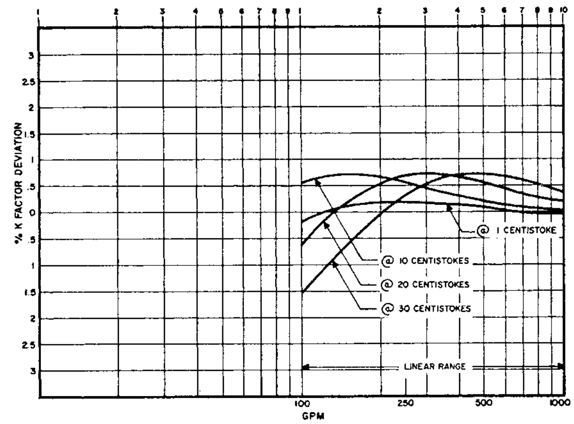


Figure 13. 4-inch 82 Series Turbine Flowmeter Viscosity Effects

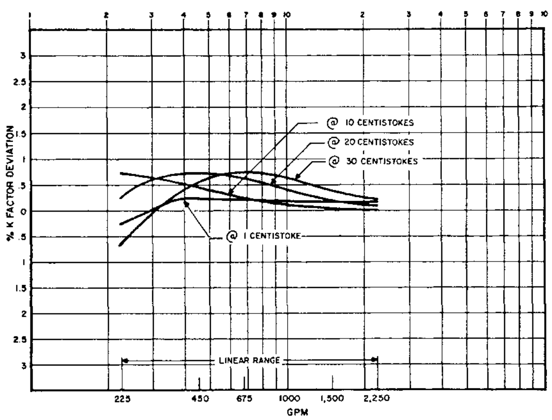


Figure 14. 6-inch 82 Series Turbine Flowmeter Viscosity Effects

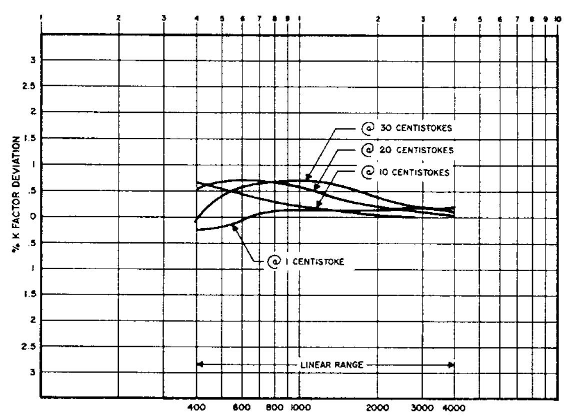


Figure 15. 8-inch 82 Series Turbine Flowmeter Viscosity Effects

II. INSTALLATION AND OPERATION

1. STANDARD SPECIFICATIONS

Flow Data: See Table 1.

End Construction:
Flanged: ANSI-RF, sizes 1/2" though 8”
Threaded: External, NPT, sizes 1/2" through 1”-1
External, tubing, sizes 5/8"-1 and 1"-1

Pressure Rating:
Flanged: ANSI Class 150; ANSI Class 300
Threaded: NPT, 7 MPa (1000 psi)
Threaded: Tubing, 20 MPa (3000 psi)
Maximum Pressure Drop: See Table 1.
Outlet Pressure (absolute): Must be greater than twice the pressure drop, plus 1.3 times the vapor pressure of the measured liquid at operating temperature.
Minimum Output Voltage: 28 mV (peak-to-peak) at minimum linear flow
Temperature Limits: -50 and +230ºC (-60 and + 450ºF)

Mounting and Dimensions:
Flanged Type: Per ANSI B16.8
Threaded and Flared Type: US Pipe Thread
Flared Type: Per MS 33656 (37º)

2. INSTALLATION

Notes:
1. Gaskets must not protrude into the flow stream.
2. It is recommended that the flowmeter be installed with the pickup coil facing either horizontally or downward (to minimize condensation buildup).
CAUTION - TO AVOID DAMAGING THE ROTOR, KEEP ALL FOREIGN MATERIAL OUT OF THE LINE DURING INSTALLATION.

Piping:

Install flowmeter (Figure 16) so that it is free of magnetic field effects and vibration. In general, do not locate it within 3 m(10 ft) of heavy electrical equipment.

The flowmeter should be mounted in a horizontal line and may be rotated in any direction on its axis.

Install the flowmeter so that arrow on flowmeter body points in the direction of the flow.

A bypass should be provided if the flow cannot be interrupted for maintenance of strainer or flowmeter.

Inside diameter (I.D.) of the piping should match diameter of the flowmeter opening. Maximum recommended allowable mismatch is 8 percent of nominal diameter.

Install strainer on upstream side. See Table 2. (Required only when particles in flow stream may physically damage or block turbine rotor due to their bulk.)

Note:

Sizes 1" and smaller are made to mate with Schedule 80 pipe. Sizes larger than 1" mate with Schedule 40 pipe.

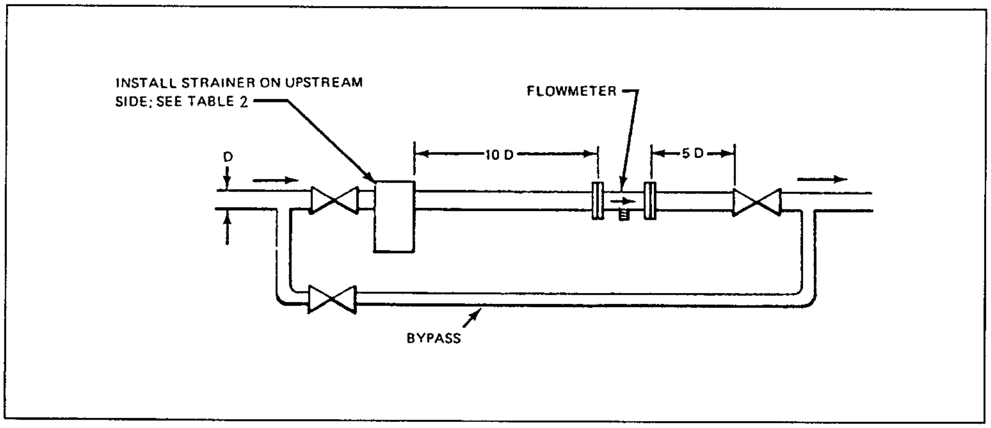


Figure 16. Flowmeter Installation

(i) <u>Flowmeter Handling And Alignment</u>

Refer to Figure 17.

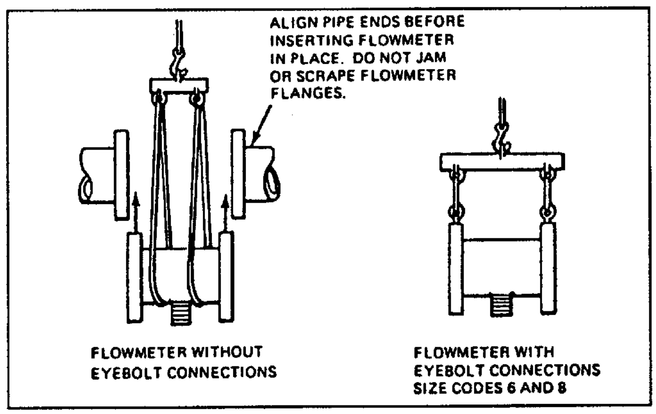


Figure 17. Flowmeter Handling and Alignment

(ii) <u>Conduit-Type Wiring</u>

Note: Suitable for Class I. Groups C and D, Division 1 operation.

Adaptor fitting kit permits connection box or field-mounted preamplifier to be close coupled to flowmeter.

CAUTION - DO NOT PERMIT WATER OR MOISTURE TO ENTER CONDUIT BOXES OR TO CONTACT CONDUCTORS.

<u>Wiring Using A Connection Box</u>:

Refer to Figure 18 for a connection box example. When exclusive conduit is used (no other leads in conduit), leads may be 0.50 mm^2 or 18 AWG shielded cable.

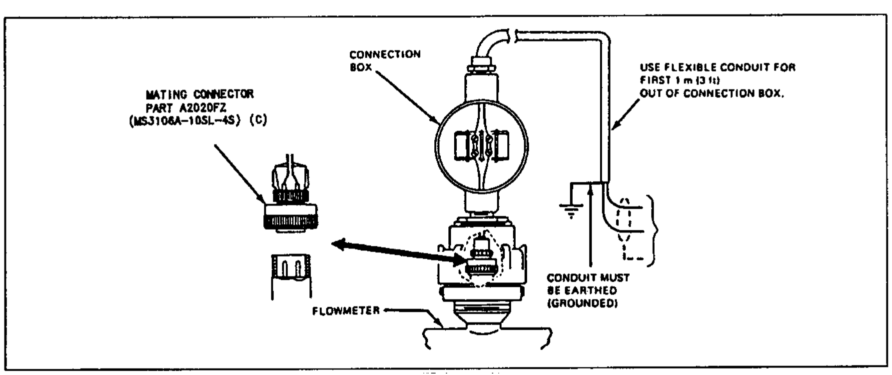


Figure 18. Wiring Using a Connection Box

Wiring Using A Field-Mounted Preamplifier:

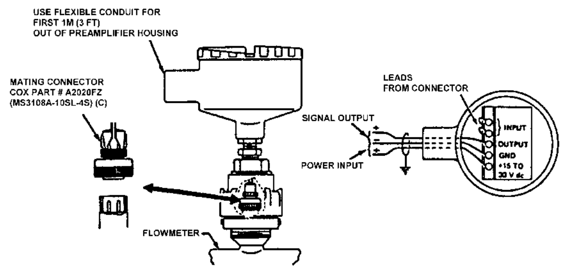


Figure 19. Wiring Using a Field-Mounted Preamplifier

3. OPERATION

Start-Up Precautions

Note: Minimum inlet pressure must equal output pressure (see Standard Specifications) plus maximum pressure drop (see Table 1)

When flow is stopped, close downstream shutoff valve (Figure 16), to keep system full.

1. Before liquid is allowed to flow though flowmeter (see Figure 16), remove flowmeter, and install a length of pipe in its place.
2. Thoroughly flush line to remove solids that could damage flowmeter rotor.
3. Replace the flowmeter.
4. Start process flowing through flowmeter gradually to prevent bearing damage by overspeeding rotor.
5. Bleed system of air before measurements are attempted. The system must be full of process liquid.

(i) Calibration Factor (K)

Accompanying each flowmeter is a calibration report. The calibration factor (flowmeter pulses per U.S. gal) is determined at a number of flow rates over the linear range of the flowmeter. The mean calibration factor is the average of the maximum and minimum calibration factors. The figure is used to standardize or preset the readout equipment.

(ii) Common Conversion Factors

The conversion factors below permit the calibration factor to be expressed in values other than pulses per U.S. gal.

Multiply K-factor (in pulses per U.S. gal):
X 42.00 = Pulses per barrel (42 U.S. gal)
X 1.201 = Pulses per imperial gal
X 0.264 = Pulses per litre
X 7.481 = Pulses per cubic foot
X 264.2 = Pulses per cubic metre
X (0.120) divided by (G) = Pulses per pound
X (0.264) divided by (G) = Pulses per kilogram

Where G= Relative Density (specific gravity)

III. MAINTENANCE

1. INTRODUCTION

Normal maintenance of the 82 Series Turbine Flowmeter consists of periodic inspection of the interior parts for signs of wear or corrosion, cleaning or replacing parts when required; and, if necessary, checking flowmeter calibration.

The frequency of this periodic maintenance will depend primarily on the service to which the flowmeter is subjected. It is suggested that the first inspection be made after six months of use. Future intervals between inspections will depend largely on results found after the initial inspection.

Refer to Table 3 for "Symptoms, Probable Causes, and Solutions" that cover:

- No flow indication.
- Flow indication with no flow in line.
- Erratic measurement or lack of repeatability.
- Indicated flow greater than actual flow.
- Indicated flow less than actual flow.

Table 3. Troubleshooting

SYMPTOMS, PROBABLE CAUSES, AND SOLUTIONS	
SYMPTOMS AND PROBABLE CAUSES	**SOLUTIONS**
1. No flow indication.	
a. Strainer (if included) or other device obstructing flow.	Check pump, strainer, etc.; clean replace, or repair.
b. Defective or improperly positioned valve.	Correct valve position, correct cause of valve failure, or replace valve.
c. Pickup coil not properly seated in coil well.	Reseat coil. Refer to “Coil Removal and Installation.”
d. Coil winding open or shorted.	Check coil. Refer to “Coil Test.”
e. Broken or earthed (grounded) transmission cable.	Repair or replace cable.
f. Defective readout device.	Repair or replace readout device.
g. Foreign material jammed between rotor and housing.	Disassemble and clean. Refer to “Disassembly and Assembly Procedures.”
h. Flowmeter improperly assembled.	Disassemble and refer to “Disassembly and Assembly Procedures.”
2. Flow indication with no flow in the line.	
a. Defective chassis earthing connection at readout device.	Repair chassis earth connection.
b. Strong ac interference.	Reroute cable, install cable in conduit, install field-mounted preamplifier (readout device wiring must be altered to bypass built-in preamplifier), or relocate flowmeter.
c. Strong vibration causing rotor to turn.	Support piping or relocate flowmeter.
d. Flow actually occurring.	Repair or replace defective valve or valve accessory.

Table 3. Troubleshooting (continued)

SYMPTOMS AND PROBABLE CAUSES	SOLUTIONS
3. Erratic measurement or lack of repeatability	
a. Foreign material obstructing flow.	Disassemble and clean. Refer to "Disassembly and Assembly Procedures."
b. Flowmeter installed with insufficient straight pipe upstream or downstream.	Correct piping and provide sufficient straight run. Refer to MI 019-115, Installation Section.
c. Partially full flowmeter or heavy gas entrainment in process liquid.	Arrange or repair piping to avoid entrainment, and bleed system on start-up.
d. Strong ac interference.	Reroute cable, install cable in conduit, install field-mounted preamplifier (readout device wiring must be altered to bypass built-in preamplifier), or relocate flowmeter.
e. Flow rate below specified minimum, causing marginal voltage output.	Increase flow rate to at least specified minimum.
f. Inlet pressure too low, causing flashing or cavitation of the fluid.	Increase inlet pressure.
4. Indicated flow greater than actual flow.	
a. Heavy gas entrainment in line.	Arrange or repair piping to avoid entrainment and bleed system on start-up.
b. Inlet pressure too low.	Increase inlet pressure.
c. Using incorrect calibration (K) factor.	Use correct calibration factor listed on Data Calibration Report that came with flowmeter.
d. Strong ac interference.	Reroute cable, install cable in conduit, install field-mounted preamplifier (readout device wiring must be altered to bypass built-in preamplifier), or relocate flowmeter.
5. Indicated flow less than actual flow.	
a. Process liquid viscosity significantly higher than originally specified.	Correct liquid viscosity or use corrected calibration (K) factor. Refer to "Calibration" below.
b. Pickup coil not properly seated in coil well.	Reseat coil. Refer to "Coil Removal."
c. Defective readout device.	Repair or replace readout device.
d. Using incorrect calibration (K) factor.	Use correct calibration factor listed on calibration report that came with flowmeter.

2. CALIBRATION

82 Series Turbine Flowmeters have excellent calibration stability. If abrasive liquids are being measured or if long-term precise calibration is required, periodic calibration checks should be made. If the bearings are changed, the calibration should be checked. Calibration consists of passing precise volumes of liquid through the flowmeter using a gravimetric or volumetric proving system, together with a gated pulse counter.

In this manner, the actual values of K (pulses per U.S. gallon) can be determined over the linear range of the flowmeter (refer to the calibration data report that came with the flowmeter). From these values, the mean K value (arithmetic mean between maximum and minimum values) can be calculated.

Individual plant practice will determine the actual proving procedure.

3. COIL REMOVAL

1. Disconnect conduit box or field-mounted preamplifier assembly (if present) from meter body.
2. Remove connector plug from pickup coil.
3. Loosen coil locknut with a 7/8-in. deepwell socket wrench (50 mm [2 in.] minimum depth).
4. Unscrew coil by hand.

4. COIL INSTALLATION

1. Screw in coil finger tight until it bottoms.
2. Tighten locknut to a torque of 20 to 40 N-rn (15 to 30 lb-ft).
3. Reconnect plug to coil.
4. Reconnect conduit box of field-mounted preamplifier (if present) to meter body.

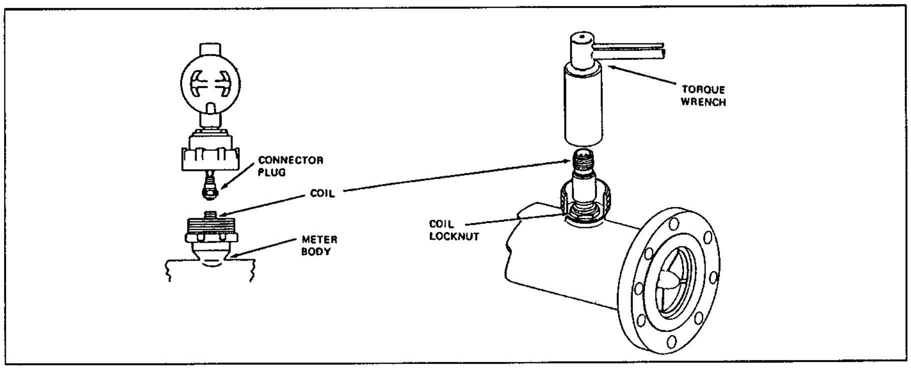


Figure 20. Coil Installation

5. COIL TEST

1. Remove cover from conduit connection box or field-mounted preamplifier, and remove coil leads from termination strip.
2. Measure resistance between coil leads with an ohmmeter. If resistance is not 3100 ohms ±10% at 21ºC (70ºF), replace coil.
3. Measure resistance between one lead and box. If resistance is not infinite, replace coil.
   Note: Coil can be tested directly by removing the connector plug. This will expose the coil terminals. See "Coil Removal and Installation" section above.

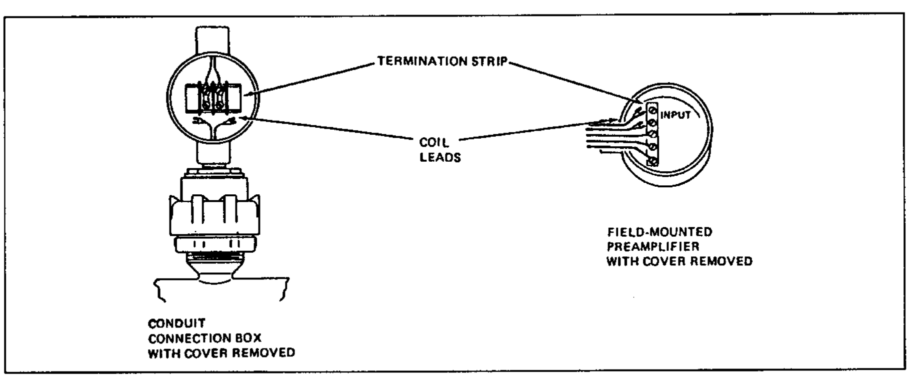


Figure 21. Coil Testing

6. DISASSEMBLY AND ASSEMBLY PROCEDURES FOR 82F (1/2" AND 3/4" SIZES) AND 82T4 (1/2" AND 1"-1 SIZES)

(i) Disassembly

Note: All illustrations shown are for the 82T4 Series. However, they apply to the 82F Series as well.

1. Remove pickup coil. (See "Coil Removal and Installation" section.)
2. Remove flowmeter from pipeline.
3. Remove upstream side retaining ring with needle probe or some sharp object.
   WARNING: WEAR SAFETY GLASSES AND USE SPECIAL CARE WHEN PERFORMING STEP 3. RETAINING RING MAY SNAP OUT OF GROOVE IN AN UNDETERMINED DIRECTION WITH HIGH VELOCITY.
4. Carefully shake sleeve, vane, and rotor into palm of hand. If parts cannot be removed freely, use a pair of tweezers and pull straight back on vane.
   Note: The downstream vane is not normally removed. If it is to be removed, mark the UPSTREAM vane.
5. Wash all parts, including downstream vane, with process compatible solvent.
6. If water is used as solvent, flush parts with isopropyl alcohol.
7. Inspect all parts for damage or wear. If required, replace parts.

(ii) Assembly

1. If downstream vane has been removed, insert vane and retaining ring. On 1/2" and 3/4" sizes, be sure that tabs on vane are not on upsets on shoulder of flowmeter. On size 1"-1, insert tabs on vane between pins located on shoulder of flowmeter.
2. Install rotor. Check for proper direction of flow from arrow on rotor.
3. Install upstream vane on 1/2″ and 3/4" sizes. Align it with downstream vane making sure vane tabs are not on upsets in shoulder of body housing. On size 1"-1, insert tabs on vane between pins on shoulder of flowmeter.
4. Install sleeve and retaining ring.
5. Check rotor for free turning by gently blowing into one end of flowmeter.
   Note: If rotor does not turn freely, repeat assembly process.
6. Reinstall flowmeter in pipeline.
   Note: If internal parts are replaced, it may be necessary to recalibrate the flowmeter. Refer to "Calibration" section.

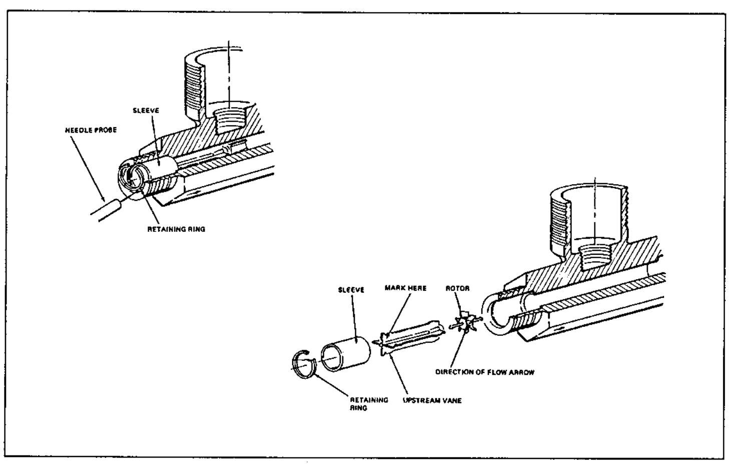


Figure 22. 1/2" – 3/4" Disassembly

7. DISASSEMBLY AND ASSEMBLY PROCEDURES FOR 82F (1" AND LARGER SIZES) AND 82T3 (5/8" AND 1”-1 SIZES)

(i) Disassembly

Note: All illustrations shown are for the 82F Series. However, they apply to the 82T3 Series as well.

1. Remove pickup coil. (See "Coil Removal and Installation" section.)
2. Remove flowmeter from pipeline.
3. Remove upstream side retaining ring with needle probe or screwdriver.
   WARNING: WEAR SAFETY GLASSES AND USE SPECIAL CARE WHEN PERFORMING STEP 3. RETAINING RING MAY SNAP OUT OF GROOVE IN AN UNDETERMINED DIRECTION WITH HIGH VELOCITY.
4. Remove vane and rotor.
   Note: On smaller sizes, if vane will not come out freely, use a pair of tweezers and pull straight back on vane. On larger sizes, use a block of wood and drive out from downstream end. The downstream vane is not normally removed. If it is to be removed, mark the UPSTREAM vane.
5. Wash all parts, including downstream vane, with process compatible solvent.
6. If water is used as a solvent, flush parts with isopropyl alcohol.
7. Inspect all parts for damage or wear. If required, replace parts.

(ii) Assembly

1. If downstream vane has been removed, insert vane and retaining ring. On 5/8" size, be sure that tabs on vane are not on upsets on shoulder of flowmeter. For sizes 1" and above, insert tabs on vane between pins located on shoulder of flowmeter.
2. Install rotor (arrow should point in direction of flow).
3. Install upstream vane and retaining ring. Follow procedure in Step 1, except on 5/8" size. Align vanes.
4. On smaller sizes, check rotor for free turning by gently blowing on end of flowmeter. On larger sizes, spin rotor gently by hand.
   Note: If rotor does not turn freely, repeat assembly process.
5. Reinstall flowmeter in pipeline.
   Note: If internal parts are replaced, it may be necessary to recalibrate the flowmeter. Refer to "Calibration" section.

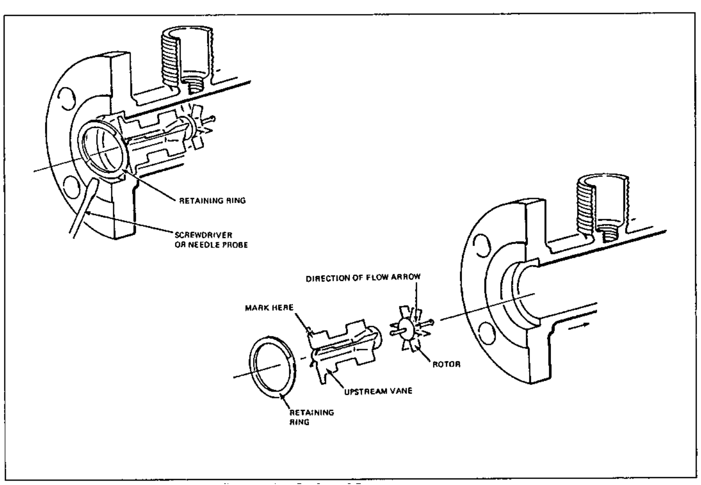
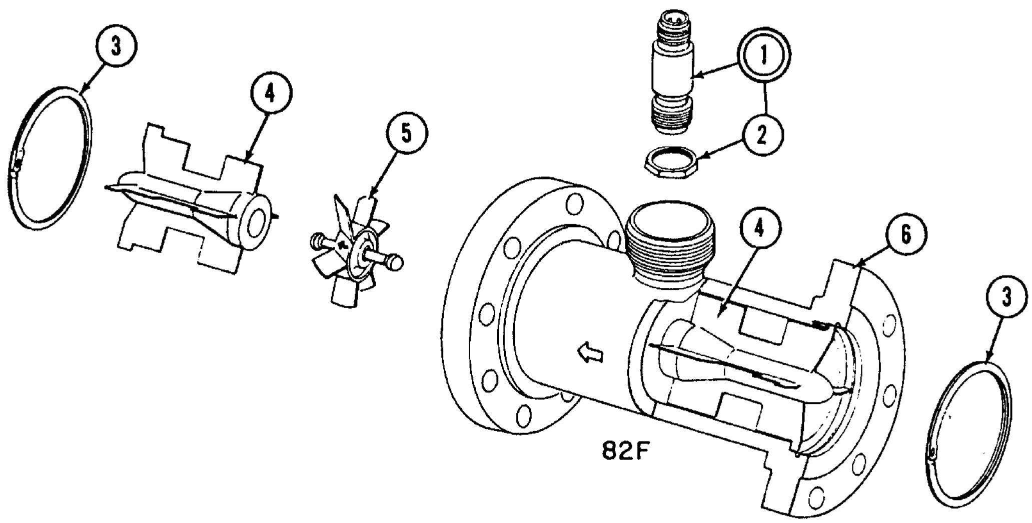


Figure 23. 1–inch and Large Disassembly

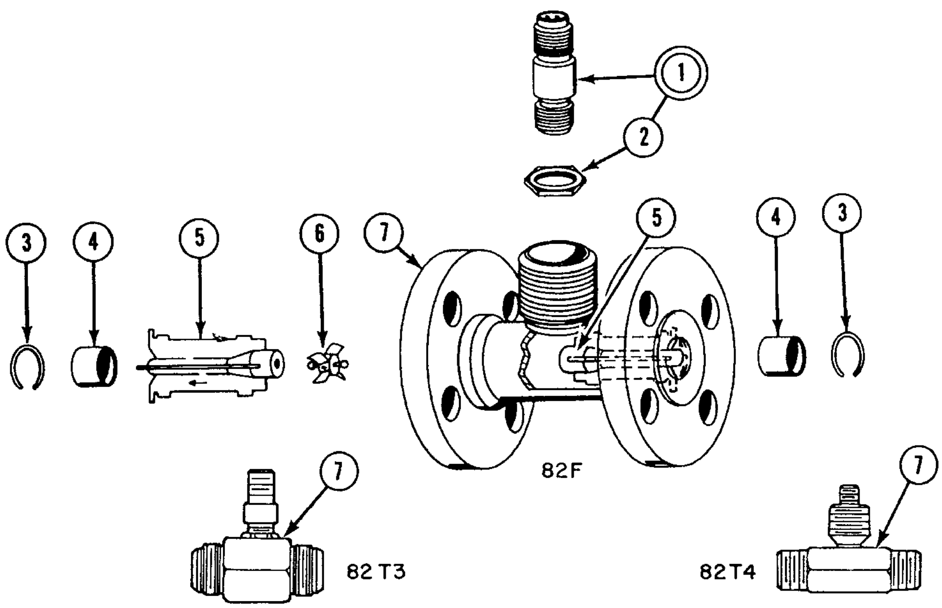
PARTS LIST



Meter Size (inches)	End Connection ASAI-RF (pounds)	Flow Meter Model Number	Item 1 Coil	Item 2 Coil Locknut	Item 3 Retaining Ring (2)	Item 4 Support Assembly Upstream	Item 4 Support Assembly Downstream	Item 5 Rotor and Shaft Assy (see Note)	Item 6 Housing
1	150	1-82F5E4	A2010SE	A2003MK	A2019TB	A2019SC	A2019SC	A2020RY	Order Entire Meter by Model Number
	300	1-82F6E4	A2010SE	A2003MK	A2019TB	A2019SC	A2019SC	A2020RY	
1 ½	150	1 ½-82F5E4	A2010SE	A2003MK	A2019TC	A2019SE	A2019SE	A2020RZ	
	300	1 ½-82F6E4	A2010SE	A2003MK	A2019TC	A2019SE	A2019SE	A2020RZ	
2	150	2-82F5E4	A2010SE	A2003MK	A2019TE	A2019SF	A2019SF	A2020SA	
	300	2-82F6E4	A2010SE	A2003MK	A2019TE	A2019SF	A2019SF	A2020SA	
3	150	3-82F5E4	A2010SK	A2003MK	A2019TF	A2019SK	A2019SK	A2020SB	
	300	3-82F6E4	A2010SK	A2003MK	A2019TF	A2019SK	A2019SK	A2020SB	
4	150	4-82F5E4	A2010SK	A2003MK	A2019TK	A2019SL	A2019SP	A2020SC	
	300	4-82F6E4	A2010SK	A2003MK	A2019TK	A2019SL	A2019SP	A2020SC	
6	150	6-82F5E4	A2010SK	A2003MK	A2019TL	A2019SM	A2019SR	A2020SE	
	300	6-82F6E4	A2010SK	A2003MK	A2019TL	A2019SM	A2019SR	A2020SE	
8	150	8-82F5E4	A2010SK	A2003MK	A2019TM	A2019SN	A2019SS	A2020SF	
	300	8-82F6E4	A2010SK	A2003MK	A2019TM	A2019SN	A2019SS	A2020SF	

Note: The rotor and Shaft Assembly is furnished as a calibrated unit and has a “K” factor assigned.

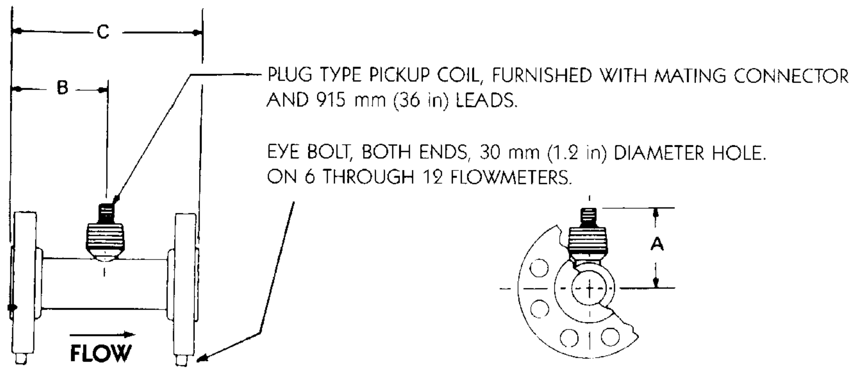
PARTS LIST



Sizes 1/2 to 3/4 Inches

Meter Size (inches)	End Connection	Flow Meter Model Number	Item 1 Coil	Item 2 Coil Locknut	Item 3 Retaining Ring (2)	Item 4 Spacer (2)	Item 5 Shaft Support Assem. (2)	Item 6 Rotor and Shaft Assem. (see note)	Item 7 Housing
½	150 lb ANSI-RF	½-82F5E4	A2003MF	A2003MK	A2038NM	A2038SN	A2038SQ	A2040LP	Order Entire Meter By Model Number
	300 lb ANSI-RF	½-82F6E4	A2003MF	A2003MK	A2038NM	A2038SN	A2038SQ	A2040LP	
¾	150 lb ANSI-RF	¾-82F5E4	A2003MF	A2003MK	A2038NE	A2038CB	A2038CK	A2040LQ	
	300 lb ANSI-RF	¾-82F6E4	A2003MF	A2003MK	A2038NE	A2038CB	A2038CK	A2040LQ	
½	½ inch NPT	½-82T4E4	A2003MF	A2003MK	A2038NM	A2038SN	A2038SQ	A2040LP	
¾	¾ inch NPT	1-182T4E4	A2003MF	A2003MK	A2038NE	A2038CB	A2038CK	A2040LQ	
½	Male, Flared $^7/_8$-14UNF-3A	$^5/_8$-182T3E4	A2003MF	A2003MK	A2038NM	NONE	A2038SQ	A2040LP	
¾	Male, Flared 1 $^5/_{16}$ – 12UN-3A	1-182T3E4	A2003MF	A2003MK	A2038NE	NONE	A2038CK	A2040LQ	

DIMENSIONS



Flange Meter Dimensions														
Size Code	A	B	C	ANSI Flange Rating Class	Flange Diameter		Bolt Hole Diameter		Bolt Circle Diameter		Bolt Hole Quantity	82 Series Approx. Weights	
	in mm	in mm	in mm		in	mm	in	mm	in	mm		Lbs.	Kg.
1/2	2.73	2.50	5.00	150	3.50	89	0.62	16			4	5	2.3
	69.3	63.0	127.0	300	3.75	95	0.62	16	2.62	67	4	7	3.2
				600	3.75	95	0.62	16	2.62	67	4	8	3.6
3/4	2.87	2.50	5.00	150	3.88	99	0.62	16	2.75	70	4	6	2.7
	72.9	63.0	127.0	300	4.62	117	0.75	19	3.25	83	4	8	3.6
				600	4.62	117	0.75	19	3.25	83	4	10	4.5
1	2.99	2.50	5.00	150	4.25	108	0.62	16	3.12	79	4	7	3.2
	75.9	63.0	127.0	300	4.88	124	0.75	19	3.50	89	4	9	4.1
				600	4.88	124	0.75	19	3.50	89	4	11	5.0
1-1/2	3.21	3.00	6.00	150	5.00	127	0.62	16	3.88	99	4	10	4.5
	81.5	76.2	152.4	300	6.12	155	0.88	22	4.50	114	4	14	6.4
				600	6.12	155	0.88	22	4.50	114	4	16	7.3
2	3.45	3.58	6.50	150	6.00	152	0.75	19	4.75	121	4	15	6.8
	87.6	90.9	165.1	300	6.50	165	0.75	19	5.00	127	8	20	9.1
				600	6.50	165	0.75	19	5.00	127	8	24	10.9
3	4.15	6.59	10.00	150	7.50	191	0.75	19	6.00	152	4	30	13.6
	105.4	167.4	254.0	300	8.25	210	0.88	22	6.62	168	8	40	18.1
				600	8.25	210	0.88	22	6.62	168	8	46	20.9
4	4.57	8.43	12.00	150	9.00	229	0.75	19	7.50	191	8	42	19.1
	116.1	214.1	304.8	300	10.00	254	0.88	22	7.88	200	8	65	29.5
				600	10.75	273	1.00	25	8.50	216	8	95	43.1
6	5.54	10.36	14.00	150	11.00	279	0.88	22	9.50	241	8	80	36.3
	140.7	263.1	355.6	300	12.50	318	0.88	22	10.62	270	12	120	54.4
				600	14.00	356	1.12	28	11.50	292	12	200	90.7
8	6.45	13.32	18.00	150	13.50	343	0.88	22	11.75	298	8	143	64.9
	163.8	338.3	457.2	300	15.00	381	1.00	25	13.00	330	12	200	90.7
				600	16.50	419	1.25	32	13.75	349	12	315	142.9

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