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# FT SERIES TURBINE FLOWMETERS

## Installation, Operation and Maintenance Manual

SERIAL NUMBER \_\_\_\_\_

The specifications contained in this manual are subject to change without notice and any user of these specifications should verify from the manufacturer that the specifications are currently in effect. Otherwise, the manufacturer assumes no responsibility for the use of specifications that have been changed and are no longer in effect.

## FT SERIES TURBINE FLOWMETERS Installation, Operation and Maintenance Manual

TM-86675 REV. U

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## 1.0 INTRODUCTION

This manual provides information and guidance for the installation, operation and maintenance of the Standard Line Turbine Flowmeters, manufactured by Flow Technology, Inc., Phoenix, Arizona.

## 2.0 STANDARD LINE FLOWMETER

The Flow Technology, Inc. Standard Line Turbine Flowmeter is a volumetric flow measuring instrument. The flow sensing element is a freely suspended, bladed rotor positioned axially in the flow stream with the flowing fluid pushing against the blades. The rotational speed of the rotor is proportional to the velocity of the fluid. Since the flow passage is fixed, the turbine rotors rotational speed is also a true representation of the volume of fluid flowing through the flowmeter. The rotation of the turbine rotor generates electrical pulses in the pickoff that is attached to the flowmeter housing in close proximity to the turning rotor. Each one of these pulses represents a discrete volume of fluid. The frequency or pulse repetition rate represents the volumetric flow rate and the accumulated pulse total represents the total volume measured. Meters provided for liquid applications are not interchangeable with meters provided for gas applications. All requests for information concerning a specific meter should contain the flowmeter model number and the flowmeter serial number.

The Standard Line Flowmeter consists of 3 basic assemblies. (See Figure 1)

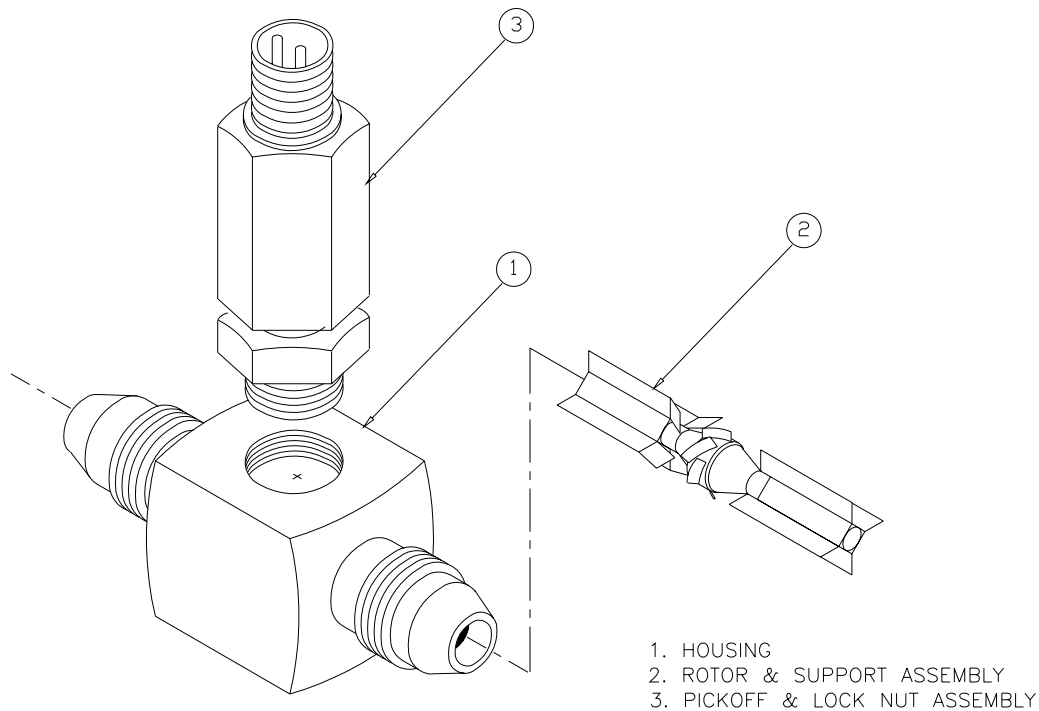


Figure 1. Flowmeter Basic Parts

### 3.0 INSPECTION UPON RECEIPT

The flowmeter should be unpacked carefully and inspected to verify that no damage occurred during shipment. Make certain that the internal parts are clean and free from packing materials or debris.

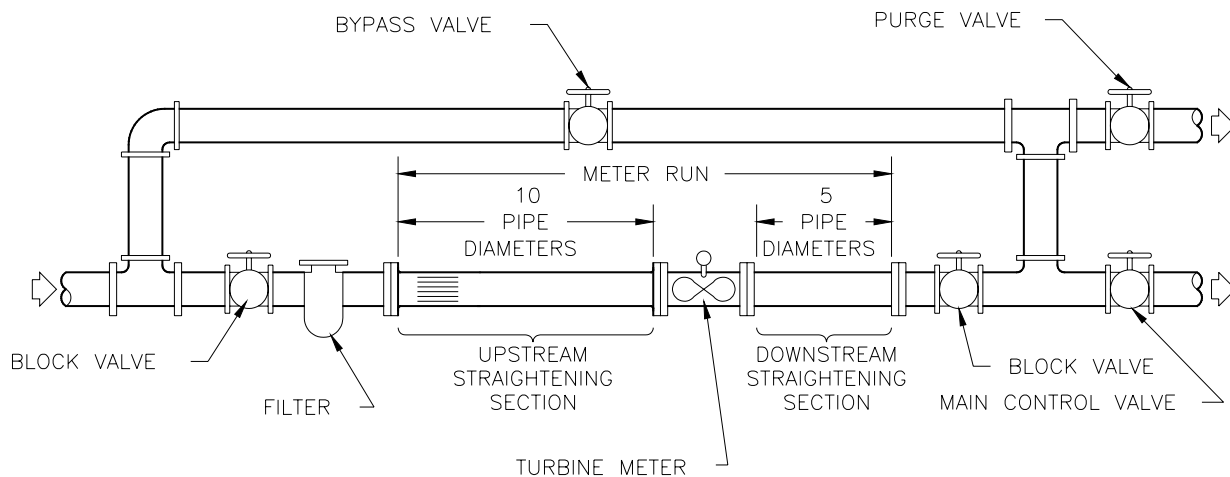
**CAUTION**  
The flowmeter is a precision instrument and may be damaged if pressurized air is used for cleaning the flowmeter or for checking the rotation of the rotor.

### 4.0 MECHANICAL CONNECTIONS

#### 4.1 Flow Conditioning

The turbine flowmeter is sensitive to velocity profile disturbances in the flow stream. For optimizing the velocity profile it is recommended that a straight run of constant diameter piping with length of at least 10 diameters upstream of the meter and at least 5 diameters downstream be provided. (See Figure 2) The upstream section should have straightening vanes or other flow conditioners. The presence of major flow disturbance generators such as pumps, valves or elbows may require longer straight sections. If swirl is present in the line ahead of the flowmeter installation, a longer straight section or additional flow conditioning may be required. Flow Technology, Inc. provides an array of innovative state of the art flow conditioners.

Figure 2. 3-Valve Bypass Manifold Pipe Schematic



## 4.2 Flow Pulsations

Piping and system components should be arranged to minimize pulsations entering the turbine meter. Pulsations may cause the meter to read high, and excessive pulsations may cause permanent bearing damage. Pulsations should be kept below 10% of the current flow rate at the meter location.

### CAUTION

Pressure should be built up gradually at start-up to avoid possible damage by over-speeding the rotor. Any severe water hammering from improper start-up or flow surges during operation must be avoided to prevent over-speeding, shaft or rotor blade breakage.

### NOTE

*Water hammering is a term used during start-up (introducing fluid into the piping) to describe a high velocity flow impact on the turbine rotor. This must be avoided to prevent damage to the mechanical parts.*

## 4.3 Purging

All flow lines in the meter system should be purged prior to installation of the meter. This will remove pipe dope, metal shavings, slag and debris that may damage the turbine meter. Control valves should be located downstream from the turbine meter. (See Figure 2) System start-ups with upstream control valves in an unfilled system can result in a hydraulic shock on the meter, causing damage and a change in calibration in liquid systems, or can cause over speed conditions in gas meter systems.

## 4.4 Installation Recommendation

For liquid flowmeters, it is recommended that the flowmeter be installed so that it remains full of fluid when the flow ceases. When the flowmeter is left installed in a line that is temporarily out of service and has been partially or fully drained, severe bearing corrosion may occur. The type and corrosiveness of the fluid being metered, the type of bearing used in the flowmeter and the length of time the line will be out of service are factors which may affect the life and operation of the flowmeters. If it is economically feasible and conditions permit, the flowmeter should be removed, cleaned and stored when there is any doubt about the fluid level in the line during these out-of-service periods. See section 10.1 inspection cleaning and storage.

## 4.5 Orientation and Calibration

The orientation of the turbine flowmeter will influence the nature of the load on the rotor bearings, and thus, the performance of the meter at low flow rates. For optimum accuracy a turbine meter should be installed in the same orientation in which it was calibrated. Standard calibration orientation is with the meter axis horizontal.

#### 4.6 Filtration

A filter should be installed upstream of the flowmeter. (See Figure 2) For 1/2 inch flowmeters, a 10 micron nominal filter should be used; for 3/4 inch and 1 inch flowmeters, a 20 micron nominal filter should be installed; for flowmeters 1-1/2 inch in diameter or larger, a 50 micron filter is recommended.

#### 4.7 Torque Requirements

The following table provides the recommended torques in pound-feet for tightening MS-33656 flared-tube end fittings:

TABLE 1 TORQUE REQUIREMENTS POUND-FEET				
SIZE	ALUMINUM TUBING		STEEL TUBING	
	MIN.	MAX.	MIN.	MAX.
1/2"	19	21	37	40
5/8"	27	30	54	58
3/4"	35	40	75	85
1"	41	58	100	116
1-1/4"	66	75	126	140
1-1/2"	66	75	158	175
2"	150	166	221	245

#### 5.0 PICKOFFS

##### 5.1 Installation

Pickoffs should bottom in the well of the flowmeter housing but should only be finger tightened to approximately 4 lb-in (4500 gm-cm max) to prevent distortion of the coil housing. The pickoff is secured in position by tightening the lock nut to approximately 25 lb-in (30000 gm-cm). The pickoff is removed by loosening the hex lock nut and unscrewing the pickoff from the housing.

**CAUTION**  
Meter pressure ratings are established with a pickoff installed. Do not operate a flowmeter under pressure without a pickoff installed.

##### 5.2 Explosion Proof Housings

Flowmeters with explosion proof housings may have the pickoff installed inside a short section of conduit pipe (spud) that is welded to the housing. Since the spud is longer than the pickoff, the pickoff cannot be finger tightened directly and an alternate method must be used to install the pickoff. A modified 11/16-inch deep socket is required to screw the pickoff into the housing and a modified 13/16-inch deep socket is used to tighten the lock nut.

### 5.2.1 Pickoff Installation Sockets

Modify a standard 11/16-inch deep socket with an elongated 3/8-inch hole as shown in Figure 3. This socket will fit the pickoff and allow easy feed through of the lead terminals without damaging the leads. Modify a standard 13/16-inch deep socket with an elongated hole. (See Figure 3) Cut the outside diameter of the socket to 1.015 inches as shown to permit the socket to tighten the lock nut inside the conduit without damaging the pickoff leads.

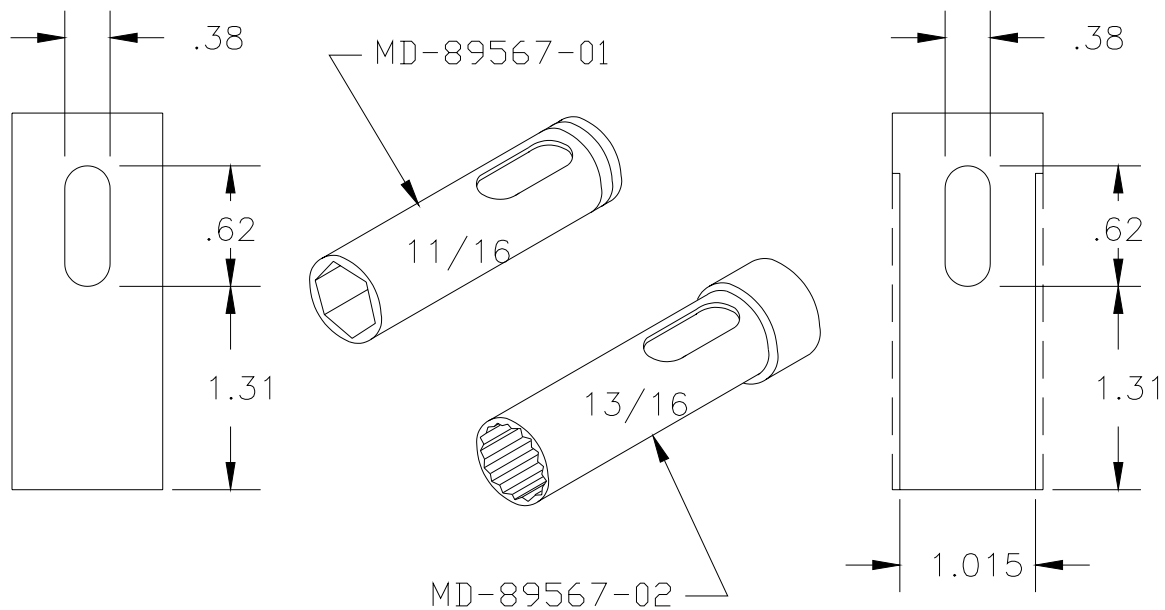


Figure 3. Pickoff Installation Sockets

### 5.3 Magnetic Pickoff

The magnetic pickoff output is a low level signal that ranges from 10 mV to several volts peak-to-peak. A pulse amplifier may be needed to convert the pickoff low level signal to a 10 V peak-to-peak pulse signal suitable for process instrumentation. Typical resistance of magnetic pickoffs are  $2275 \Omega \pm 20\%$ .

### 5.4 RF Pickoff

The modulated carrier (RF) pickoff must be installed with an appropriate amplifier (consult factory). The amplifier is needed to convert the modulated carrier signal to a 10 V peak-to-peak pulse signal suitable for process instrumentation. Typical resistance of modulated carrier pickoffs is  $10 \Omega \pm 10\%$ .

## 6.0 ELECTRICAL CONNECTIONS

### 6.1 Connections

Standard pickoffs are available with a two-contact type MS3102A-10SL-4P connector or with threaded body and pigtail connectors.

### 6.2 Connection Cable

The connecting cable between the flowmeter and the electronic instrumentation should be a two conductor, 22 AWG, shielded and twisted cable with a vinyl jacket (Belden 8761 or equivalent). The cable should not be installed in a conduit or tray containing power lines, or close to strong electromagnetic sources such as electric lines, electric motors, transformers, welding machines, or high voltage lines. These sources may induce transient electrical noise in the coil and cause false pulse signals. Connections from standard pickoffs are not polarized and may be connected in either position. For non-standard pickoffs please refer to manufacturer's specifications.

### 6.3 Grounding Considerations

The shield of the cable is to be grounded at only one point in accordance with the instruction of the display instrument. Flow Technology, Inc. display instruments specify where the shield is to be grounded.

## 6.4 Signal Processing

An electronic signal conditioning circuit is required to either convert the frequency output of the flowmeter into a visual presentation on a display or to provide process control signals. Flow Technology, Inc. manufactures a complete line of electronic packages, which include rate and total displays, rate converters and microprocessor based units for linearization and temperature / pressure compensation.

Pickoff	Connector	Specifications
Standard	2 Pin MS	Non-polarized Pins
27-31386	3 Pin MS	Pins: A = Coil      B = Coil      C = N/C Inductance = 0.350 mh $\pm$ 10 %      Resistance = 3.5 ohms $\pm$ 10 %
Amplified Pickoffs 27-94057	3 Pin MS  Wire Leads	Pins: A = Power      B = Ground      C = Pulse  Red = Power      Black = Ground      White = Pulse  Input Power = 8 to 32 VDC @ 10 ma Output = 0 to 5 VDC Pulse Output Impedance = 2.2 K ohms  Mag Amp:      Frequency Range = 10 Hz to 10 KHz Input Sensitivity = 20 MV p-p  RF Amp:      Frequency Range = 10 to 3200 Hz Oscillator Carrier Frequency = 45 KHz
Pick-off w/RTD RF 27-62730 Mag 27-62731	4 Pin MS  Wire Leads	Pins: A=Coil      B=Coil      Non-polarized C= RTD high      D= RTD low & RTD compensation Leads: White= Coil      Non-polarized Red= RTD high      Black= RTD low & RTD compensation  RTD= 100 Ohm Platinum

## 7.0 BIDIRECTIONAL FLOWMETERS

Turbine flowmeters can be configured to measure flow in both directions and provide direction-sensing capability. This is accomplished by adding a second pickoff located with respect to the first pickoff in such a way as to achieve a 90-phase shift. The location of the pickoffs are determined by the number of blades on the rotor.

## 8.0 OPERATION

### 8.1 Over Range

In general, turbine flowmeters remain quite linear when they are over ranged, and may not provide any indication that the instrument is being misused. However, the pressure drop will become excessive and over speeding of the bearings could cause permanent damage. Bearings may also be damaged by excessive downstream thrust load. The probability of an over speed condition for a liquid meter usually occurs during system start up when there is still air in the lines. Air should be bled carefully from the lines before high flow range is established. The flow rate or output frequency should be monitored to insure maximum capability is not exceeded. Flow Technologies's specifications should be consulted for specific maximum operating flow rates. See tables 4,5,6 and 7. Under extreme conditions, the maximum operating flow rates can be exceeded for brief periods of time without meter damage. Following are the maximum allowable over range capabilities:

<u>Bearing Type</u>	<u>Liquid</u>	<u>Gas</u>
Ball	50%	10%
Pivot	10%	10%
Journal	50%	N/A

### 8.2 Under Range

When used below the minimum specified range, turbine meters may become very non-linear. The repeatability of the meter may also be reduced due to bearing and magnetic pickoff drag.

### 8.3 Liquid Turbine Flowmeter Characteristics

#### 8.3.1 Introduction

Optimum performance of a turbine meter system depends upon a valid calibration as well as the correct selection of supporting equipment. The rotational speed of a turbine rotor depends upon fluid properties as well as the fluid velocity. The most significant fluid property for a liquid meter is the kinematic viscosity. As liquid viscosity increases, the slip of the turbine rotor due to viscous drag is increased, and the rotational speed and hence pick-off frequency is decreased. Due to these effects, the kinematic viscosity of the calibration fluid should approximate the service conditions as closely as possible.

#### 8.3.2 Standard Calibration

Standard liquid calibrations at FTI are done with MIL-C-7024 Type II solvent or water at room temperature. The viscosity of these fluids is approximately 1.25 and 1 centistokes respectively. The standard calibration consists of 10 data points distributed over the normal 10:1 range of the flowmeter. If viscosities or flow ranges other than these are required, they must be specified.



### 8.3.3 Single Viscosity Calibration

If the flowmeter is to be used at a viscosity other than the standard calibration viscosities, an oil blend calibration should be done on the meter to simulate the operating conditions. The calibration curve produced will represent the flowmeter's output characteristics for that specific viscosity. If the flowmeter is used with liquids having viscosities greater than 3 centistokes, the linearity of the K-factor will be reduced.

### 8.3.4 Multiple Viscosity Calibrations

If the viscosity is changing due to varying temperature in the system, the performance characteristics over a range the viscosities can be established. This is done by performing multiple calibrations at different viscosities to cover the range of interest. The K-factor of the meter is then plotted as a function of  $\text{Hz}/\nu$ . The K-factor is the number of pulses generated by a flowmeter for every unit volume of fluid passing through it. Hz is the output frequency of the meter and  $\nu$  is the kinematic viscosity of the fluid in centistokes. The plot of K vs.  $\text{Hz}/\nu$  is commonly referred to as a universal viscosity curve. The data is plotted in this manner because all points fall on a single smooth curve. To obtain a useful curve, calibration points for calibrations at several viscosities are required. By observing the output frequency of the flowmeter and obtaining the viscosity or temperature of the fluid, the value of  $\text{Hz}/\nu$  can be calculated. Using the universal viscosity curve, the value of K corresponding to the known value of  $\text{Hz}/\nu$  can be determined. With the K-factor known, the flow through the meter can be determined from the expression:

$$GPM = \frac{\text{Hz (60)}}{K - \text{factor}}$$

## 8.4 Gas Turbine Flowmeter Characteristics

### 8.4.1 Introduction

Accurate performance of gas turbine flowmeters depend on a valid calibration that simulates the conditions the meter will operate in. Changes in the pressure and temperature of a gas directly affect the density and kinematic viscosity of the fluid. These changing fluid properties affect the performance of gas flowmeters in much the same way as liquid flowmeters.

Due to the nature of gasses to be compressed, the volume of gas measured is dependent on the pressure and temperature as established by Boyle's Law and Charles' Law. Using these relationships, the actual volume of gas measured can be related to a standard set of conditions that provide useful technical data. The standard conditions for pressure and temperature used at Flow Technology, Inc. are 14.7 pounds per square inch absolute (PSIA) and 520 degrees Rankine (60 degrees Fahrenheit) respectively. For proper conversions, the absolute measurement for pressure and temperature must be used.

The following equation is used to convert the actual volumetric flow rate ( $Q_A$ ) in Actual Cubic Feet per Minute (ACFM) to the equivalent standard flow rate ( $Q_S$ ) in Standard Cubic Feet per Minute (SCFM).

$$Q_S = Q_A \left( \frac{P_A}{P_S} \right) \left( \frac{T_S}{T_A} \right)$$

Where:

$Q_S$  = Standard flow rate in SCFM

$Q_A$  = Actual measured flow rate in ACFM

$P_A$  = Actual measured pressure at pressure tap on meter (PSIA)

$P_S$  = Standard Pressure (14.7 PSIA)

$T_A$  = Actual measured temperature downstream of meter ( R)

$T_S$  = Standard temperature (520 R)

#### 8.4.2 Air Calibration

Gas calibrations at FTI are done using air at ambient conditions. These conditions are typically 14.2 PSIA and 72 F. The standard calibration consists of 10 data points distributed over the normal 10:1 range of the flowmeter. If conditions or flow ranges other than these are required, they must be specified.

#### 8.4.3 Single Pressure Calibrations

If the flowmeter is to be used at conditions that vary significantly from the standard calibration, a calibration at equivalent conditions should be performed to simulate the actual operating conditions. The calibration curve produced will represent the flowmeter's output characteristics for the specified gas at the actual operating conditions.

#### 8.4.4 Multiple Pressure Calibrations

Performance characteristics over a range of pressures can be established for operating conditions where the temperature and pressure are changing. This is done by performing multiple calibrations at different pressures to cover the range of interest. The information obtained is then plotted on a curve of K-factor versus Hz/ $\nu$  where the K-factor is the pulses per unit volume generated by the flowmeter and the Hz/ $\nu$  is the frequency output of the flowmeter divided by the kinematic viscosity of the fluid. The procedure is similar to liquid meters using the universal viscosity curve. By reading the output frequency of the flowmeter during operation and dividing it by the kinematic viscosity of the fluid being used, the volumetric flow rate can be determined by reading the K-factor from the universal viscosity curve and calculating the flow rate:

$$CFM = \frac{Hz (60)}{K - factor}$$

Electronic instrumentation is available that can be programmed with the universal viscosity curve and setup with pressure and temperature transducers that will automatically make these calculations and read out the corrected flow rate.

## 9.0 SPECIFICATIONS AND OPTIONS

Table 2 shows the complete model numbering system for the FT series flowmeters. The sections that follow describe the contents of Table 2 in detail.

Tables 3 thru 7 describe the different bearings and their applications.

TABLE 2  
FT MODEL NUMBERING SYSTEM

FT								
BASE MODEL	2-8 Through 192 ( 1/2" Through 12" )							
END FITTINGS	Refer to Section 9.1							
CALIBRATION	Refer to Section 9.2							
NON STANDARD UNITS	U = To signify required units of measure other than GPM or ACFM R = To signify special calibration flow range other than normal 10:1 or extended range B = to signify both changes in units and special flow range							
SERVICE	L = Liquid G = Gas P = Gas with pressure tap							
CONSTRUCTION MATERIALS	Refer to Section 9.3							
BEARINGS	A = Ball Bearing D = Carbide Journal E = Graphite Journal G = Ceramic Journal H = Ball Bearing Self Lubricating (FT64 & smaller gas meters) Refer to Section 9.4							
PICKOFFS	Refer to Section 9.5							
SPECIAL CODE	Special meter configurations will not be addressed in this manual please contact the factory for a description of the special code.							

## 9.1 End Fittings

AE = AN (or MS) external straight

BE = British Standard external pipe threads 1/2" to 4"

NE = NPT external threads, 1/2" to 6"

HB = Hose Barb

WF = Wafer type serrated surface

C1 = 150# Raised Face Flange

C2 = 300# Raised Face Flange

C3 = 600# Raised Face Flange

C4 = 900# Raised Face Flange

C5 = 1500# Raised Face Flange

C6 = 2500# Raised Face Flange

J1 = 150# Ring Joint Flange

J2 = 300# Ring Joint Flange

J3 = 600# Ring Joint Flange

J4 = 900# Ring Joint Flange

J5 = 1500# Ring Joint Flange

J6 = 2500# Ring Joint Flange

D1 = DIN Flange PN16

D2 = DIN Flange PN40

D3 = DIN Flange PN100

D4 = DIN Flange PN160

D5 = DIN Flange PN250

D6 = DIN Flange PN400

## 9.2 Calibration

KA = 3 Point, K-factor average, in Air

KW = 3 Point, K-factor average, in Water

KS = 3 Point, K-factor average, in Solvent

KB = 3 Point, K-factor average, in Oil Blend

NA = 10 Point, normal 10:1 range, in Air

NW = 10 Point, normal 10:1 range, in Water

NS = 10 Point, normal 10:1 range, in Solvent

NB = 10 Point, normal 10:1 range, in Oil blend

XA = 10 Point, extended range, in Air

XW = 10 Point, extended range, in Water

XS = 10 Point, extended range, in Solvent

XB = 10 Point, extended range, in Oil blend

TA = 20 Point, normal 10:1 range, in Air

TW = 20 Point, normal 10:1 range, in Water

TS = 20 Point, normal 10:1 range, in Solvent

TB = 20 Point, normal 10:1 range, in Oil blend

YA = 20 Point, extended range, in Air

YW = 20 Point, extended range, in Water

YS = 20 Point, extended range, in Solvent  
YB = 20 Point, extended range, in Oil blend  
GA = 30 Point, extended range, in Air  
GW = 30 Point, extended range, in Water  
GS = 30 Point, extended range, in Solvent  
GB = 30 Point, extended range, in Oil blend  
U2 = Universal Viscosity Curve, 2 viscosities  
U3 = Universal Viscosity Curve, 3 viscosities  
R1 = Reynolds # Calibration, 10 Point 1 Pressure  
R2 = Reynolds # Calibration, 10 Point 2 Pressure  
R3 = Reynolds # Calibration, 10 Point 3 Pressure  
E1 = Reynolds # Calibration, 20 Point 1 Pressure  
E2 = Reynolds # Calibration, 20 Point 2 Pressure  
E3 = Reynolds # Calibration, 20 Point 3 Pressure  
LW = 10 Point 10:1 Range, in Water, Premium linearity  
LS = 10 Point 10:1 Range, in Solvent, Premium linearity  
BA = Bidirectional, 1 Pickoff, 10 points each direction, Air  
BW = Bidirectional, 1 Pickoff, 10 points each direction, Water  
BS = Bidirectional, 1 Pickoff, 10 points each direction, Solvent  
BB = Bidirectional, 1 Pickoff, 10 points each direction, Oil blend  
CA = Bidirectional, 2 Pickoff, 10 points each direction, Air  
CW = Bidirectional, 2 Pickoff, 10 points each direction, Water  
CS = Bidirectional, 2 Pickoff, 10 points each direction, Solvent  
CB = Bidirectional, 2 Pickoff, 10 points each direction, Oil blend

### 9.3 Construction Materials

C = 304 Housing, 430F Rotor  
D = 304 Housing, 17-4 Rotor  
E = 316 Housing, 430F Rotor  
G = 316 Housing, 316 Rotor  
H = 316 Housing, 17-4 Rotor  
N = Hast C Housing, Hast C Rotor  
Q = PVC Housing, PVC Rotor  
R = Monel 400 Housing, Monel 400 Rotor  
T = Carp 20 Housing, Carp 20 Rotor

### 9.4 Bearing Code

A = 440C Ball Bearings.  
D = Carbide Journal - Carbide Shaft and Bearing.  
E = Graphite Journal - 316 SST Shaft and Graphite Bearing  
G = Ceramic Journal - Ceramic Shaft and Bearings  
H = 440C Ball Bearings. (Polymer retainer )

Table 3 BEARING APPLICATION GUIDE				
CODE	BEARING TYPE	SERVICE	BEARING TEMPERATURE RATING	MATERIAL
A	BALL	LIQUID OR GAS	-450° F TO 300° F	440C SST
D	CARBIDE JOURNAL	LIQUID	UP TO 1200° F	C-2 CARBIDE
E	GRAPHITE JOURNAL	LIQUID	UP TO 500° F	316 SHAFT GRAPH. BRG.
G	CERAMIC JOURNAL	LIQUID	UP TO 1200° F	ALUMINUM BASED CERAMIC
H	BALL	LIQUID OR GAS	-450° F TO 300° F	440C SST POLYMER RETAINER

Meter temperature rating may be limited by the pickoff temperature rating

### 9.5 Pickoffs

- 1 = RF MS Connector 400° F, 27-31199-101
- 2 = MAG MS connector 400° F, 27-30880-101
- 3 = MAG Explosion Proof 400° F, 27-30880-102 leads / 27-30931-102 EP
- 5 = RF Explosion Proof 400° F, 27-31199-102 leads / 27-31949-101 EP
- 6 = MAG MS connector 750°F, 27-80666-104
- 7 = MAG Explosion Proof 750° F, 27-80666-104 MS / 27-82333-102 EP
- 8 = RF MS Cox Equivalent 400° F, 27-84097-102
- 9 = RF MS 5/8 Thd. 400° F, 27-84097-101
- S8 = RF F & P 400° F, 27-31386-101
- L = RF MS connector 750° F, 27-88628-102
- M = RF Explosion Proof 750° F, 27-88826-103
- Y = RF Explosion Proof (CSA) 400° F, 27-13869-101
- Z = MAG Explosion Proof (CSA) 400° F, 27-13868-101
- U = MAG MS (Factory Mutual) 400° F, 27-32400-101
- X = RF MS (Factory Mutual) 300° F, 27-32404-101
- PP = MAG Leads (Factory Mutual) 400° F, 27-32400-103
- SS = RF Leads (Factory Mutual 300° F, 27-32404-103
- TT = MAG Explosion Proof (Factory Mutual) 400° F, 27-32400-102
- XX = RF Explosion Proof (Factory Mutual) 300° F, 27-32404-102
- A1 = RF MS Amplified 230° F, 27-61313-104
- A2 = MAG MS Amplified 230° F, 27-61313-101
- A3 = MAG Explosion Proof 230° F, 27-61313-102
- A4 = MAG Leads Amplified 230° F, 27-61313-103
- A5 = RF Explosion Proof Amplified 230° F, 27-61313-105
- A6 = RF Leads Amplified 230° F, 27-61313-106

**TABLE 4**  
**LIQUID SERVICE - BALL BEARING**

MODEL	STD RANGE 10:1 (GPM) RF & MAG PICKOFF	EXTENDED RANGE (GPM) RF PICKOFF	EXTENDED RANGE (GPM) MAG PICKOFF	NOMINAL K FACTOR PULSE/ GALLON	MAX FREQ. (HZ)
FT4-8	.25-2.5	.03-3	.1-3	48000	2000
FT6-8	.5-5	.05-5	.12-5	25000	2100
FT8-8	.75-7.5	.08-8	.16-8	16000	2000
FT-08	1-10	.1-10	.2-10	12000	2000
FT-10	1.25 - 12.5	.15-15	.3-15	9600	2000
FT-12	2-20	.25-25	.5-25	5400	1800
FT-16	5-50	.6-60	1-60	2400	2000
FT-20	9-90	1-100	1-100	1300	1950
FT-24	15-150	1.6-160	2.5-160	600	1500
FT-32	22-225	2.5-250	3.5-250	350	1300
FT-40	40-400	4.5-450	5.0-450	180	1200
FT-48	65-650	N/A	7.5-750	75	812
FT-64	125-1250	N/A	15-1500	30	625
FT-96	300-3000	N/A	50-3500	28	1400
FT128	550-5500	N/A	60-6000	14	1300
FT160	850-8500	N/A	100-10000	8.5	1200
FT192	1200-12000	N/A	1500-15000	5.0	1000

Notes:

1. Repeatability =  $\pm .05\%$
2. Linearity =  $\pm .5\%$  of reading except as noted. Values are valid for viscosities of 3 centistokes or less based on standard 10:1 range.
3. RF Pickoff not applicable for meter sizes FT-48 and larger.
4. Linearity =  $\pm .75\%$  of reading for FT4-8 and FT6-8 when high temp mag pickoff is used.
5. Premium linearity available over select ranges consult factory.



**TABLE 5**  
**LIQUID SERVICE - JOURNAL BEARING**

MODEL	STD RANGE 10:1 (GPM) RF & MAG PICKOFF	EXTENDED RANGE (GPM) RF PICKOFF	EXTENDED RANGE (GPM) MAG PICKOFF	NOMINAL K FACTOR PULSE/ GALLON	MAX FREQ. (HZ)
FT4-8	.25-2.5	.1-3.0	.12-3.0	48000	2000
FT6-8	.5-5.0	.15-5.0	.2-5.0	25000	2000
FT8-8	.75-7.5	.2-8.0	.25-8.0	16000	2000
FT-08	1.0-10.0	.25-10	.3-10	12000	2000
FT-10	1.25 - 12.5	.3-15	.4-15	9600	2000
FT-12	2-20	.5-25	.5-25	6000	2000
FT-16	5-50	1.0-60	1.0-60	2400	2000
FT-20	9-90	1.0-100	1.5-100	1300	1950
FT-24	15-150	1.6-160	2.5-160	600	1500
FT-32	22-220	2.5-250	3.5-250	350	1300
FT-40	40-400	4.5-450	5.0-450	180	1200
FT-48	65-650	N/A	7.5-750	75	812
FT-64	125-1250	N/A	15-1500	30	625
FT-96	300-3000	N/A	50-3500	28	1400
FT128	550-5500	N/A	60-6000	14	1300
FT160	850-8500	N/A	100-10000	8.5	1200
FT192	1200-12000	N/A	150-15000	5.0	1000

Notes:

1. Repeatability = +/- .1% for FT-12 and smaller, +/- .05% for FT-16 and larger.
2. Linearity = +/- .5% of reading except as noted.  
Values are valid for viscosities of 3 centistokes or less based upon standard 10:1 range.
3. Linearity is +/- 2% of reading for FT4-8.
4. Linearity is +/- .75% of reading for FT6-8 when high temp mag pickoff is used
5. Premium linearity available over select ranges consult factory.
6. RF pickoff not applicable for meter sizes FT-48 and larger.

**TABLE 6**  
**GAS SERVICE - BALL BEARING "H" CODE**

MODEL	STD RANGE 10:1 (ACFM) RF & MAG PICKOFF	EXTENDED RANGE (ACFM) RF PICKOFF	EXTENDED RANGE (ACFM) MAG PICKOFF	NOMINAL K FACTOR PULSE / ACF	MAX FREQ. (HZ)
FT2-8	.1-1.0	.09-1.25	N/A	114000	1900
FT4-8	.25-2.5	.2-3.0	N/A	40800	1700
FT6-8	.5-5.0	.25-5.0	.4-5.0	24000	2000
FT8-8	.75-7.5	.4-8.0	.5-8.0	16000	2000
FT-08	1.0-10.0	.5-10	.75-10	12000	2000
FT-10	1.25 - 12.5	.6-15	1-15	9600	2000
FT-12	2-20	1-25	1.5-25	6000	2000
FT-16	5-50	1.5-60	2.5-60	2400	2000
FT-20	9-90	2.5-100	5-100	1300	1950
FT-24	15-150	4-160	6-160	600	1500
FT-32	22-220	5-250	8-250	350	1300
FT-40	40-400	9-450	10-450	180	1200
FT-48	65-650	N/A	15-750	75	812
FT-64	125-1250	N/A	30-1500	30	625

Notes:

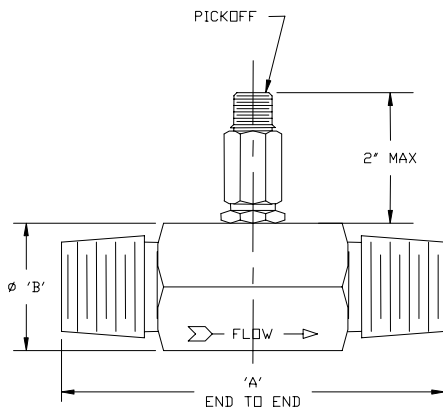
1. Gas service - Air @ 14.7 PSIA and 60 F.
2. Repeatability = +/- .1%.
3. Linearity = +/- 1.0% of full scale based on standard 10:1 range.
4. MAG Pickoff not applicable for FT2-8.
5. MAG Pickoff range is .35 - 2.5 ACFM for FT4-8.
6. Linearity for FT2-8 is 4% of full scale, repeatability is +/- .5%.
7. Linearity for FT4-8 is 3% of full scale, repeatability is +/- .3%.
8. Linearity for FT6-8 is 1.5% of full scale, repeatability is +/- .15%.
9. RF Pickoff not applicable for meter sizes FT-48 and larger.

**TABLE 7**  
**GAS SERVICE - BALL BEARING "A" CODE**

MODEL	STD RANGE 10:1 (ACFM) RF & MAG PICKOFF	EXTENDED RANGE (ACFM) RF PICKOFF	EXTENDED RANGE (ACFM) MAG PICKOFF	NOMINAL K FACTOR PULSE / ACF	MAX FREQ. (HZ)
FT2-8	.1-1.0	.09-1.25	N/A	93000	1550
FT4-8	.25-2.5	.2-3.0	N/A	45000	2000
FT6-8	.5-5.0	.25-5.0	.4-5.0	24000	2000
FT8-8	.75-7.5	.4-8.0	.5-8.0	16000	2000
FT-08	1.0-10.0	.5-10	.75-10	12000	2000
FT-10	1.25 - 12.5	.6-15	1-15	9600	2000
FT-12	2-20	1-25	1.5-25	6000	2000
FT-16	5-50	1.5-60	2.5-60	2400	2000
FT-20	9-90	2.5-100	5-100	1300	1950
FT-24	15-150	4-160	6-160	600	1500
FT-32	22-220	5-250	8-250	350	1300
FT-40	40-400	9-450	10-450	180	1200
FT-48	65-650	N/A	15-750	75	812
FT-64	125-1250	N/A	30-1500	30	625
FT-96	300-3000	N/A	70-3500	9.0	467
FT128	550-5500	N/A	120-6000	4.0	325
FT160	850-8500	N/A	200-10000	2.0	240
FT192	1200-12000	N/A	300-15000	1.0	167

Notes:

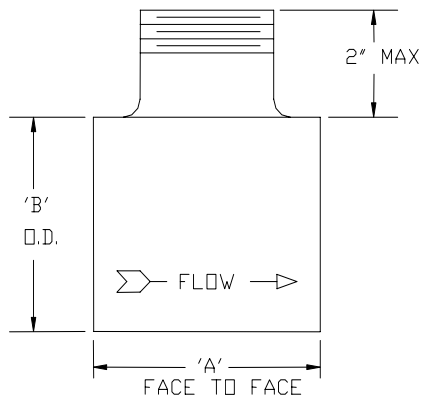
1. Gas service - Air @ 14.7 PSIA and 60 F.
2. Repeatability = +/- .1%.
3. Linearity = +/- 1.0% of full scale based on standard 10:1 range.
4. MAG Pickoff not applicable for FT2-8.
5. MAG Pickoff range is .35 - 2.5 ACFM for FT4-8.
6. Linearity for FT2-8 is 4% of full scale.
7. RF Pickoff not applicable for meter sizes FT-48 and larger.



NPT ANS MS - STANDARD LINE

MODEL NO. PREFIX	NOMINAL END FITTING (INCH)	A	B
FT2-8	1/2	2.45	1.00
FT4-8			
FT6-8			
FT8-8			
FT-08			
FT-10	5/8 (MS) 3/4 (NPT)	2.72	1.31
FT-12	3/4	3.25	1.38
FT-16	1	3.56	1.63
FT-20	1 1/4	4.06	1.88
FT-24	1 1/2	4.59	2.13
FT-32	2	6.06	2.75
FT-40	2 1/2	8.90	2.88
FT-48	3	13.00	3.50
FT-64	4	12.00	4.50
FT-96	6	17.50	6.63

NOTE: 1" NPT enclosure connection is standard on FT-16 and larger wafer meters. Meters smaller than FT-16 will have pickoff connection only.



WAFER - STANDARD LINE

MODEL NO. PREFIX	NOMINAL END FITTING (INCH)	A	B
FT2-8	1/2	1.88	1.38
FT4-8	1/2	1.88	1.38
FT6-8	1/2	1.88	1.38
FT8-8	1/2	1.88	1.38
FT-08	1/2	1.88	1.38
FT-10	3/4	1.94	1.69
FT-12	3/4	1.94	1.69
FT-16	1	2.50	2.00
FT-20	1 1/4	2.50	2.50
FT-24	1 1/2	2.50	2.88
FT-32	2	3.00	3.63
FT-40	2 1/2	5.25	4.13
FT-48	3	5.75	5.00
FT-64	4	5.00	6.18
FT-96	6	6.13	8.50

MODEL NO. PREFIX	NOMINAL END FITTING (INCH)	150 #		300 #		600 #		900 #		1500 #		2500 #	
		A	B	A	B	A	B	A	B	A	B	A	B
FT2-8	1/2	5.00	3.50	5.00	3.75	5.00	3.75	7.00	4.75	7.00	4.75	7.00	5.25
FT4-8	1/2	5.00	3.50	5.00	3.75	5.00	3.75	7.00	4.75	7.00	4.75	7.00	5.25
FT6-8	1/2	5.00	3.50	5.00	3.75	5.00	3.75	7.00	4.75	7.00	4.75	7.00	5.25
FT8-8	1/2	5.00	3.50	5.00	3.75	5.00	3.75	7.00	4.75	7.00	4.75	7.00	5.25
FT-08	1/2	5.00	3.50	5.00	3.75	5.00	3.75	7.00	4.75	7.00	4.75	7.00	5.25
FT-10	3/4	5.50	3.88	5.50	4.63	5.50	4.63	5.50	5.13	5.50	5.13	7.00	5.50
FT-12	3/4	5.50	3.88	5.50	4.63	5.50	4.63	7.00	5.13	7.00	5.13	7.00	5.50
FT-16	1	5.50	4.25	5.50	4.88	5.50	4.88	8.00	5.88	8.00	5.88	8.00	6.25
FT-20	1 1/4	6.00	4.63	6.00	5.25	6.00	5.25	8.00	6.25	8.00	6.25	8.00	7.25
FT-24	1 1/2	6.00	5.00	6.00	6.13	6.00	6.13	9.00	7.00	9.00	7.00	9.00	8.00
FT-32	2	6.50	6.00	6.50	6.50	6.50	6.50	9.00	8.50	9.00	8.50	9.00	9.25
FT-40	2 1/2	7.00	7.00	7.00	7.50	9.00	7.50	9.00	9.63	9.00	9.63	10.00	10.50
FT-48	3	10.00	7.50	10.00	8.25	10.00	8.25	10.00	9.50	10.00	10.50	10.00	12.00
FT-64	4	12.00	9.00	12.00	10.00	12.00	10.75	12.00	11.50	12.00	12.25	12.25	14.00
FT-96	6	14.00	11.00	14.00	12.50	14.00	14.00	14.00	15.00	14.00	15.50	14.00	19.00
FT128	8	16.00	13.50	16.00	15.00	16.00	16.50	16.00	18.50	16.00	19.00	16.00	21.75
FT160	10	20.00	16.00	20.00	17.50	20.00	20.00	20.00	21.50	20.00	23.00	20.00	26.50
FT192	12	24.00	19.00	24.00	20.50	24.00	22.00	24.00	24.00	24.00	26.50	24.00	30.00

Figure 4. Dimensions

## 10.0 PERIODIC MAINTENANCE

Maintenance of the Standard Line Flowmeter consists of periodic inspections to insure that the internal parts have not suffered any corrosion or incrustation by measuring fluid. Should the assembly be damaged, it should be returned to the factory for exchange or repair.

### 10.1 Inspection Cleaning and Storage

For inspection and cleaning of internal parts, the rotor and support assembly may be withdrawn from the housing. The rotor support assembly and the housing may be cleaned with appropriate solvent or alcohol. If liquid flowmeters are to be stored or out of service for an extended period, it should be dipped in a light rust proofing preservative or machine oil and capped. Gas flowmeters should be cleaned and capped to prevent dust or foreign materials.

#### CAUTION

Service for some fluids may require special cleaning procedures before installation. Please consult fluid manufacturer and/or use industry accepted procedures.

One of the largest single sources of poor turbine meter performance is foreign material buildup on bearings whether they are journal type or ball type. It is recommended that whenever possible, the turbine meter be thoroughly flushed with an appropriate solvent immediately after use. The solvent should be chemically neutral, and highly volatile so that complete drying can take place soon after the flushing operation. Some appropriate solvents would be ethyl alcohol or stoddard solvent.

All turbine flowmeters include some type of bearing for supporting its rotor. The standard line flowmeter is normally equipped with ball bearings, but journal bearings fabricated of tungsten carbide, ceramic, epoxy impregnated graphite and other non-metallic materials are also available. If the bearings in the flowmeter become damaged or worn, the meter should be sent to the factory for bearing replacement. If this is not possible, a bearing replacement kit is available for most models. All bearings are not field replaceable. Consult the factory and describe the particular flowmeter before ordering a bearing replacement kit.

## 10.2 Removing Internals

There are several variations of the basic turbine flowmeter design. This section will explain the general procedure for disassembling Flow Technology, Inc. turbine flowmeters. Refer to the following sections for detailed instructions on disassembly of specific flowmeters.

### CAUTION

Observe flow direction markings carefully. Some of the internal parts are symmetrical and may fit and function forward and reverse. The calibration will shift due to variations in the rotor blade edges and the degree of bend in the support trim tabs if installed incorrectly.

Before removing the housing retaining ring note the orientation of the retaining ring, the hook on the retaining ring prevents the support/spacer from spinning.

1. Familiarize yourself with the figure applicable to your model before proceeding.
2. Remove the upstream retaining ring, note the orientation.
3. Insert a plastic rod into the downstream end of the meter and gently press against the downstream support. Select a large enough rod so that it cannot accidentally slip past the support vanes and impact the rotor. Gently slide the internal assembly out of the housing being careful not to drop any of the internal parts as they clear the housing. Maintain compression between the supports to insure that the internals remain assembled until you have noted the flow direction markings on the supports and the rotor.
4. Locate the flow direction of the supports and the rotor. The downstream side of the rotor will have two small marks which are typically hand scribed on the hub. If the marks are not clear, remark the rotor to assure correct re-assembly. If you use a marking pen or pencil, be aware that your markings may be removed during cleaning.
5. Spin the rotor slowly, and note any signs of scoring, wobble, damaged or bent blades. Replace the rotor if it shows any signs of damage.

Important: Do not straighten the tabs on the support adjacent to the rotor. These are trim tabs used to improve meter performance. Altering the tab angle will cause a shift in the K-factor.

6. Clean or replace parts as necessary.
7. Reverse procedure to reinstall. Insure that the flow direction arrow on the internals match the flow direction arrow on the housing when the internals are reinstalled.

### 10.3 General Handling Techniques

1. All work with bearings should be done in a clean, dry, dust and static free area.
2. Consider all foreign materials to be abrasive, corrosive or otherwise destructive.
3. Verify that the shaft and rotor have been cleaned and are free of oil, contamination and burrs.
4. Keep all bearings in their original unopened packages until ready for installation. Remove the bearings from their protective packages one at a time, as required.
5. The bearings should be handled with tweezers or other special non-magnetic tools.
6. Never touch high precision bearings with fingers unprotected by finger cots or lint free gloves.
7. Seat the bearing squarely and apply even pressure to the race making contact. ( See Figure 5 )
8. When installing a bearing in the rotor apply pressure to the outer race.
9. When installing a bearing onto a shaft, apply pressure to the inner race.
10. Never transfer force between the outer and inner races, or damage could result and cause increased friction, increased torque, and shortened bearing life.
11. Shock or impact techniques should never be used to seat the bearing.
12. Installing the small retaining rings requires a quality pair of sharp tweezers and good dexterity. The bearing retaining rings are under spring tension and can easily shoot out while removing or installing. Wear eye protection.

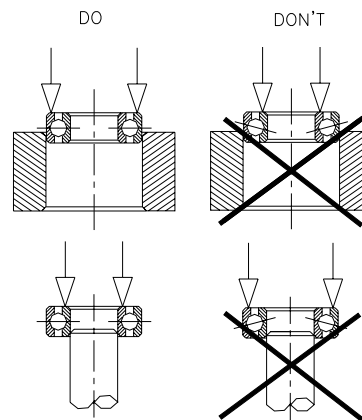


Figure 5. Bearing Seating

## 10.4 Ball Bearing Replacement

Ball bearings may be replaced in the field by the customer without significantly changing the flowmeter performance, provided the downstream orientation of the rotor is maintained. Complete replacement sets of calibrated internals are also available.

### 10.4.1 Ball Bearing Replacement For:

Liquid Models:	FT4-8
Gas Models Bearing Code H:	FT-10; FT-12

Refer to Figures 7, 11

1. Remove the retaining ring (2) from either end of the flowmeter housing, note the orientation.
2. Gently slide the flowmeter rotor support assembly out of the housing, being careful not to drop any of the internal parts as they clear the housing.
3. Remove the downstream support (6) and the cone (7A) from the shaft (7B). Note on the FT4-8 flanged meters there is an upstream and downstream spacer (8) between the support (6) and the retaining ring (2).
4. Note that the rotor (7C) is marked on the downstream side with two lines on the rotor hub.
5. Gently slide the rotor assembly from the shaft (7B).
6. Slide both bearings (10) and the bearing spacer (11) out of the rotor hub (7C).
7. Verify the retaining ring (9) is in good condition and seated in the center of the rotor.
8. Reverse steps 1 through 5 for re-assembly. Insure the flow direction arrow on the internals match the flow direction arrow on the housing when the internals are reinstalled. Insure the rotor (7C) is properly oriented with markings on the downstream side.



#### 10.4.2 Ball Bearing Replacement For:

Liquid Models	FT6-8; FT8-8; FT-08; FT-10; FT-12; FT-16; FT-20; FT-24
Gas Models Bearing Code A & H:	FT2-8; FT4-8; FT6-8; FT8-8; FT-08; FT-16; FT-20; FT-24
Gas Models Bearing Code A:	FT-10; FT-12

Refer to Figure 7, 8, 9, 10 & 12

1. Remove the retaining ring (2) from either end of the flowmeter housing, note the orientation.
2. Gently slide the flowmeter rotor support assembly out of the housing, being careful not to drop any of the internal parts as they clear the housing.
3. Remove the downstream support (6) and cone (7A) from the shaft (7B). Note on the flanged FT2-8 thru FT-08 meters there is an upstream and downstream spacer (8) between the support (6) and the retaining ring (2).
4. Note that the rotor (7C) is marked on the downstream side with two lines on the rotor hub.
5. Gently slide the rotor assembly from the shaft.
6. Remove the retaining ring (9) from the marked side of the rotor (7C) and slide both bearings (10) and bearing spacer (11) out of the rotor hub.

Note: No bearing spacers (11) are present on liquid meter sizes FT6-8 through FT-08. Gas meter models FT2-8 through FT-08 with bearing code H have only one bearing and no spacer.

7. Install the two new ball bearings (10), spacer (11) as required, and retaining ring (9) into rotor hub (7C).
8. Reverse steps 1 through 5 for re-assembly. Insure that the flow direction arrow on the internals match the flow direction arrow on the housing when the internals are reinstalled. Insure the rotor (7C) is properly oriented with markings on the downstream side.

### 10.4.3 Ball Bearing Replacement For:

Models (Liquid and Gas) Bearing Code A & H	FT-32
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Refer to Figure 13

1. Remove the retaining ring (2) from either end of the flowmeter housing, note the orientation.
2. Gently slide the complete set of internals out of the housing, being careful not to drop any of the internal parts as they clear the housing.
3. Remove support (6) from the shaft (7B).
4. Note that the rotor (7C) is marked on the downstream side with two lines on the rotor hub.
5. Gently slide the rotor assembly from the shaft (7B).
6. Remove the retaining ring (9) from the marked side of the rotor (7C) and slide both bearings (10) and bearing spacer (11) out of the rotor hub.
7. Install the two new ball bearings (10), spacer (11) and retaining ring (9) into the rotor hub.
8. Reverse steps 1 through 5 for re-assembly. Insure that the flow direction arrow on the internals matches the flow direction arrow on the housing when the internals are reinstalled. Insure the rotor (7C) is properly oriented with markings on the downstream side.

#### 10.4.4 Ball Bearing Replacement For:

Models (Liquid and Gas) Bearing Code A & H	FT-40; FT-48; FT-64
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Refer to Figure 14

1. Remove the retaining ring (5) from the upstream end of the flowmeter housing (1).
2. Gently slide the complete set of internals out of the housing, being careful not to drop any of the internal parts as they clear the housing.
3. Remove one of the self-locking nuts (3), from one end of the shaft (7).
4. Remove support (4), cone (8), and spacer (11) or (9) from the shaft (7). Note wider spacer (9) is on the downstream side.
5. Note that the rotor (6) is marked on the downstream side with two lines on the rotor hub.
6. Gently slide the rotor assembly (6) and sleeve (14) from the shaft (7).
7. Remove the retaining ring (10) from the marked side of the rotor (6) and slide both ball bearings (13) and bearing spacer (12) out of the rotor hub.
8. Install the two new ball bearings (13), spacer (12) and retaining ring (10) into the rotor hub. Slide sleeve (14) back into the inside diameter of the ball bearings (13).
9. Reverse steps 1 through 6 for re-assembly. Insure that the flow direction arrow on the internals matches the flow direction arrow on the housing when the internals are reinstalled. Insure the rotor (6) is properly oriented with markings on the downstream side.

#### 10.4.5 Ball Bearing Replacement For:

Model Liquid & Gas Bearing Code A:	FT-96
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Refer to Figure 15

1. Remove the retaining ring (5) from the upstream end of the flowmeter housing (1).
2. Remove the self-locking nut (3) and washer (15) from the upstream end of the shaft (7).
3. Remove the upstream support (4), cone (8) and spacer (11) from the shaft (7).
4. Gently pull the shaft (7) out from the downstream end of the housing (1) until it passes through the rotor assembly (6).
5. Gently remove the rotor assembly (6) and sleeve (14) from the upstream end of the housing (1).
6. Note that the slots on the outside ring of the rotor (6) are on the downstream side.
7. Remove the bearing retaining ring (10) from the downstream side of the rotor (6) and slide both ball bearings (13) and the center spacer (12) out of the rotor hub.
8. Install the new ball bearings (13) and spacer (12) in the rotor hub (6) and secure with bearing retaining ring (10).
9. Slide the rotor assembly (6) and sleeve (14) onto the shaft (7), for rotors with rings make sure the teeth are facing downstream.
10. Slide the spacer (11), cone (8), upstream support assembly (4), and washer (15) onto the shaft (7).
11. Tighten the self-locking nut (3) on the upstream end of the shaft (7).
12. Install the retaining ring (5) in the housing.

#### 10.4.6 Ball Bearing Replacement For:

Model Liquid & Gas Bearing Code A:	FT-128
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Refer to Figure 16

1. Remove the retaining ring (5) from the upstream end of the flowmeter housing (1).
2. Remove the self-locking nut (3) and washer (15) from the upstream end of the shaft (7).
3. Remove the upstream support (4), cone (8) and spacer (9) from the shaft (7).
4. Gently pull the shaft (7) out from the downstream end of the housing (1) until it passes through the rotor assembly (6).
5. Gently remove the rotor assembly (6) from the upstream end of the housing (1).
6. Note that the slots on the outside ring of the rotor (6) are on the downstream side.
7. Remove the bearing retaining ring (10) from the downstream side of the rotor (6) and slide both ball bearings (13) and the center spacer (12) out of the rotor hub.
8. Install the new ball bearings (13) and spacer (12) in the rotor hub (6) and secure with bearing retaining ring (10).
9. Slide the rotor assembly (6) onto the shaft (7), making sure the teeth on the ring are on the downstream side.
10. Slide the spacer (9), cone (8), upstream support assembly (4), and washer (15) onto the shaft (7).
11. Tighten the self-locking nut (3) on the upstream end of the shaft (7).
12. Install the retaining ring (5) in the housing.

#### 10.4.7 Ball Bearing Replacement For:

Model Liquid & Gas Bearing Code A:	FT-192
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Refer to Figure 17

1. Remove the retaining ring (5) from the upstream end of the flowmeter housing (1).
2. Remove the self-locking nut (3) from the upstream end of the shaft (7).
3. Remove the upstream support assembly (4) and spacer (11) from the shaft (7).
4. Gently pull the shaft (7) out from the downstream end of the housing (1) until it passes through the rotor assembly (6).
5. Gently remove the rotor assembly (6) and sleeve (14) from the upstream end of the housing (1).
6. Note that the slots on the outside ring of the rotor (6) are on the downstream side.
7. Remove the bearing retaining ring (10) from the downstream side of the rotor (6) and slide both ball bearings (13), the center spacer (12), wave spring (16), and spacers (17) out of the rotor hub.
8. Install the new ball bearings (13), spacer (12), wave spring (16) and spacers (17) in the rotor hub (6) and secure with bearing retaining ring (6).
9. Slide the rotor assembly (6) and sleeve (14) onto the shaft (7), making sure the teeth on the ring are on the downstream side.
10. Slide the spacer (11) and upstream support assembly (4) onto the shaft (7).
11. Tighten the self-locking nut (3) on the upstream end of the shaft (7).
12. Install the retaining ring (5) in the housing.

## 10.5 Journal Bearing Replacement

Flow Technology, Inc. has bearing replacement kits available for turbine flowmeters equipped with journal bearings. The use of a replacement kit will allow the customer to repair the flowmeter in the field. To maintain accuracy it is necessary that the meter be recalibrated or the entire internal assembly be replaced with a complete set of calibrated internals. Journal bearings have the same basic design as their ball bearing counterparts, however, instead of removable ball bearings with spacers and retaining rings, the journal bearings are pressed into the rotor and utilize a special cone (or washer) for a thrust surface. The procedure for removing and inserting the internal assembly from the flowmeter housing is the same for journal and ball bearing flowmeters.

### 10.5.0.1 Replacement Kits

The part numbers for replacement rotating assembly kits can be obtained from the parts list in this manual. Complete sets of calibrated internals are available and strongly recommended over replacing only the rotating assembly. Complete calibrated internals can be ordered by specifying the flowmeter model and serial number.

### 10.5.0.2 Self-Lubricating Bearings

For epoxy impregnated graphite and non-metallic (Teflon, Torlon, etc.) journal bearings, the replacement kit consists of a journal bearing, rotor and shaft assembly (includes a sleeve on FT-32) that replaces the existing rotor subassembly. The rotor, journal bearing, and shaft comprise a factory matched set of components designed for a specific flowmeter.

### 10.5.0.3 Carbide and Ceramic

The replacement kits for tungsten carbide or ceramic journal bearings on the FT-24 and smaller meters consist of a journal bearing, shaft, rotor and cone assembly. The upstream and downstream cones have carbide or ceramic thrust washers installed. These are factory-matched components. Replacement rotating assembly kits are not available for FT-32 meters. Contact factory for replacement of complete internals. The replacement kits for tungsten carbide and ceramic journal bearings for FT-40 and larger meters consist of a journal bearing, rotor, sleeve and thrust washers. These are factory-matched components.

### 10.5.1 Journal Bearing Replacement For:

Model: FT-24 and smaller
Journal Material: Graphite (and other self-lubricating materials)

Refer to Figures 20 and 21

1. Remove the retaining ring (2) from the upstream end of the housing (1), note the orientation.
2. Gently slide the flowmeter rotor support assembly out of the housing being careful not to drop any of the internal parts as they clear the housing. FT4-8 thru FT-08 will have support spacers.
3. Remove the upstream support (6) and cone assembly (15A) from the shaft (15B). This is a close tolerance fit and may require twisting the supports to free the shaft.
4. Remove shaft (15B) and rotor assembly (15C) from the downstream support (6) and cone assembly (15A).
5. Install the new rotor (15C) and journal bearing assembly (15D) into the downstream support (6) and cone assembly (15A). Observe the downstream marking on the rotor. The flange of the journal bearing marks the downstream side of the rotor on the FT-16 and larger.
6. Install the upstream support (6) and cone assembly (15A) on the new rotor assembly.
7. Install the completed assembly into the flowmeter housing by inserting the downstream support in accordance with the flow direction arrow on the housing.
8. Install the upstream retaining ring (2) (same orientation before removing) and check to make sure that the rotor (15C) rotates in the housing.



### 10.5.2 Journal Bearing Replacement For:

Model: FT-24 and smaller
Journal Material: Ceramic and Tungsten Carbide

Refer to Figures 18 and 19

1. Remove the retainer ring (2) from the upstream end of the housing (1), note the orientation.
2. Gently slide the flowmeter rotor support assembly out of the housing, being careful not to drop any of the internal parts as they clear the housing. FT4-8 thru FT-08 will have support spacers.
3. Remove both support (6) and cone assemblies (7A) from the shaft (7B). This is a close tolerance fit and may require twisting the supports to free the shaft.
4. Install cone assemblies (7A) into both supports (6).
5. Install rotor (7C) and journal bearing assembly (7D) in the downstream support (6) and cone assemblies (7A).
6. Install upstream support (6) and cone assemblies (7A) on the new rotor assembly (7C).
7. Install the completed assembly into the flowmeter housing by inserting the downstream support in accordance with the flow direction arrow on the housing.
8. Install the upstream retaining ring (2) (same orientation before removing) and check to make sure that the rotor (7C) rotates in the housing.

### 10.5.3 Journal Bearing Replacement For:

Model: FT-32
Journal Material: Graphite (and other self-lubricating materials)

Refer to Figure 23

1. Remove the retaining ring (2) from the upstream end of the housing (1), note the orientation.
2. Gently slide the complete set of internals out of the housing, being careful not to drop any of the internal parts as they clear the housing.
3. Remove the upstream support (6) from the shaft (14).
4. Remove the rotor assembly (15C) from the shaft (14).
5. Install rotor (15C) and journal bearing assembly (15D) on the shaft (14). Observe the downstream marking on the rotor. The flange of the journal bearing (15D) marks the downstream side of the rotor.
6. Install the support (6) on the shaft (14).
7. Install the completed assembly into the flowmeter housing by inserting the downstream support in accordance with the flow direction arrow on the housing.
8. Install the upstream retaining ring (2) (same orientation before removing) and check to make sure that the rotor (15C) rotates in the housing.

#### 10.5.4 Journal Bearing Replacement For:

Model: FT-32
Journal Material: Ceramic or Tungsten Carbide

Refer to Figure 22

1. Remove the retaining ring (2) from the upstream end of the housing (1), note the orientation.
2. Gently slide the complete set of internals out of the housing, being careful not to drop any of the internal parts as they clear the housing.
3. Remove the upstream support (6) from the shaft (14).
4. Remove the rotor assembly (16C) from the shaft (14).
5. Install rotor (16C) and journal bearing assembly (16D) on the shaft (14). Observe the downstream marking on the rotor.
6. Install the support (6) on the shaft (14).
7. Install the completed assembly into the flowmeter housing by inserting the downstream support in accordance with the flow direction arrow on the housing.
8. Install the upstream retaining ring (2) (same orientation before removing) and check to make sure that the rotor (16C) rotates in the housing.

### 10.5.5 Journal Bearing Replacement For

Model: FT-40; FT-48; and FT64  
Journal Material: Ceramic and Tungsten Carbide

Refer to Figure 24

1. Remove the retaining ring (5) from the upstream end of the housing (1).
2. Gently slide the complete set of internals out of the housing, being careful not to drop any of the internal parts as they clear the housing.
3. Remove one of the self-locking nuts (3) from the end of the shaft (7).
4. Remove the upstream support (4) and cone (8) from the shaft (7).
5. Remove the sleeve (10), thrust washers (9), bearing (11) and rotor (6) from the shaft.
6. Install rotor (6), journal bearing (11), thrust washers (9), and sleeve (10) on the shaft against the downstream support (4) and cone (8). Observe the downstream marking on the rotor. Insure that the groove on the thrust washers face the bearing.
7. Install the upstream support (4) and cone (8) on the shaft against the new rotor assembly (6).
8. Tighten the self-locking nuts (3) on the end of the shaft (7).
9. Install the completed assembly into the flowmeter housing by inserting the downstream support in accordance with the flow direction arrow on the housing.
10. Install the retaining ring (5) and check to make sure that the rotor (6) rotates in the housing.

### 10.5.6 Journal Bearing Replacement For:

Model: FT-96; and FT-128 Journal Material: Tungsten Carbide
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Refer to Figures 25 and 26

1. Remove the retaining ring (5) from the upstream end of the flowmeter housing (1).
2. Remove the self locking nut (3) and washer (15) from the upstream end of the shaft (7).
3. Remove the upstream support (4), cone (8) and thrust washer (9) from the shaft (7).
4. Gently pull the shaft (7) out from the downstream end of the housing (1) until it passes through the rotor assembly (6).
5. Gently remove the rotor assembly (6), sleeve (10), and downstream thrust washer (9) from the upstream end of the housing (1).
6. Note that the slots on the outside ring of the rotor (6) are on the downstream side.
7. Install rotor (6), journal bearing (11), thrust washers (9) and sleeve (10) on the shaft against the downstream support (4) and cone (8). Insure the groove on the thrust washers face the bearing.
8. Slide the support (4), cone (8) and washer (15) onto the shaft.
9. Tighten the self-locking nuts (3) on the end of the shaft (7).
10. Install the retaining ring (5) and check to make sure that the rotor (6) rotates in the housing.

### 10.5.7 Journal Bearing Replacement For:

Model: FT-192
Journal Material: Tungsten Carbide

Refer to Figure 27

1. Remove the retaining ring (5) from the upstream end of the flowmeter housing (1).
2. Remove the self-locking nut (3) from the upstream end of the shaft (7).
3. Remove the upstream support assembly (4) and thrust washer (9) from the shaft (7).
4. Gently pull the shaft (7) out from the downstream end of the housing (1) until it passes through the rotor assembly (6).
5. Gently remove the rotor assembly (6), sleeve (10), and thrust washer (9) from the upstream end of the housing (1).
6. Note that the slots on the outside ring of the rotor (6) are on the downstream side.
7. Install rotor (6), journal bearing (11), spacer (9), thrust washer (9) and sleeve (10), on the shaft against the downstream support assembly (4). Insure the groove on the thrust washers face the bearing.
8. Slide the support assembly (4) onto the shaft (7).
9. Tighten the self-locking nuts (3) on the end of the shaft (7).
10. Install the retaining ring (5) and check to make sure that the rotor (6) rotates in the housing.

## 11.0 TROUBLESHOOTING GUIDE

The following guide shows some of the common problems that may occur during the operation of turbine flowmeters. Various causes are given for each problem including a description of the cause and the corrective action to be taken.

TABLE 8 Meter Reads High	
Probable Cause	Corrective Action
Line not full of fluid, gas jetting through meter (liquid meter only).	Fill and bleed system.
Cavitation, fluid vaporizes as it slips over rotor blades (liquid meter only). Cavitation of the fluid as it passes through the meter.	Check for insufficient backpressure and insure that the flow rate is throttled down stream of the meter. Increase static pressure of system if it is safe and feasible.
Meter installed backwards.	Check to see if the flow direction arrow on the flowmeter is aligned with the direction of flow.
Internals installed backwards.	Verify internals are installed properly.
Meter installed in different orientation than when calibrated.	Insure meter is installed in horizontal position unless otherwise specified on data sheet.
Flowmeter is not mated to proper electronics.	Check data sheets and assemble system correctly.
Operating fluid has a different kinematic viscosity than the original calibration.	Recalibrate meter at correct kinematic viscosity.
Electronics picking up noise. A.C. signals override flowmeter signals and are detected as pulses.	Separate power cables from signal cables and check for noise signal of sufficient amplitude to be mistaken as a flowmeter signal. Check for improper connection of ground shield. Shield to be connected at only one end of system.
Flange gasket is protruding in to flow stream creating jetting.	Correctly align gasket.
Foreign material upstream or in flowmeter creating jetting.	Remove material, install manufactures recommended filtration.
Input line to flowmeter has a much smaller opening than meter, creating jetting.	Check input line connections and size per manufacturer recommendations.
Swirl in flow stream created by valves, line geometry, fittings and insufficient flow straightening causing rotor to have artificially high frequency.	Check the geometry of the line, install appropriate flow straighteners.
Diagnostic equipment used to check the turbine meter is incorrect.	Check calibration and accuracy of diagnostic equipment used to check turbine flowmeter.

TABLE 9  
Meter Reads Low

Probable Cause	Corrective Action
Corroded or worn bearings.	Replace bearings.
Bearing misapplication.	Use proper bearings.
Improper flowmeter assembly after installing bearing kit.	Check for proper internal component assembly.
Fluid contamination.	Clean internals and check location, size and condition of filter and/or replace fluid.
Meter installed backwards.	Check to see if the flow direction arrow on the flowmeter is aligned with the direction of flow.
Internals installed backwards.	Verify internals are installed properly.
Meter installed in different orientation than calibration.	Insure meter is installed in horizontal position unless otherwise specified on data sheet.
Gasket intrudes into line and blocks flow.	Reposition gasket.
Bent rotor blades.	Visually inspect and replace rotor if necessary.
Fluid pulsations.	Provide damping in the system.
Shift in fluid viscosity.	Insure the operating condition remains equivalent with the calibration conditions. If the viscosity cannot be stabilized contact the factory for additional information.
Swirl in flow stream created by valves, line geometry, fittings and insufficient flow straightening causing rotor to have artificially low frequency.	Check the geometry of the line, install appropriate flow straighteners.
Electronics not detecting some pulses.	Adjust amplifier gain.
A.C. signals override flowmeter signals and are detected as pulses.	Check for A.C. signals that override flowmeter signals. Insure signal and power cables are not run together.
Flowmeter is not mated to proper electronics.	Check data sheets and assemble system correctly.
Loose pickoff.	Verify that the pickoff bottoms in the housing and secure locknut.
Improper hook-up of cable shield.	Check for improper connection of ground shield. Shield to be connected at only one end of system.



TABLE 10  
Zero Output

Probable Cause	Corrective Action
Pickoff not connected or not properly installed.	Check connection between pickoff and amplifier or readout. Verify that the pickoff bottoms in the housing and secure locknut.
Pickoff defective. Impedance mismatch.	Perform resistance test on pickoff. Insure that amplifier has been matched to flowmeter. Some amplifiers require tuning for non-standard pickoffs. Verify proper type of amplifier is used.
System temperature above meter rating.	Insure the fluid temperature is not above the operational temperature of the meter.
Amplifier overheated.	Insure that the temperature range of the amplifier is not exceeded.
Flowmeter and readout device are not connected properly.	Check wiring connections of system and verify connections are correctly installed.
Broken wire in system.	Check continuity of interconnecting wires between components.
Excessive distance from flowmeter to readout device.	Check distance between pickoff and amplifier. Distance should not exceed 300 feet for magnetic pickoffs and 30 feet for RF pickoffs.
Flowmeter rotor locked and will not turn.	Disassemble flowmeter and inspect for debris lodged in rotor. Inspect for damaged bearings or other internal components.
Flow rate below minimum required for meter operation.	Check flowmeter and electronic data sheet for low cutoff frequency.
No flow in system.	Check for closed valves in system or a by-pass valve in an open position.

TABLE 11  
Intermittent Operation

Probable Cause	Corrective Action
Loose electrical connections.	Check and tighten connections.
Improperly seated pickoff.	Verify that pickoff is bottomed and retighten lock nut.
Intermittent electromagnetic noise.	Separate power cables from signal cables and check for noise signal of sufficient amplitude to be mistaken as a flowmeter signal.
Electronic malfunction.	Troubleshoot electronics. Consult electronics manual.
Fluid temperature exceeds range of pickoff.	Replace with high temperature pickoff or reduce operating temperature.
Ambient temperature exceeds range of electronics.	Relocate the electronics to reduce temperature to an acceptable level.
Bearings are worn, broken or contaminated.	Replace bearings and recalibrate meter. Provide appropriate filtration.
Uneven flow, flow surging or pulsating.	Increase system backpressure or provide damping.

TABLE 12  
Non-repeatable Meter Output

Probable Cause	Corrective Action
Bearings have become worn, damaged or corroded.	Replace bearings as necessary and recalibrate meter. Check for appropriate filtration and material / fluid compatibility.
Internals have become contaminated with foreign material.	Clean or replace meter internals including supports, cones, rotor and/or bearings and recalibrate meter. Check for appropriate filtration as necessary.
Damaged internals.	Replace internals and recalibrate meter.
Line not full of fluid - bubbles or froth present (Liquid meters only).	Check plumbing for source of bubbles or froth and correct. Bleed line of foreign gas.
Cavitation of the fluid as it passes through the meter (Liquid meters only).	Check for insufficient backpressure and insure the flow rate is throttled down stream of the meter. Increase static pressure of the system if it is safe and feasible.
Shift in fluid viscosity.	Insure the operating condition remains equivalent to the calibration conditions. If viscosity cannot be stabilized, contact the factory for additional information.
Internals not properly secured.	Inspect retaining rings for proper seating. Inspect bore for signs of scoring. Reseat retaining ring(s) and/or replace internals if necessary.
Piping configuration changed.	Insure the operational piping configuration is the same as that with which the meter was calibrated. If not, recalibrate meter with the new piping configuration.
Intermittent operation.	Intermittent operation will cause non-repeatable meter output. Refer to the trouble shooting section on intermittent operation.

TABLE 13  
Constant Non-Zero Output

Probable Cause	Corrective Action
Improper oscillation of amplifier circuit.	Pickoff and amplifier mismatch, replace with compatible component.
Electronics picking up noise.	Separate power cables from signal cables and check for noise signal of sufficient amplitude to be mistaken as a flowmeter signal.
Improper wiring.	Check for appropriate wiring configuration and connections.
Electronic malfunction.	See electronic manual troubleshooting guide to correct problem.

## 12.0 PARTS LIST

The following pages contain a detailed listing of the turbine flowmeter parts referenced in this manual. For non-standard material, please consult factory for part numbers. Information from the list must be used when contacting the factory for repairs, ordering spare parts or for questions in reference to the turbine flowmeters.

Unless otherwise noted refer to Figure 6, Illustrated Parts Breakdown, for visual identification of the various components of the flowmeters.

**TABLE 14**  
**Liquid Service Turbine Flowmeter Parts List**

ITEM	DESCRIPTION	QTY	FT 4-8	FT6-8
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-30837-03	13-30514-04
	b. NPT		13-31314-46	13-31314-16
	c. Flanged #150 ANSI Flanged #300 ANSI		13-85778-101 13-85778-102	13-85779-101 13-85779-102
	d. Wafer		13-82869-03	13-82869-06
2	Retaining Ring	2	57-11235-01	57-31648-02
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-11702-44	54-11702-43
	b. NPT		54-11702-44	54-11702-43
	c. Flanged		54-11702-44	54-11702-43
	d. Wafer		54-11702-81	54-80956-06
		Refer to:	FIGURE 18	FIGURE 18
7	Rotating Assembly (brg code G)	1	53-84897-102	53-84922-103
		Refer to:	FIGURE 7	FIGURE 8
7	Rotating Assembly (brg code A)	1	53-84921-101	53-84922-101
7A	Cones	2	55-11703-14	5511703-01
7B	Shaft	1	52-11234-03	52-10907-14
	Rotor Assembly (brg code A)	1	53-84442-101	53-30896-102
7C	Rotor	1	53-84219-01	53-31166-14
9,10,11	Ball Bearing Replacement Kit	1	86-17413-102	86-17414-101
8*	Spacers, Support	2	41-84900-01	41-84900-02

\* FT4-8 and FT6-8 flanged meters require support spacers between the retaining rings and rotor supports to properly position rotor in housing. Refer to Figures 7, 8 and 18.

**TABLE 15**  
**Liquid Service Turbine Flowmeter Parts List**

ITEM	DESCRIPTION	QTY	FT 8-8	FT-08
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-30514-06	13-31219-02
	b. NPT		13-31314-36	13-31314-26
	c. Flanged #150 ANSI Flanged #300 ANSI		13-85780-101 13-85780-102	13-85781-101 13-85781-102
	d. Wafer		13-82869-09	13-82869-12
2	Retaining Ring	2	57-31648-01	57-31648-03
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-11702-40	54-11702-41
	b. NPT		54-11702-40	54-11702-41
	c. Flanged		54-11702-40	54-11702-41
	d. Wafer		54-80956-05	54-80956-04
		Refer to:	FIGURE 18	FIGURE 18
7	Rotating Assembly (brg code G)	1	53-89860-103	53-89911-101
		Refer to:	FIGURE 8	FIGURE 8
7	Rotating Assembly (brg code A)	1	53-89860-101	53-84924-101
7A	Cones	2	55-11703-01	5511703-01
7B	Shaft	1	52-11907-14	52-10907-14
	Rotor Assembly (brg code A)	1	53-30896-124	53-30896-105
7C	Rotor	1	53-31677-04	53-31166-08
9,10,11	Ball Bearing Replacement Kit	1	86-17414-101	86-17414-101
8*	Spacers, Support	2	53-84900-03	53-84900-04

\* FT8-8 and FT-08 flanged meters require support spacers between the retaining rings and rotor supports to properly position rotor in housing. Refer to Figures 8 and 18.

**TABLE 16**  
**Liquid Service Turbine Flowmeter Parts List**

ITEM	DESCRIPTION	QTY	FT-10	FT-12
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-30884-02	13-30877-02
	b. NPT		13-51275-02	13-51044-03
	c. Flanged #150 ANSI Flanged #300 ANSI		13-85782-101 13-85782-102	13-85783-101 13-85783-102
	d. Wafer		13-82869-15	13-82869-18
2	Retaining Ring	2	57-11728-03	57-11728-03
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-31660-04	54-31333-08
	b. NPT		54-31660-04	54-31333-08
	c. Flanged		54-31660-04	54-31333-08
	d. Wafer		54-31660-09	54-31333-13
		Refer to:	FIGURE 19	FIGURE 19
7	Rotating Assembly (brg code G)	1	53-89860-104	53-88123-108
		Refer to:	FIGURE 10	FIGURE 10
7	Rotating Assembly (brg code A)	1	53-84925-101	53-84926-104
7A	Cones	2	55-31334-02	55-31334-02
7B	Shaft	1	52-10182-09	52-10182-09
	Rotor Assembly (brg code A)	1	53-30888-101	53-30895-111
7C	Rotor	1	53-31167-02	53-31168-25
9,10,11	Ball Bearing Replacement Kit	1	86-17415-101	86-17415-101

TABLE 17  
Liquid Service Turbine Flowmeter Parts List

ITEM	DESCRIPTION	QTY	FT-16	FT-20
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-80024-02	13-80023-02
	b. NPT		13-80024-04	13-80023-04
	c. Flanged #150 ANSI Flanged #300 ANSI		13-88335-01 13-85784-102	13-85785-101 13-85785-102
	d. Wafer		13-82869-21	13-82869-24
2	Retaining Ring	2	57-31920-05	57-31920-06
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-31194-20	54-31623-10
	b. NPT		54-31194-20	54-31623-10
	c. Flanged		54-31194-20	54-31623-10
	d. Wafer		54-31194-21	54-31623-11
		Refer to:	FIGURE 19	FIGURE 19
7	Rotating Assembly (brg code G)	1	53-89860-105	53-89860-106
		Refer to:	FIGURE 10	FIGURE 10
7	Rotating Assembly (brg code A)	1	53-84927-101	53-89860-107
7A	Cones	2	55-11710-02	55-11710-02
7B	Shaft	1	52-13152-1-13	52-13152-1-13
	Rotor Assembly (brg code A)	1	53-30023-101	53-30947-102
7C	Rotor	1	53-31169-15	53-31170-01
9,10,11	Ball Bearing Replacement Kit	1	86-17416-101	86-17416-101



**TABLE 18**  
**Liquid Service Turbine Flowmeter Parts List**

ITEM	DESCRIPTION	QTY	FT-24	FT-32
			FIGURE 6	FIGURE 6
		Refer to:		
1	Housing, Flowmeter	1		
	a. MS		13-51892-02	13-51871-02
	b. NPT		13-51930-02	13-51870-03
	c. Flanged #150 ANSI Flanged #300 ANSI		13-85786-101 13-85786-102	13-85787-101 13-85787-102
	d. Wafer		13-82869-27	13-82869-30
2	Retaining Ring	2	57-31920-03	57-31920-04
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6*	Supports	2		
	a. MS		54-51931-06	54-80972-01 *
	b. NPT		54-51931-06	54-80972-01 *
	c. Flanged		54-51931-06	54-80972-01 *
	d. Wafer		54-84031-01	54-85603-102
		Refer to:	FIGURE 19	FIGURE 22
7	Rotating Assembly (brg code G)	1	53-89860-108	N/A
		Refer to:	FIGURE 10	FIGURE 13
7	Rotating Assembly (brg code A)	1	53-84929-101	N/A
7	Cones	2	55-11820-04	N/A
7*	Shaft	1	52-13152-2-17	52-13152-2-17 *
	Rotor Assembly (brg code A)	1	53-30037-101	53-61031-101 *
7C	Rotor	1	53-31171-13	53-31172-10
9,10,11	Ball Bearing Replacement Kit	1	86-17417-103	86-17417-101

\* For FT-32 meters with S/N 3202339 and up.  
For FT-32 meters with S/N below 3202339 consult factory.

**TABLE 19**  
**Liquid Service Turbine Flowmeter Parts List**

ITEM	DESCRIPTION	QTY	FT-40	FT-48
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-86223-01	N/A
	b. NPT		13-85738-101	13-85754-101
	c. Flanged #150 ANSI Flanged #300 ANSI		13-85788-101 13-85788-102	13-85789-101 13-85789-102
	d. Wafer		13-82869-50	13-82869-49
2	Retaining Ring	1	57-13038-225	57-13038-287
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-85632-101	N/A
	b. NPT		54-85632-101	54-85753-101
	c. Flanged		54-85632-101	54-85753-101
	d. Wafer		54-85632-102	54-85753-102
		Refer to:	FIGURE 14	FIGURE 14
8	Cones	2	55-85631-01	55-85750-01
7	Shaft	1	52-85122-02	52-85122-04
	Rotor Assembly (brg code A)	1	53-85744-101	53-61457-106
6	Rotor	1	53-85739-01	53-85135-01
10,12,13	Ball Bearing Replacement Kit	1	86-17418-102	86-17418-102

**TABLE 20**  
**Liquid Service Turbine Flowmeter Parts List**

ITEM	DESCRIPTION	QTY	FT-64	FT-96
			FIGURE 6	FIGURE 6
		Refer to:		
1	Housing, Flowmeter	1		
	a. MS		N/A	N/A
	b. NPT		13-85798-101	13-82281-101
	c. Flanged #150 ANSI Flanged #300 ANSI		13-85790-101 13-85790-102	13-85792-101 13-85792-102
	d. Wafer		13-82869-39	13-82869-48
2	Retaining Ring	1	57-13038-400	57-13038-600
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		N/A	N/A
	b. NPT		54-86099-101	54-85430-101
	c. Flanged		54-86099-101	54-85430-101
	d. Wafer		54-80539-103	54-32162-103
		Refer to:	FIGURE 14	FIGURE 15
8	Cones	2	55-86100-01	55-85428-01
7	Shaft	1	52-85122-04	52-85424-01
	Rotor Assembly (brg code A)	1	53-85159-101	53-60838-101
6	Rotor	1	53-85152-01	53-89957-01
10,12,13	Ball Bearing Replacement Kit	1	86-17418-102	86-17506-101

**TABLE 21**  
**Liquid Service Turbine Flowmeters Parts List**

ITEM	DESCRIPTION	QTY	FT-128	FT-192
			FIGURE 6	FIGURE 6
		Refer to:		
1	Housing, Flowmeter	1		
	a. MS		N/A	N/A
	b. NPT		N/A	N/A
	c. Flanged #150 ANSI		13-85793-101	13-85795-111
	d. Wafer		N/A	N/A
2	Retaining Ring	1	57-13038-800	57-85796-01
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		N/A	N/A
	b. NPT		N/A	N/A
	c. Flanged		54-85383-101	54-80015-101
	d. Wafer		N/A	N/A
		Refer to:	FIGURE 16	FIGURE 17
8	Cones	2	55-85378-01	N/A
7	Shaft	1	52-85377-01	52-80025-01
	Rotor Assembly (brg code A)	1	Consult Factory	Consult Factory
6	Rotor	1	53-80008-107	53-80008-102
10,12,13	Ball Bearing Replacement Kit	1	86-60125-101	86-61507-101

**TABLE 22**  
**Gas Service Turbine Flowmeters Parts List Bearing Code H**

ITEM	DESCRIPTION	QTY	FT 2-8	FT4-8
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-86374-115	13-86374-115
	b. NPT		13-86374-116	13-86374-116
	c. Flanged #150 ANSI Flanged #300 ANSI		13-86374-117 13-86374-185	13-86374-117 13-86374-185
	d. Wafer		13-86374-154	13-86374-154
2	Retaining Ring	2	57-31648-03	57-31648-03
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-61232-01	54-61232-01
	b. NPT		54-61232-01	54-61232-01
	c. Flanged		54-61232-01	54-61232-01
	d. Wafer		54-61232-04	54-61232-04
		Refer to:	FIGURE 9	FIGURE 9
7	Rotating Assembly, (brg code H)	1	53-61462-101	53-61462-102
7A	Cones	2	55-61231-01	55-61231-01
7B	Shaft	1	52-10182-05	52-10182-05
	Rotor Assembly (brg code H)	1	53-30896-127	53-30896-129
7C	Rotor	1	53-61245-03	53-61245-08
9,10	Ball Bearing Replacement Kit	1	86-17414-103	86-17414-103
8*	Spacer support	2	41-84900-04	41-84900-04

\* FT2-8 and FT4-8 flanged meters require support spacers between retaining rings and rotor supports to properly position rotor in housing. Refer to Figure 9.

**TABLE 23**  
**Gas Service Turbine Flowmeters Parts List Bearing Code H**

ITEM	DESCRIPTION	QTY	FT 6-8	FT 8-8
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-86374-115	13-86374-115
	b. NPT		13-86374-116	13-86374-116
	c. Flanged #150 ANSI Flanged #300 ANSI		13-86374-117 13-86374-185	13-86374-117 13-86374-185
	d. Wafer		13-86374-154	13-86374-154
2	Retaining Ring	2	57-31648-03	57-31648-03
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-61232-01	54-61232-01
	b. NPT		54-61232-01	54-61232-01
	c. Flanged		54-61232-01	54-61232-01
	d. Wafer		54-61232-04	54-61232-04
		Refer to:	FIGURE 9	FIGURE 9
7	Rotating Assembly, (brg code H)	1	53-61462-103	53-61462-104
7A	Cones	2	55-61231-01	55-61231-01
7B	Shaft	1	52-10182-05	52-10182-05
	Rotor Assembly (brg code H)	1	53-30896-131	53-30896-133
7C	Rotor	1	53-61245-02	53-61245-01
9,10	Ball Bearing Replacement Kit	1	86-17414-103	86-17414-103
8*	Spacers, support *	2	41-84900-04	41-84900-04

\* FT6-8 and FT8-8 flanged meters require support spacers between retaining rings and rotor supports to properly position rotor in housing. Refer to Figure 9.

**TABLE 24**  
**Gas Service Turbine Flowmeters Parts List Bearing Code H**

ITEM	DESCRIPTION	QTY	FT-08
		Refer to:	FIGURE 6
1	Housing, Flowmeter	1	
	a. MS		13-86374-115
	b. NPT		13-86374-116
	c. Flanged #150 ANSI Flanged #300 ANSI		13-86374-117 13-86374-185
	d. Wafer		13-86374-154
2	Retaining Ring	2	57-31648-03
3	Locknut, Pickoff	1	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101
6	Supports	2	
	a. MS		54-61232-01
	b. NPT		54-61232-01
	c. Flanged		54-61232-01
	d. Wafer		54-61232-04
		Refer to:	FIGURE 9
7	Rotating Assembly, (brg code H)	1	53-61462-105
7A	Cones	2	55-61231-01
7B	Shaft	1	52-10182-05
	Rotor Assembly (brg code H)	1	53-30896-135
7C	Rotor	1	53-61245-04
9,10	Ball Bearing Replacement Kit	1	86-17414-103
8*	Spacers, support *	2	41-84900-04

\* FT-08 flanged meters require support spacers between retaining rings and rotor supports to properly position rotor in housing. Refer to Figure 9.

TABLE 25  
Gas Service Turbine Flowmeters Parts List Bearing Code H

ITEM	DESCRIPTION	QTY	FT-10		FT-12	
			Refer to:	FIGURE 6	Refer to:	FIGURE 6
1	Housing, Flowmeter	1				
	a. MS			13-86374-118		13-86374-121
	b. NPT			13-86374-119		13-86374-122
	c. Flanged #150 ANSI Flanged #300 ANSI			13-86374-120 13-86374-190		13-86374-123 13-86374-195
	d. Wafer			13-86374-155		13-86374-156
2	Retaining Ring	2		57-11728-03		57-11728-03
3	Locknut, Pickoff	1		46-10036-01		46-10036-01
4	Connector, W/Boot, MS Pickoff	1		15-89515-101		15-89515-101
6	Supports	2				
	a. MS			54-31660-04		54-31333-08
	b. NPT			54-31660-04		54-31333-08
	c. Flanged			54-31660-04		54-31333-08
	d. Wafer			54-31660-09		54-31333-13
			Refer to:	FIGURE 11		FIGURE 11
7	Rotating Assembly, (brg code H)	1		53-61462-106		53-61462-107
7A	Cones	2		55-31334-05		55-31334-05
7B	Shaft	1		52-10182-09		52-10182-09
	Rotor Assembly (brg code H)	1		53-30888-104		53-30895-113
7C	Rotor	1		53-31167-08		53-31168-29
9,10,11	Ball Bearing Replacement Kit	1		86-17415-104		86-17415-104



**TABLE 26**  
**Gas Service Turbine Flowmeters Parts List Bearing Code H**

ITEM	DESCRIPTION	QTY	FT-16	FT-20
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-86374-124	13-86374-127
	b. NPT		13-86374-125	13-86374-128
	c. Flanged #150 ANSI Flanged #300 ANSI		13-86374-126 13-86374-200	13-86374-129 13-86374-205
	d. Wafer		13-86374-157	13-86374-158
2	Retaining Ring	2	57-13038-90	57-13038-100
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-31194-20	54-31623-10
	b. NPT		54-31194-20	54-31623-10
	c. Flanged		54-31194-20	54-31623-10
	d. Wafer		54-31194-21	54-31623-11
		Refer to:	FIGURE 12	FIGURE 12
7	Rotating Assembly, (brg code H)	1	53-61462-108	53-61462-109
7A	Cones	2	55-11710-02	55-11710-02
7B	Shaft	1	52-13152-1-13	52-13152-1-13
	Rotor Assembly (brg code H)	1	53-61457-103	53-61457-104
7C	Rotor	1	53-31169-22	53-31170-05
9,10,11	Ball Bearing Replacement Kit	1	86-17416-103	86-17416-103

TABLE 27  
Gas Service Turbine Flowmeters Parts List Bearing Code H

ITEM	DESCRIPTION	QTY	FT-24		FT-32	
			Refer to:	FIGURE 6	Refer to:	FIGURE 6
1	Housing, Flowmeter	1				
	a. MS			13-86374-130		13-86374-133
	b. NPT			13-86374-131		13-86374-134
	c. Flanged #150 ANSI			13-86374-132		13-86374-135
	Flanged #300 ANSI			13-86374-210		13-86374-215
	d. Wafer			13-86374-159		13-86374-160
2	Retaining Ring	2		57-31920-03		57-31920-04
3	Locknut, Pickoff	1		46-10036-01		46-10036-01
4	Connector, W/Boot, MS Pickoff	1		15-89515-101		15-89515-101
6	Supports	2				
	a. MS			54-51931-06		54-80972-01 *
	b. NPT			54-51931-06		54-80972-01 *
	c. Flanged			54-51931-06		54-80972-01 *
	d. Wafer			54-84031-01		54-85603-102
			Refer to:	FIGURE 12		FIGURE 13
7	Rotating Assembly, (brg code H)	1		53-61462-110		N/A
7A	Cones	2		55-11820-04		N/A
7B	Shaft	1		52-13152-2-17		52-13152-2-17
	Rotor Assembly (brg code H)	1		53-61457-105		53-61021-103
7C	Rotor	1		53-31171-18		53-31172-18
9,10,11	Ball Bearing Replacement Kit	1		86-17417-105		86-17417-105

\* For FT-32 meters with S/N 3202339 and up. FT-32 meters with S/N below 3202339 consult factory.

**TABLE 28**  
**Gas Service Turbine Flowmeters Parts List Bearing Code H**

ITEM	DESCRIPTION	QTY	FT-40	FT-48
			Refer to: FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-86374-136	N/A
	b. NPT		13-86374-137	13-86374-139
	c. Flanged #150 ANSI Flanged #300 ANSI		13-86374-138 13-86374-226	13-86374-140 13-86374-226
	d. Wafer		13-86374-161	13-86374-162
2	Retaining Ring	1	57-13038-225	57-13038-287
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-85632-101	54-85753-101
	b. NPT		54-85632-101	54-85753-101
	c. Flanged		54-85632-101	54-85753-101
	d. Wafer		54-85632-102	54-85753-102
		Refer to:	FIGURE 14	FIGURE 14
8	Cones	2	55-85631-01	55-85750-01
7	Shaft	1	52-85122-02	52-85122-04
	Rotor Assembly (brg code H)	1	53-61457-107	53-61457-108
6	Rotor	1	53-85741-01	53-85136-01
9,10,11	Ball Bearing Replacement Kit	1	86-17418-105	86-17419-102

**TABLE 29**  
**Gas Service Turbine Flowmeters Parts List Bearing Code H**

ITEM	DESCRIPTION	QTY	FT-64
		Refer to:	FIGURE 6
1	Housing, Flowmeter	1	
	a. MS		N/A
	b. NPT		13-86374-141
	c. Flanged #150 ANSI Flanged #300 ANSI		13-86374-142 13-86374-248
	d. Wafer		13-86374-163
2	Retaining Ring	1	57-13038-387
3	Locknut, Pickoff	1	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101
6	Supports	2	
	a. MS		54-86099-101
	b. NPT		54-86099-101
	c. Flanged		54-86099-101
	d. Wafer		54-80539-103
		Refer to:	FIGURE 14
8	Cones	2	55-86100-01
7	Shaft	1	52-85122-04
	Rotor Assembly (brg code H)	1	53-61457-110
6	Rotor	1	53-85153-01
10,12,13	Ball Bearing Replacement Kit	1	86-17419-102

**TABLE 30**  
**Gas Service Turbine Flowmeters Parts List Bearing Code A**

ITEM	DESCRIPTION	QTY	FT2-8	FT4-8
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-30837-03	13-30837-03
	b. NPT		13-31314-46	13-31314-46
	c. Flanged #150 ANSI Flanged #300 ANSI		13-85778-101 13-85778-102	13-85778-101 13-85778-102
	d. Wafer		13-82869-03	13-82869-03
2	Retaining Ring	2	57-11235-01	57-11235-01
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-11702-44	54-11702-44
	b. NPT		54-11702-44	54-11702-44
	c. Flanged		54-11702-44	54-11702-44
	d. Wafer		54-11702-81	54-11702-81
		Refer to:	FIGURE 7	FIGURE 7
7	Rotating Assembly, (brg code A)	1	53-60076-101	53-84921-102
7A	Cones	2	55-11703-14	55-11703-14
7B	Shaft	1	52-11234-03	52-11234-03
	Rotor Assembly (brg code A)	1	53-61457-101	53-61457-102
7C	Rotor	1	53-84219-11	53-84219-02
9,10	Ball Bearing Replacement Kit	1	86-17413-102	86-17413-102
8*	Spacers, support	2	41-84900-01	41-84900-01

\* FT2-8 and FT4-8 flanged meters require support spacers between retaining rings and rotor supports to properly position rotor in housing. Refer to Figure 7 .

**TABLE 31**  
**Gas Service Turbine Flowmeters Parts List Bearing Code A**

ITEM	DESCRIPTION	QTY	FT 6-8	FT 8-8
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-30514-04	13-30514-06
	b. NPT		13-31314-16	13-31314-26
	c. Flanged #150 ANSI Flanged #300 ANSI		13-85779-101 13-85779-102	13-85780-101 13-85780-102
	d. Wafer		13-82869-06	13-82869-06
2	Retaining Ring	2	57-31648-01	57-31648-02
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-11702-43	54-11702-40
	b. NPT		54-11702-43	54-11702-40
	c. Flanged		54-11702-43	54-11702-40
	d. Wafer		54-80956-06	54-80956-05
		Refer to:	FIGURE 8	FIGURE 8
7	Rotating Assembly, (brg code A)	1	53-84922-102	53-89860-112
7A	Cones	2	55-11703-01	55-11703-01
7B	Shaft	1	52-10907-14	52-10907-14
	Rotor Assembly (brg code A)	1	53-30896-119	53-30896-109
7C	Rotor	1	53-31166-35	53-31677-09
9,10	Ball Bearing Replacement Kit	1	86-17414-101	86-17414-101
8*	Spacers, support	2	41-84900-02	41-84900-03

\* FT6-8 and FT8-8 and flanged meters require support spacers between retaining rings and rotor supports to properly position rotor in housing. Refer to Figure 8.

**TABLE 32**  
Gas Service Turbine Flowmeters Parts List Bearing Code A

ITEM	DESCRIPTION	QTY	FT-08
		Refer to:	FIGURE 6
1	Housing, Flowmeter	1	
	a. MS		13-31219-02
	b. NPT		13-31314-36
	c. Flanged #150 ANSI Flanged #300 ANSI		13-85781-101 13-85781-102
	d. Wafer		13-82869-12
2	Retaining Ring	2	57-31648-03
3	Locknut, Pickoff	1	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101
6	Supports	2	
	a. MS		54-11702-41
	b. NPT		54-11702-41
	c. Flanged		54-11702-41
	d. Wafer		54-80956-04
		Refer to:	FIGURE 8
7	Rotating Assembly, (brg code A)	1	53-84924-102
7A	Cones	2	55-11703-01
7B	Shaft	1	52-10909-14
	Rotor Assembly (brg code A)	1	53-30896-110
7C	Rotor	1	53-31166-22
9,10	Ball Bearing Replacement Kit	1	86-17414-101
8*	Spacers, support	2	41-84900-04

\* FT-08 flanged meters require support spacers between retaining rings and rotor supports to properly position rotor in housing. Refer to Figure 8.

**TABLE 33**  
**Gas Service Turbine Flowmeters Parts List Bearing Code A**

ITEM	DESCRIPTION	QTY	FT-10	FT-12
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-30884-02	13-30877-02
	b. NPT		13-51275-02	13-51044-03
	c. Flanged #150 ANSI Flanged #300 ANSI		13-85782-101 13-85782-102	13-85783-101 13-85783-102
	d. Wafer		13-82869-15	13-82869-18
2	Retaining Ring	2	57-11728-03	57-11728-03
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-31660-04	54-31333-08
	b. NPT		54-31660-04	54-31333-08
	c. Flanged		54-31660-04	54-31333-08
	d. Wafer		54-31660-09	54-31333-13
		Refer to:	FIGURE 10	FIGURE 10
7	Rotating Assembly, (brg code A)	1	53-89860-113	53-89860-114
7A	Cones	2	55-31334-02	55-31334-02
7B	Shaft	1	52-10182-09	52-10182-09
	Rotor Assembly (brg code A)	1	53-30888-102	53-30895-102
7C	Rotor	1	53-31167-03	53-31168-12
9,10,11	Ball Bearing Replacement Kit	1	86-17415-101	86-17415-101



TABLE 34  
Gas Service Turbine Flowmeters Parts List Bearing Code A

ITEM	DESCRIPTION	QTY	FT-16	FT-20
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-80024-02	13-80023-02
	b. NPT		13-80024-04	13-80023-04
	c. Flanged #150 ANSI Flanged #300 ANSI		13-88335-01 13-85784-102	13-85785-101 13-85785-102
	d. Wafer		13-82869-21	13-82869-24
2	Retaining Ring	2	57-31920-05	57-31920-06
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-31194-20	54-31623-10
	b. NPT		54-31194-20	54-31623-10
	c. Flanged		54-31194-20	54-31623-10
	d. Wafer		54-31194-21	54-31623-11
		Refer to:	FIGURE 10	FIGURE 10
7	Rotating Assembly, (brg code A)	1	53-84927-102	53-89860-115
7A	Cones	2	55-11710-02	55-11710-02
7B	Shaft	1	52-13152-1-13	52-13152-1-13
	Rotor Assembly (brg code A)	1	53-30023-105	53-30947-103
7C	Rotor	1	53-31169-22	53-31170-05
9,10,11	Ball Bearing Replacement Kit	1	86-17416-101	86-17416-101

**TABLE 35**  
**Gas Service Turbine Flowmeters Parts List Bearing Code A**

ITEM	DESCRIPTION	QTY	FT-24	FT-32
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-51892-02	13-51871-02
	b. NPT		13-51930-02	13-51870-03
	c. Flanged #150 ANSI Flanged #300 ANSI		13-85786-101 13-85786-102	13-85787-101 13-85787-102
	d. Wafer		13-82869-27	13-82869-30
2	Retaining Ring	2	57-31920-03	57-31920-04
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6*	Supports	2		
	a. MS		54-51931-06	54-80972-01 *
	b. NPT		54-51931-06	54-80972-01 *
	c. Flanged		54-51931-06	54-80972-01 *
	d. Wafer		54-84030-01	54-85603-102
		Refer to:	FIGURE 10	FIGURE 13
7	Rotating Assembly, (brg code A)	1	53-84929-102	N/A
7A	Cones	2	55-11820-04	N/A
7B	Shaft	1	52-13152-2-17	52-13152-3-21
	Rotor Assembly (brg code A)	1	53-30037-102	53-61021-102
7C	Rotor	1	53-31171-18	53-31172-18
9,10,11	Ball Bearing Replacement kit	1	86-17417-103	86-17417-103

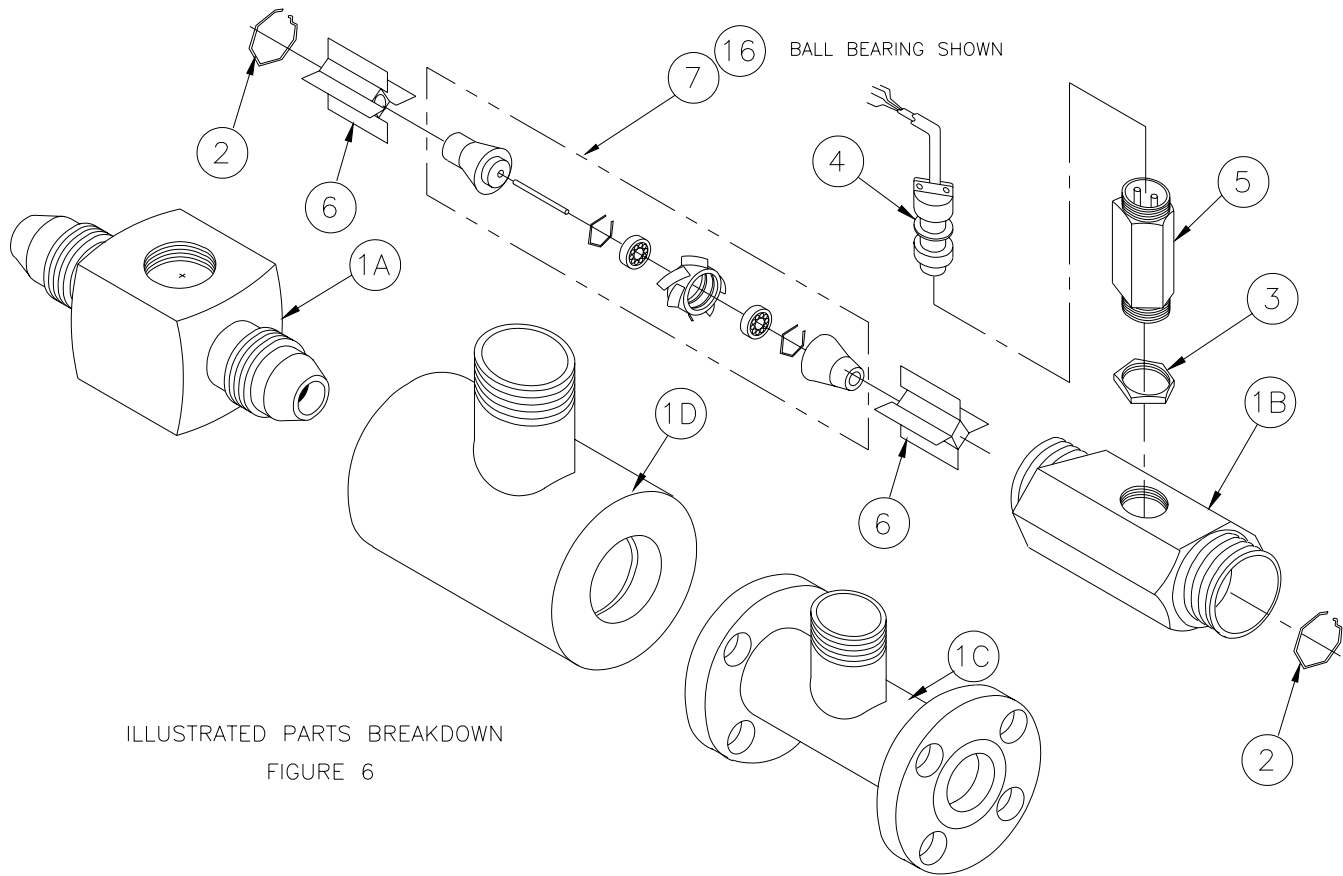
\* For FT-32 meters with S/N 3202339 and up. FT-32 meters with S/N below 3202339 consult factory.

**TABLE 36**  
**Gas Service Turbine Flowmeters Parts List Bearing Code A**

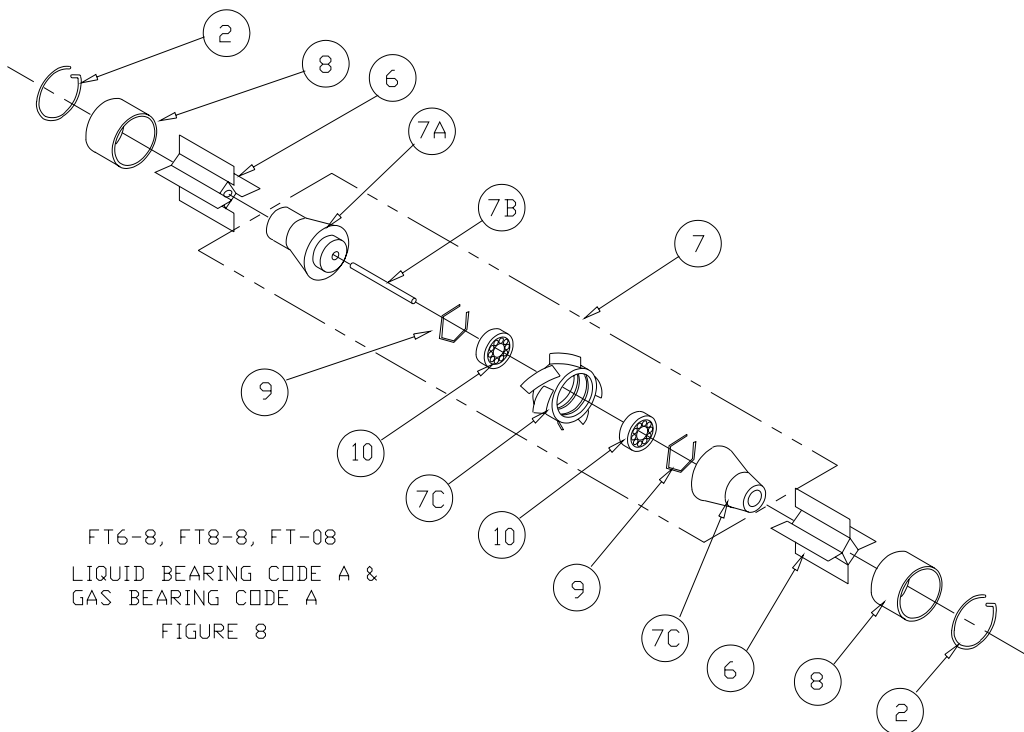
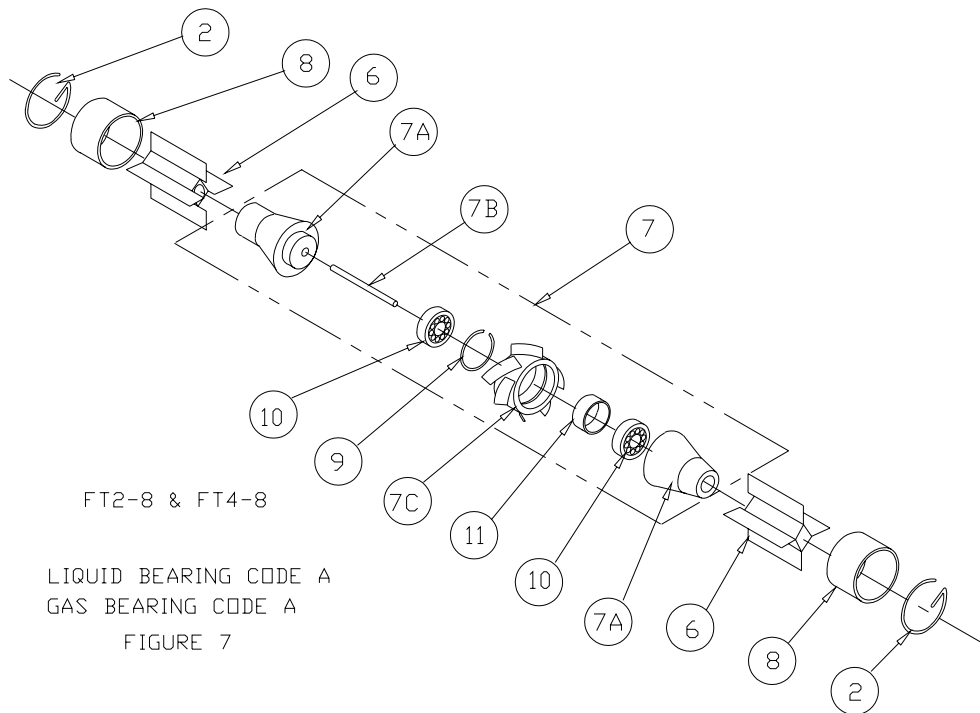
ITEM	DESCRIPTION	QTY	FT-40	FT-48
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		13-86223-01	N/A
	b. NPT		13-85738-101	13-85754-101
	c. Flanged #150 ANSI Flanged #300 ANSI		13-85788-101 13-85788-102	13-85789-101 13-85789-102
	d. Wafer		13-82869-50	13-82869-49
2	Retaining Ring	1	57-13038-225	57-13038-287
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-85632-101	54-85753-101
	b. NPT		54-85632-101	54-85753-101
	c. Flanged		54-85632-101	54-85753-101
	d. Wafer		54-85632-102	54-85753-102
		Refer to:	FIGURE 14	FIGURE 14
8	Cones	2	55-85631-01	55-85750-01
7	Shaft	1	52-85122-02	52-85122-04
	Rotor Assembly (brg code A)	1	53-85744-102	53-61457-111
6	Rotor	1	53-85741-01	53-85136-01
10,12,13	Ball Bearing Replacement kit	1	86-17418-102	86-17419-101

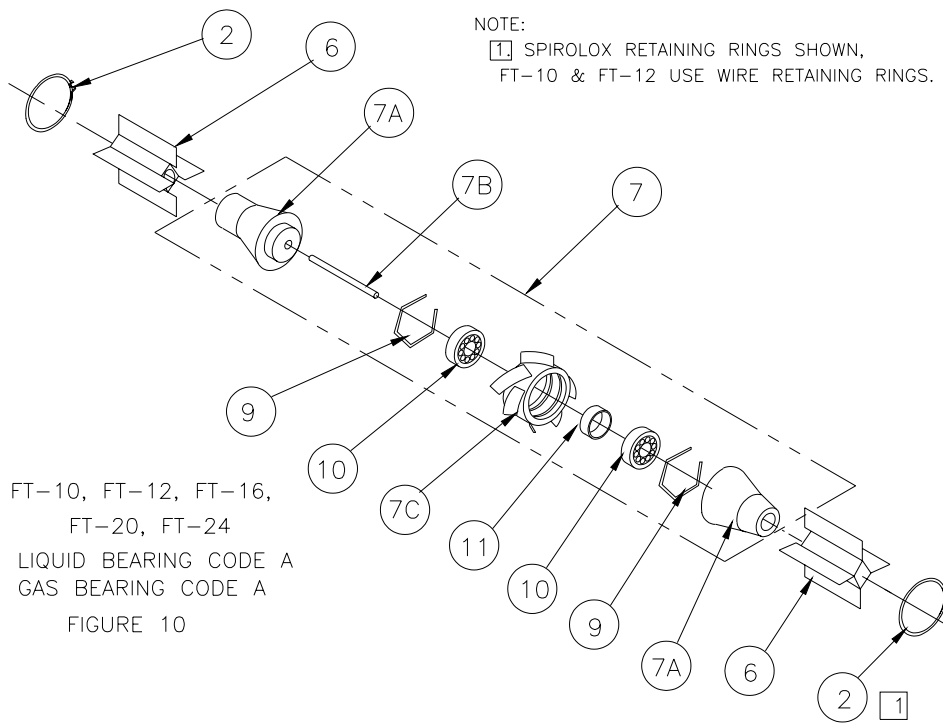
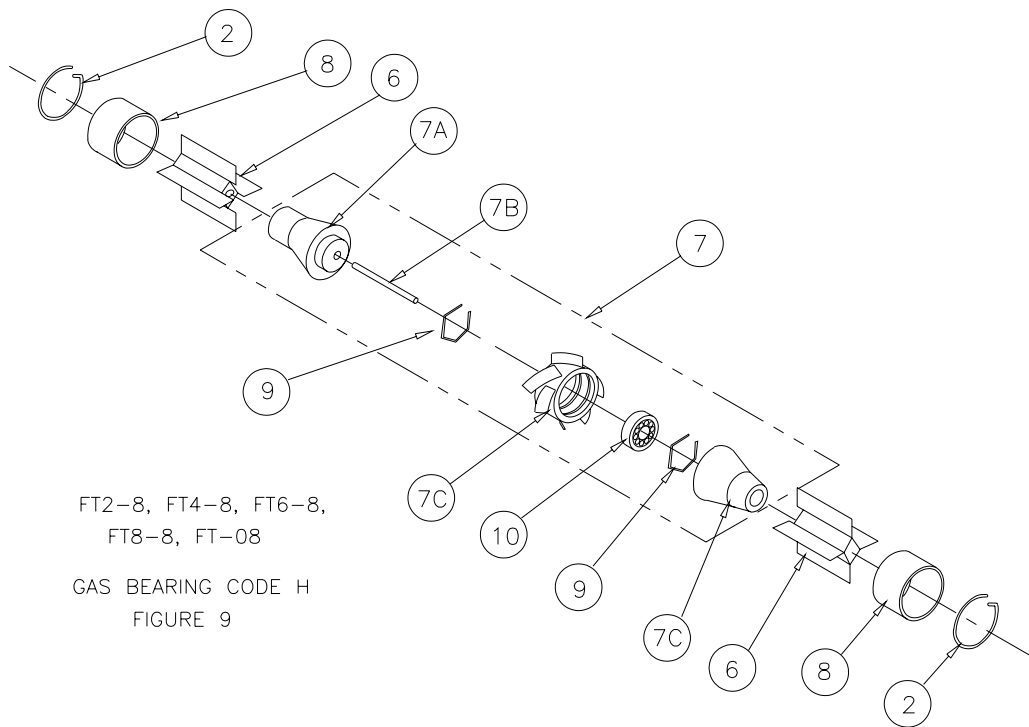
**TABLE 37**  
**Gas Service Turbine Flowmeters Parts List Bearing Code A**

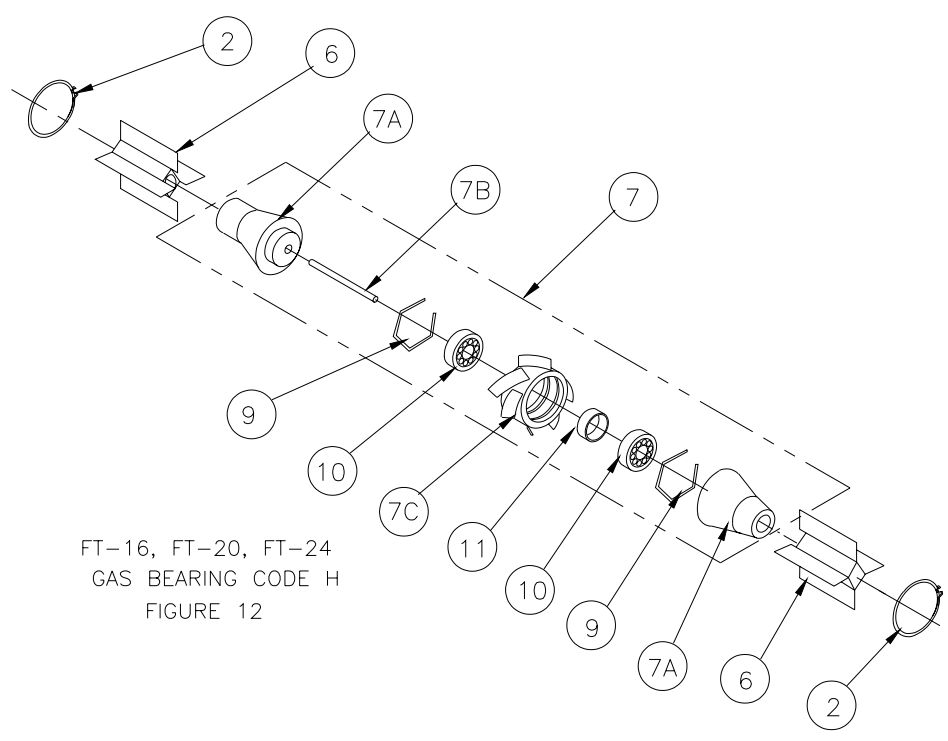
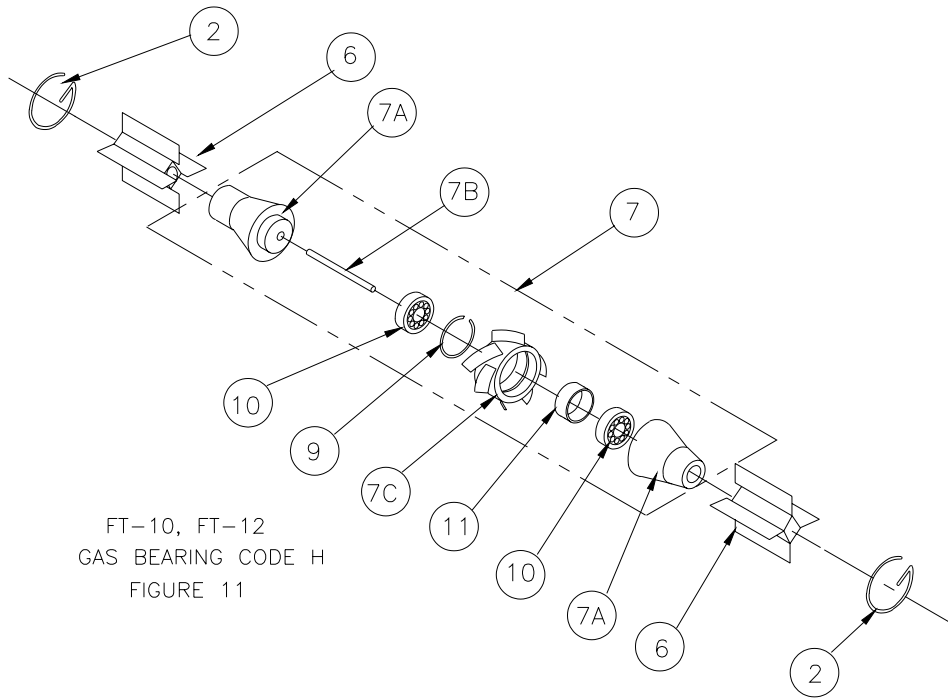
ITEM	DESCRIPTION	QTY	FT-64	FT-96
		Refer to:	FIGURE 6	FIGURE 6
1	Housing, Flowmeter	1		
	a. MS		N/A	N/A
	b. NPT		13-85798-101	13-82281-101
	c. Flanged #150 ANSI Flanged #300 ANSI		13-85790-101 13-85790-102	13-85792-101 13-85792-102
	d. Wafer		13-82869-39	13-82869-48
2	Retaining Ring	1	57-13038-387	57-13038-600
3	Locknut, Pickoff	1	46-10036-01	46-10036-01
4	Connector, W/Boot, MS Pickoff	1	15-89515-101	15-89515-101
6	Supports	2		
	a. MS		54-86099-101	N/A
	b. NPT		54-86099-101	54-85430-101
	c. Flanged		54-86099-101	54-85430-101
	d. Wafer		54-80539-103	54-32162-103
		Refer to:	FIGURE 14	FIGURE 15
8	Cones	2	55-86100-01	55-85428-01
7	Shaft	1	52-85122-04	52-85424-01
	Rotor Assembly (brg code A)	1	53-61457-109	Consult Factory
6	Rotor	1	53-85153-01	53-51432-112
10,12,13	Ball Bearing Replacement kit	1	86-17418-102	86-17506-101



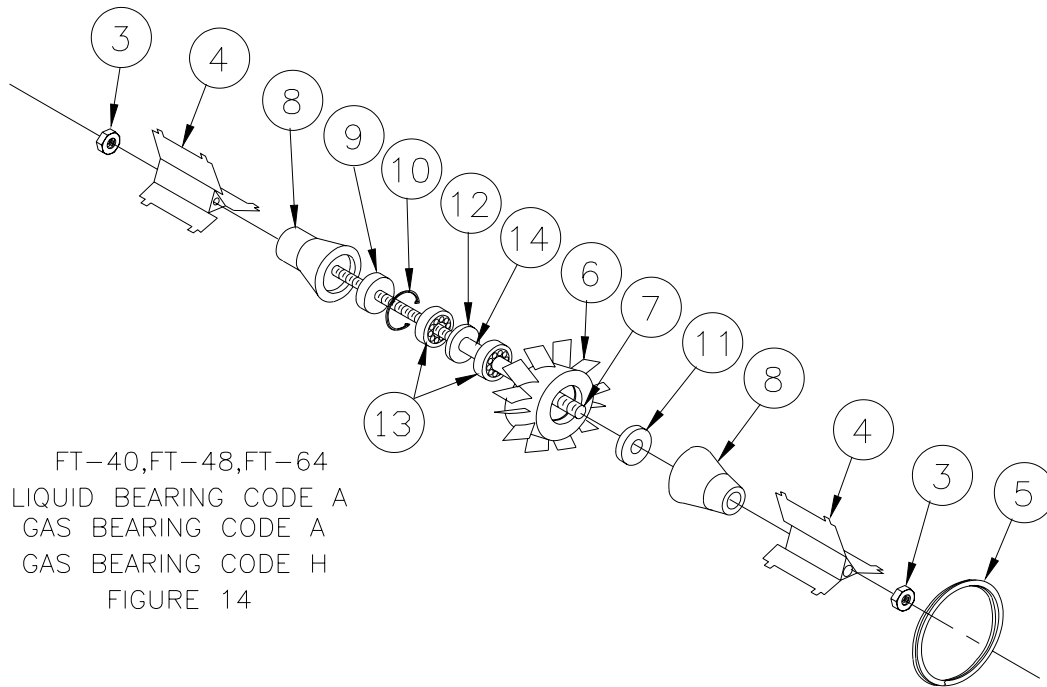
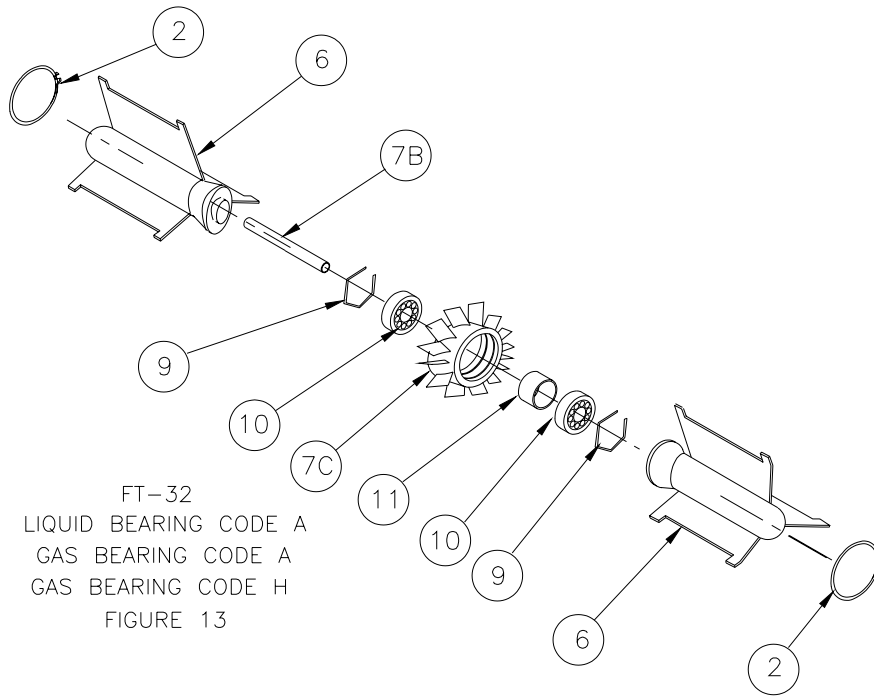
ILLUSTRATED PARTS BREAKDOWN  
 FIGURE 6

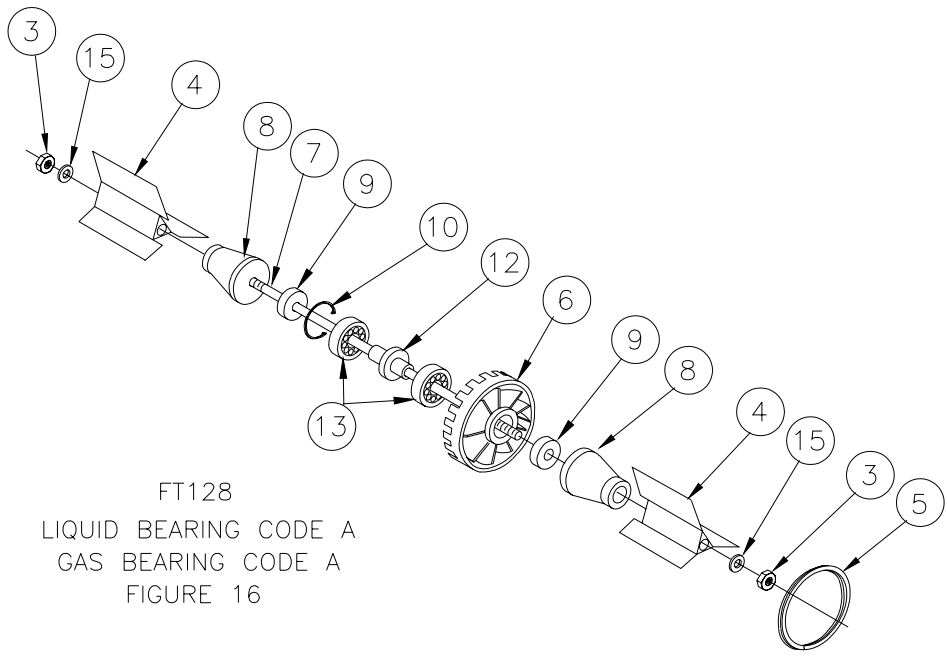
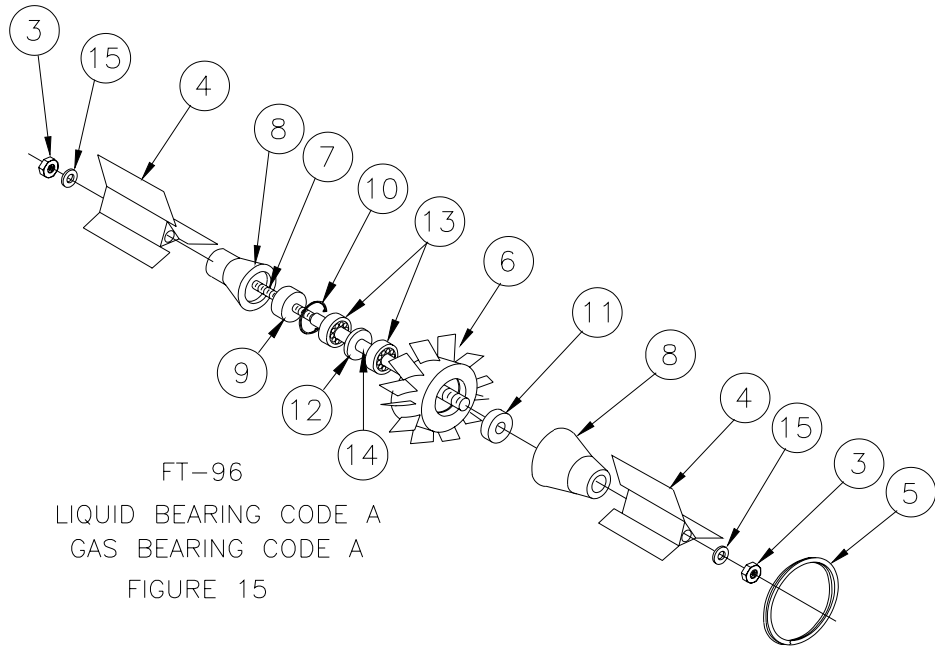


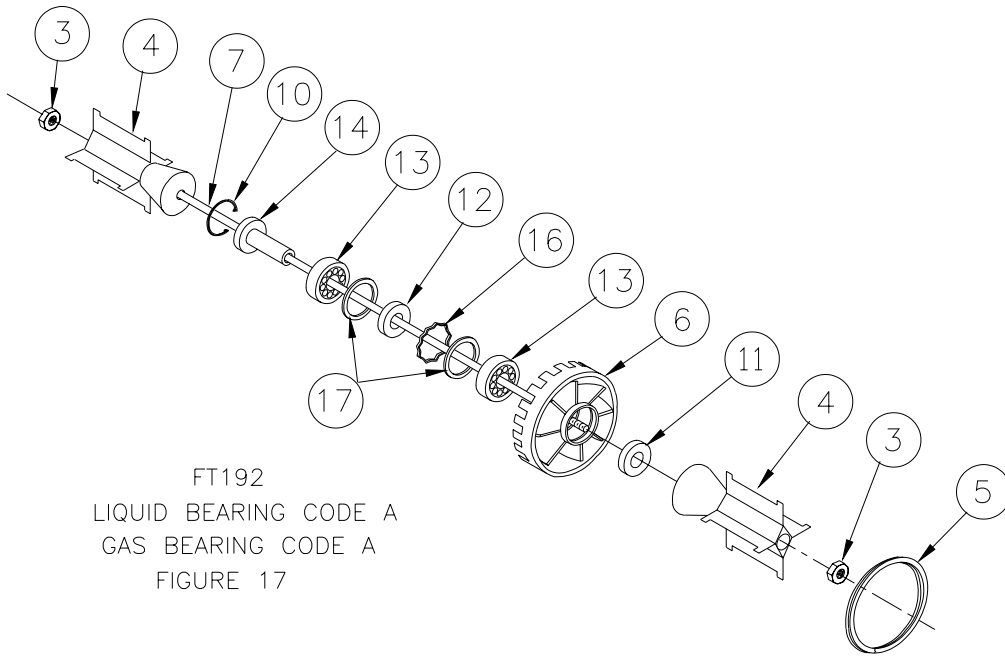




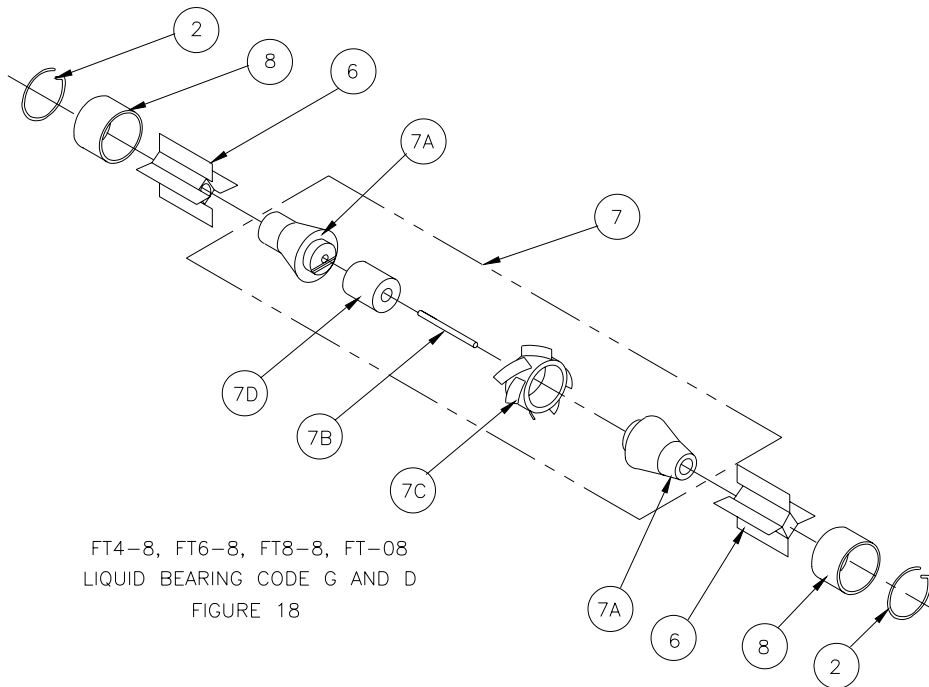




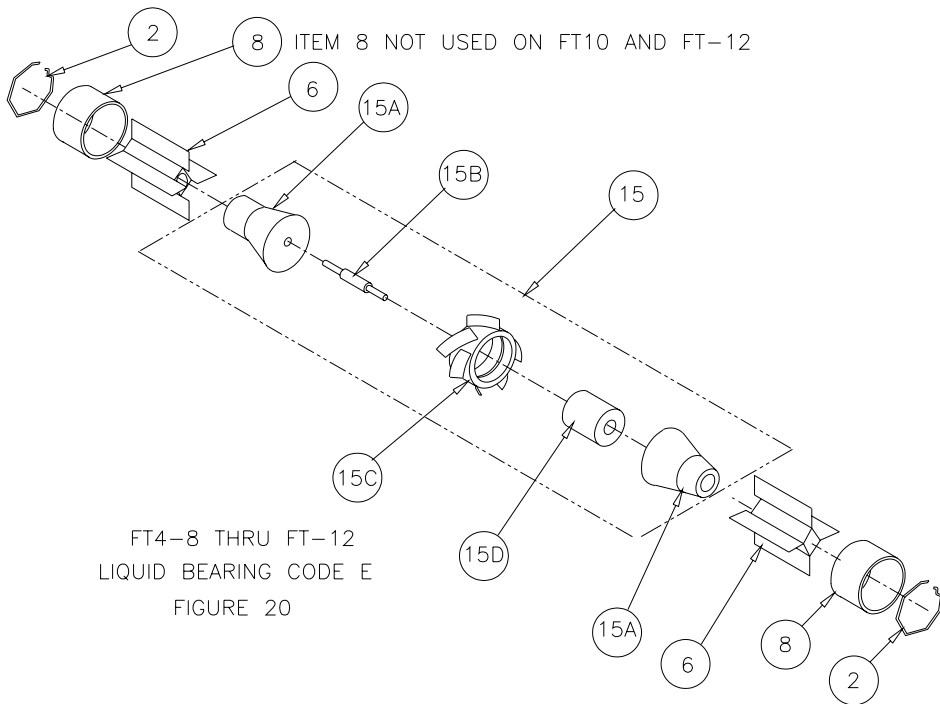
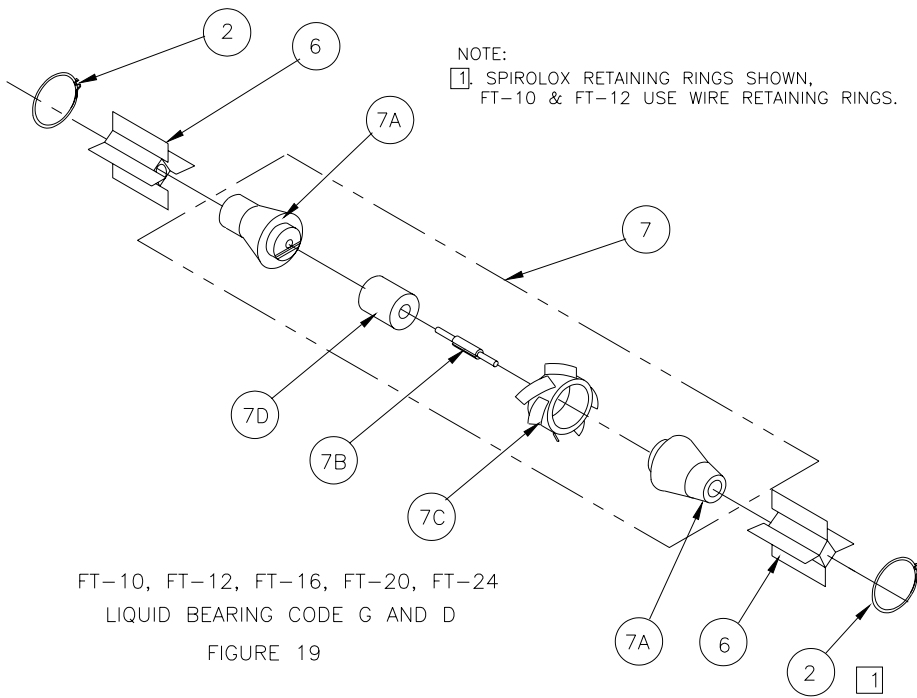


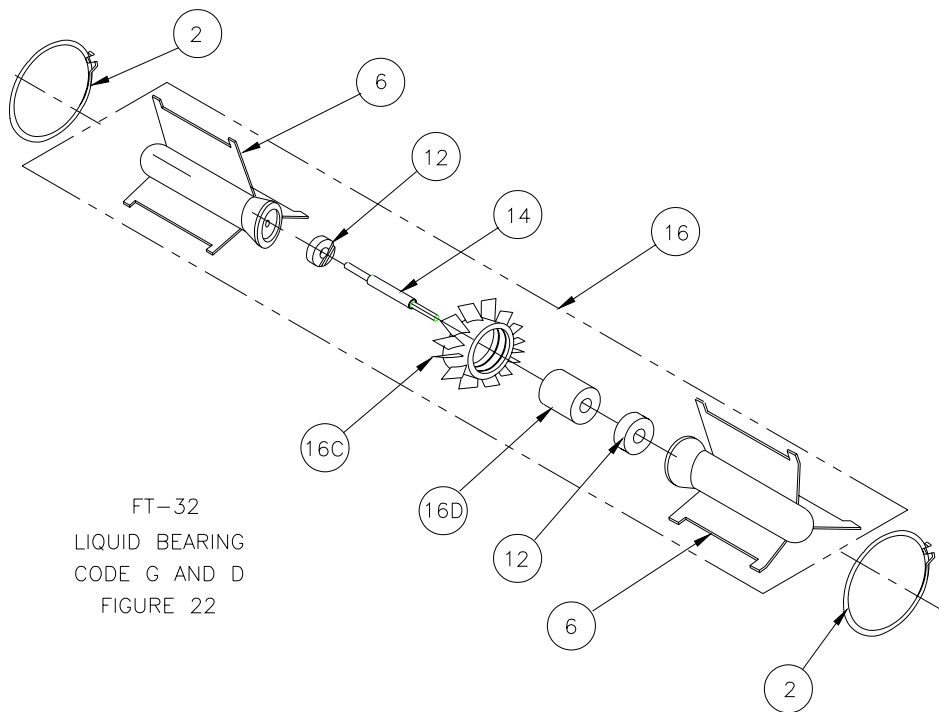
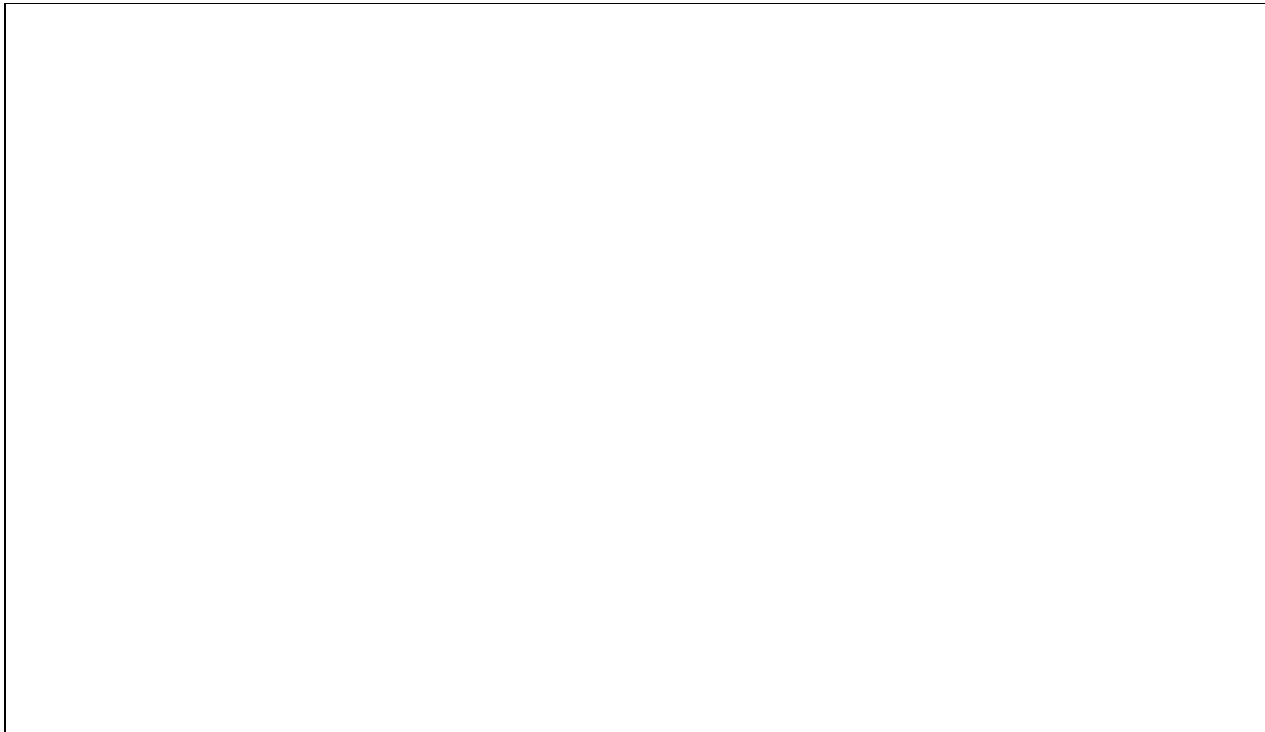


FT192  
 LIQUID BEARING CODE A  
 GAS BEARING CODE A  
 FIGURE 17

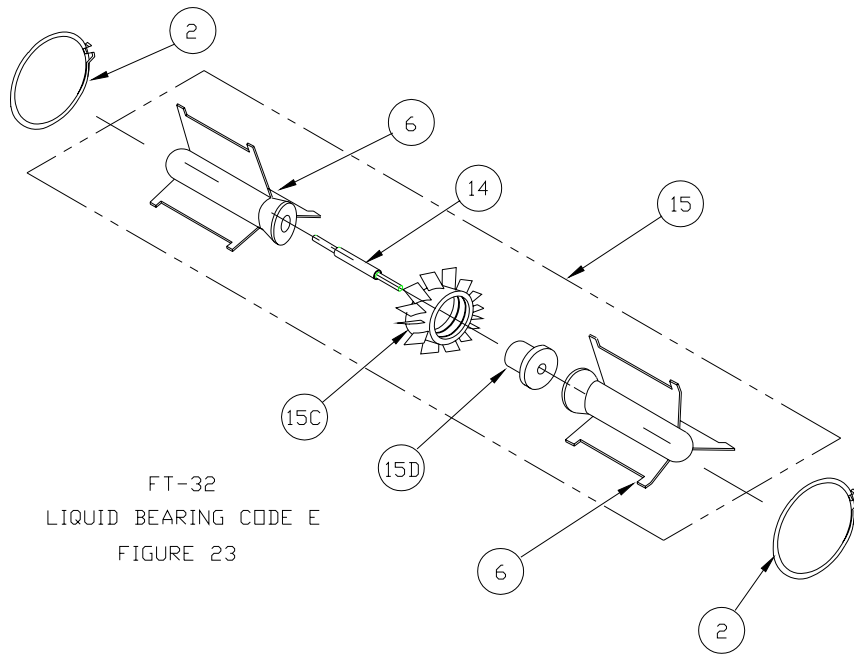


FT4-8, FT6-8, FT8-8, FT-08  
 LIQUID BEARING CODE G AND D  
 FIGURE 18

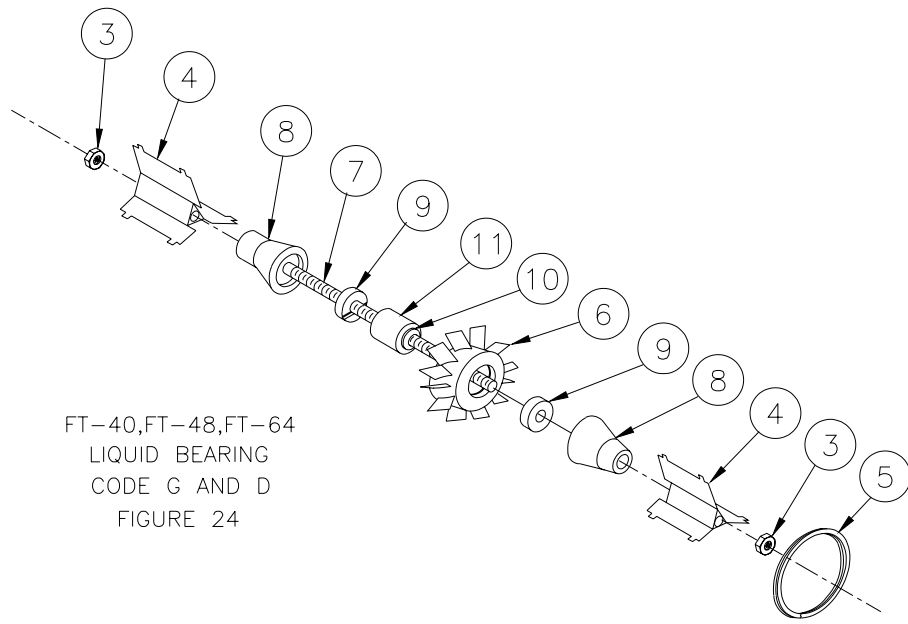




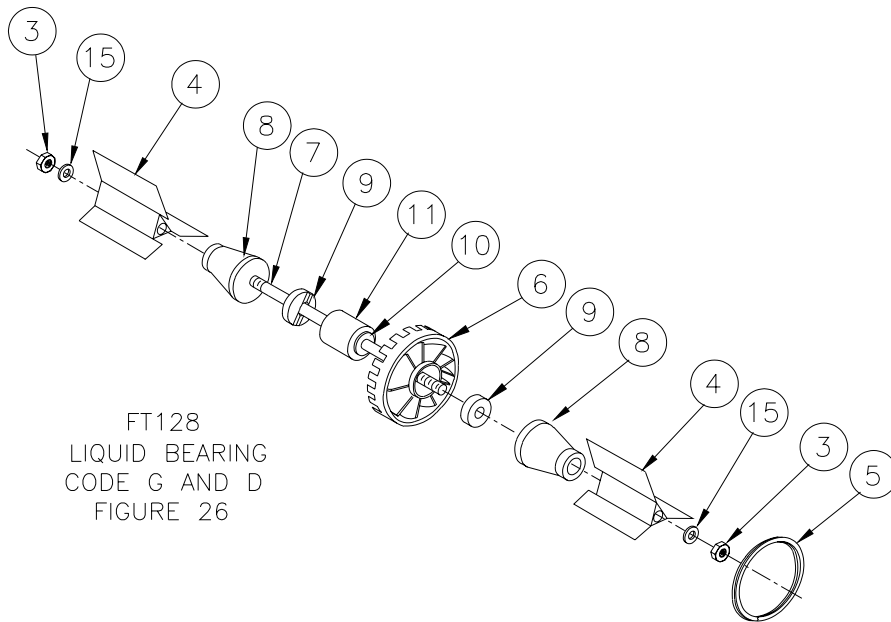
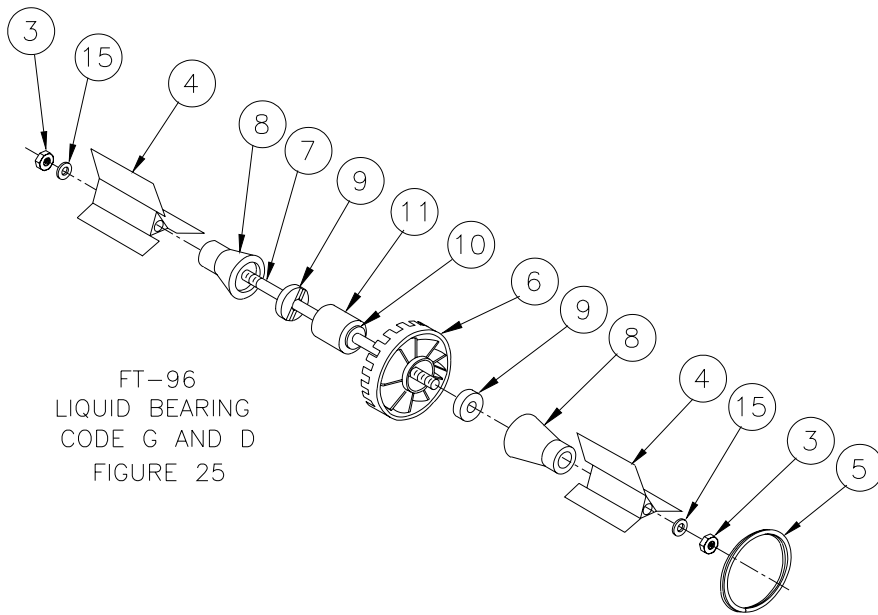
FT-32  
LIQUID BEARING  
CODE G AND D  
FIGURE 22

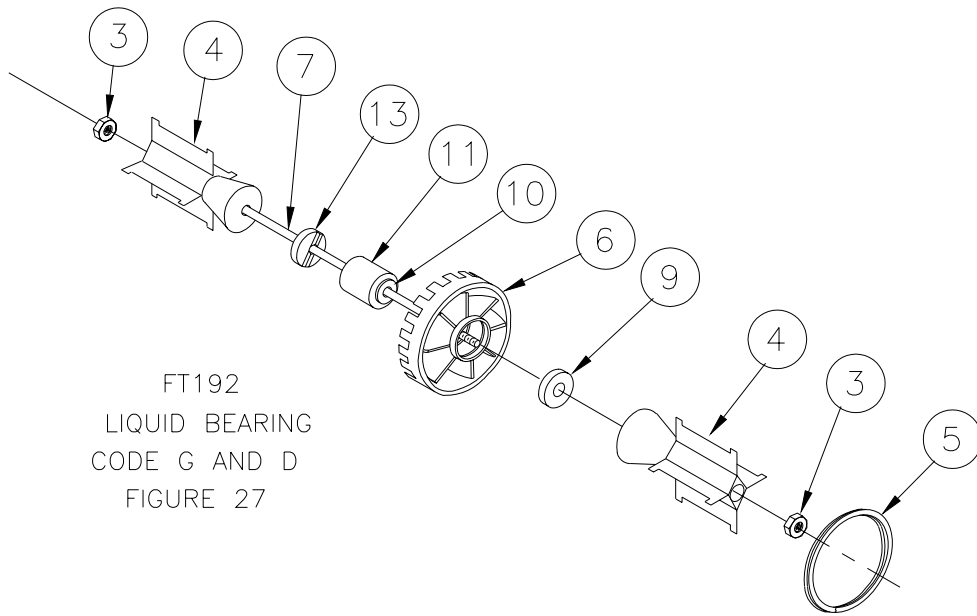


FT-32  
LIQUID BEARING CODE E  
FIGURE 23



FT-40, FT-48, FT-64  
LIQUID BEARING  
CODE G AND D  
FIGURE 24





FT192  
 LIQUID BEARING  
 CODE G AND D  
 FIGURE 27