



TS Series

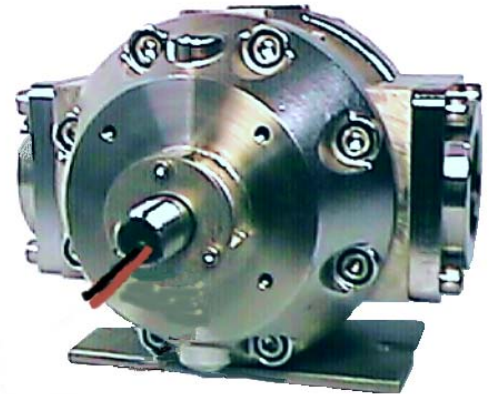
S & E... assy.

316 Stainless Steel,
Electronic Output

Manual FPPMS12, Rev. 2008-03

Installation, Operation & Parts Manual

Flow meter P/No.: _____
Flow meter S/No.: _____



MODEL

- TS10C**
- TS15C**
- TS20C**
- TS30C**

Register

- none**
- set up for: _____
- ELNC**
- EMR³**
- EPSON Printer**
- other: _____

Register components are supported with separate manuals, also supplied with the flow meter.

Accessories

- none**
- Strainer, standard**
- Air Eliminator**
- 1-stage Solenoid Valve**
- 2-stage Solenoid Valve**



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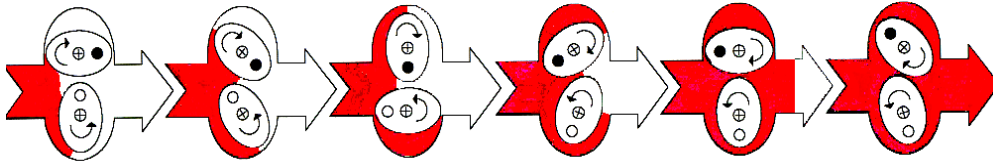
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Name of Distributor who supplied this flow meter: _____

Phone number for Distributor Service Department: _____

TS Series, Principle of Operation



- Only 2 moving parts.
- Patented 'Waveform' oval gears = sustained accuracy with a minimum of maintenance.
- No metal-to-metal contact in measuring chamber or in bearings.
- The lowest differential pressure values amongst rotary PD meters.

=> **Lower Cost of Ownership!**

About FPP Meters

We thank you for purchasing an **FPP Meter** for liquid measurement service. **FPP Meters**, formerly Fluid Power Products, is now a trade name of Tuthill Transfer Systems. FPP was established in 1980. Since its inception, the company has been dedicated to manufacturing cost-effective, high performance flow metering devices for petroleum, industrial, commercial and municipal service.

Our facilities include computerized order entry and inventory control, so that you are assured of accurate and prompt deliveries. Furthermore, our production personnel ensure that each order, regardless of size, receives individual attention.

Constant attention to new product development and production design, our high standards of manufacture and final testing are the reasons why **FPP Meters** meet your most demanding requirements. With the 'Waveform' oval gear (2003 patent) meter accuracy is better than ever before.

Our meters are used in batching, blending, process control and to dispense fluids in liquid handling facilities throughout the World. Service includes gasohol blends, bio-diesel and special formulation racing fuels.

Principle of Operation

Positive Displacement meters have a measuring chamber, where inlet & outlet are separated by rotors, a rotating element or sliding vanes. As the liquid passes through the flow meter, it causes the rotors/element/vanes to turn, which forms the basis for volumetric measurement.

The **Oval Gear** metering principle is based on two elliptical (oval) gears, which turn on center on two horizontal shafts inside a measuring chamber formed by two overlapping cylinders. The oval gears have meshing teeth along their entire circumference, ensuring that the gears will maintain correct position in relation to each other at all times, without the use of timing gears.

The volume being transferred from the inlet to the outlet side (= volume measured), forms between the oval gear and the side of the measuring chamber, alternately in the upper and the lower half of the measuring chamber.



In a full 360° rotation of the gears, four such known volumes are released to the downstream side of the flow meter.

With precision machining and close internal tolerances, the slippage is minimal for superior linearity (accuracy) over a broad turn-down ratio. Oval gear meters are largely unaffected by changes in liquid viscosity.

The TS Series meter is designed to provide:

- **V●● Assy:** Drive to a mechanical register, including RAD adaptor for the register.
- **E●● Assy:** Electrical pulse signal to an electronic register, including RAD adaptor for installation of the electronic register.
- **S●● Assy:** Electrical pulse signal to a remote electronic register.

In the two electronic versions, the flow meter is 100% glandless with static O-ring seals only. An internal magnet wheel with 4, 6 or 12 poles turns on a shaft mounted on the gear plate. As each pole passes by the tip of the pulser (Hall Effect, Quadrature Hall Effect or Reed Switch type), a square wave pulse signal is generated.

Standard signal from the Hall Effect pulser is a digital current sinking output. When a sourcing signal is required, add the PIA-300 signal conditioner.

Fluid Compatibility

FPP Meters flow meters are available in anodized aluminum and stainless steel, with a variety of rotor types and seals, to ensure compatibility with a broad range of liquids. If in doubt about compatibility with a specific fluid, please refer to the **FPP Technical Manual**. If that publication does not provide a clear answer, please consult with your authorized FPP Meter distributor, or Customer Care at the factory.

Do not change service liquid, without consulting with your authorized FPP Meter distributor.

Installation, Start-Up & Operation

SAFETY INSTRUCTIONS

Make sure that all necessary safety precautions have been taken, including proper clothing, personal safety equipment and fire safety equipment if required.

Before Start-Up of the Flow Meter, **make certain** that:

1. The meter is properly mounted, secured and piped.
2. All connections are tight.
3. All bleed and drain valves are closed.
4. Do NOT smoke near meter, or use meter near an open flame, when metering flammable liquids. Fire or Explosion could result.
5. This meter is not intended for use on liquids, which require 3A Sanitary equipment for human consumption. It may be used on edible liquids, which do not spoil easily, such as vegetable oils, liquid sweeteners & similar.

Install the Flow Meter and Accessories in compliance with all applicable Local, State & Federal Construction, Electrical and Safety Codes.

OPERATING TEMPERATURE

TS Series assemblies are rated for:

- F●● assy See register temperature rating
- W●● assy -40°F/+225°F (-40°C/+107°C).

However:

- They are not suitable for cryogenic service.
- When operating temperature exceeds +120°F (+50°C), pressure rating is reduced. Please refer to FPP Technical Manual for details.

OPERATING PRESSURE

Maximum **non-shock** Operating Pressure is:

- Flow Meter/Strainer : 400 PSI (28 BAR) } at 100°F
- Air Eliminator/Valves: 150 PSI (10 BAR) } (= +38°C)

The flow meter should never be operated in excess of this pressure. Care should be taken to eliminate thermal and hydraulic shock conditions, so that system pressure never exceeds Maximum Working Pressure rating.

Installation

- Protective caps installed in flow meter flanges prior to shipment should remain in place until you are ready to install in the piping system.
- Positive Displacement meters are designed to operate full of liquid. The meter should be installed in a manner, so that it **remains full of liquid at all times**.

The flow meter is not designed to operate on air, but the design and materials of construction allow for operation on vapor *for short periods of time* without damage to the oval gears or flow meter internals.
- **Hydraulic shock** can be harmful to flow meter and other system components. Consideration to eliminate hydraulic shock should be given in selection of pump and design of the piping system.
- Flow meters are designed to withstand a certain level of **vibrations**, such as might be experience on retail delivery tank trucks. If the flow meter will be used in a system with higher levels of vibration, it must be protected with:
 - Vibration isolating pad under the mounting pedestal.
 - Vibration isolators (flexible hose) on both inlet & outlet.
- The flow meter can operate with liquid going Left-to-Right, Right-to-Left or Vertical Up, but it must be installed with **rotor shafts in horizontal position** (= with vertical end covers). Failure to observe this will impact negatively on flow meter accuracy.
- It is recommended that a **Strainer** be installed upstream of each flow meter, to prevent damage from foreign matter, such as welding slag, pipe scale or parts breaking off other equipment.

- Allow adequate space for removal of strainer basket cover, so strainer basket can be cleaned.
- If no fluid is specified, strainer basket comes standard with 40 mesh. We also offer:
 - 20 mesh for high viscosity liquids, such as heavy fuel oil, automotive lube oils, liquid sugars, molasses, etc.
 - 100 mesh for gasoline, alcohol & solvent service..
- Flush the system to remove all debris, scale and welding slag **prior to flow meter installation**. If this is not possible, temporarily remove rotors (oval gears), and reinstall after the system has been flushed.
- Apply pipe compound to male threads, to **install the two companion flanges**. Tighten to a position, that allows the meter to bolt to the companion flanges, free of pipe stress.
- The **meter should always be supported** by bolting firmly to a solid platform or foundation. Never use the connecting pipe as the means of support.
- When installing the flow meter, consider future maintenance of both flow meter and accessories. The meter can be serviced in place, provided block (isolation) valves are included, and adequate space allowed.
- In critical installations a **by-pass line is recommended**, so flow can continue while flow meter is being serviced.

Continued . . .

Installation, Start-Up/Operation & Direction of Flow

- When an **Air Eliminator** is included in the flow meter assembly, the strainer/air eliminator must be in horizontal position, since the air eliminator operates on a gravity principle. A few drops of liquid may be expelled when the air eliminator vents, so vent ports should be piped back to storage or to a collection tank (sloping towards the tank).
- **Thermal relief valves are recommended**, and should be installed whenever it is possible to block (isolate) the flow meter between two valves. The pressure rise in a closed system, from just a few degrees increase in temperature, can be many times normal working pressure.
- **Connections for calibration** should be provided during installation. An easy means for diverting flow into a calibration vessel (or master meter) should be considered. Refer a diagram for the suggested installation is shown below.

Start-Up & Operation

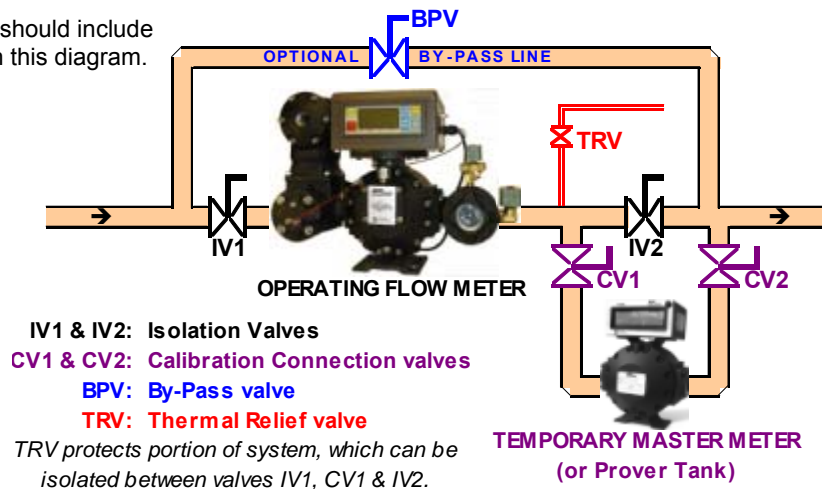
Very slowly fill the system with liquid, to avoid operating the flow meter on air or vapor. This can be accomplished in the following manner:

1. Throttle the meter inlet valve, and allow the system to fill slowly by gravity.
2. Crack open the outlet valve. Start the pump, and then slowly crack open the inlet valve, filling the meter slowly before fully opening the inlet and outlet valves.

In normal operations:

- Avoid sudden changes in temperature.
- Avoid sudden changes in flow rate.
- Gradually increase or decrease the flow rate.

The optimum flow meter installation should include the components & features shown in this diagram.



- Normal Operation : BPV, CV1 & CV2 closed
 Service/Maintenance : IV1 & IV2 closed (by-pass open)
 During Calibration : IV2 & BPV closed, other valves open

Reversing Direction of Flow

When a flow meter has been ordered for Left-to-Right flow, but Right-to-Left is found to be more practical, the flow meter can be re-assembled in the field.

The electronic flow meter can operate in either direction. However, if the electronic register is utilizing the quadrature pulse signal, the leads must be reconnected to reflect the change in direction of flow.

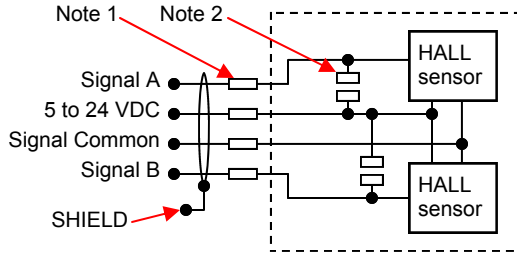
The strainer (with or without air eliminator) can be transferred to the other side of the flow meter.

Solenoid valves can be moved to the other side of the flow meter without any further modifications.

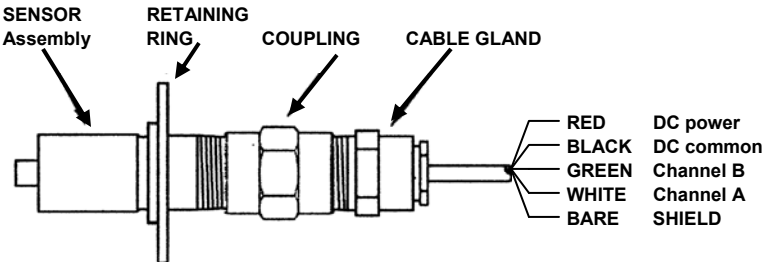
TS Series - Pulse Pick-Ups

Hall Effect Sensor (standard pulser)

**FLAME PROOF RATED SENSORS EEx d FOR ZONE 1 APPLICATIONS.
ExII 2 G CE0344 EEx d IIA T4 ITS05ATEX15076X**



Notes: 1 = Cable attachment
2 = Provision for pull-up resistor



Initial installation occurs at the factory, where the sensor is installed in a flow meter. The user's manual shows the sensor in place in the flow meter. The manual includes a 'Meter Disassembly and Repair' section. See part A: Pulser O-ring or Pulser. There are no replaceable parts in the sensor assembly itself. The flow meter must be drained of fluid and depressurized before sensor replacement. The replacement sensor must be installed exactly as the original. Opening of any associated devices to disconnect and reconnect the sensor cable must be done according to safety standards applicable to the hazardous area. The cable attached to the sensor needs to be suitably protected and terminated in an ATEX approved terminal assembly, that provides the same level of protection as the sensor itself.

INTRINSICALLY SAFE RATED SENSORS FOR Cl. I, Div. 1, Grp D and Zone 0 APPLICATIONS. CD1002, UL 9HA6, DEMKO 04 ATEX0334817 EEx ia IIA T4 HALL EFFECT SENSORS

The standard meter pulser is a Hall Effect device, which may have one or two output signals. Some reed switch pulsers are available for battery powered registers. A PIA-300 pulse isolator/amplifier may be required for longer cable lengths.

- Features:**
- Digital current sinking output. For sourcing output, add PIA-300 signal conditioner.
 - Bipolar operated with alternating north and south magnetic poles.
 - Operating speed : 0-100 kHz
 - Operating temperature : -40°F to +300°F = -40°C to +150°C

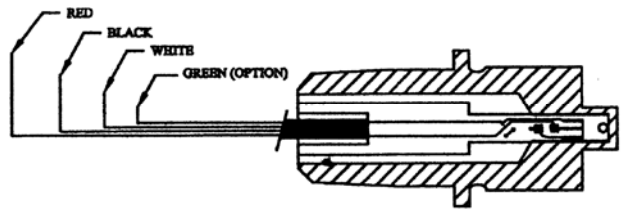
- Color Code:**
- Red = Positive 4-28VDC
 - Black = Negative (signal common)
 - White = Signal output A
 - Green = Signal output B (optional)

CAUTION
*If connected incorrectly,
The pulser will be
damaged beyond repair.*

Pull-up Resistor (R1) The pull-up resistor provides the necessary voltage and current levels to guarantee a logic-1 level, whenever the output transistor is in the 'off' state. Most sensors have internal 10K ohm pull-up resistors. Some pulse receivers have pull-up resistors. Refer to the receiver's manual.

$$\text{Pull-up resistor size (k}\Omega\text{)} = \frac{V_{\text{supply}} (4\text{-}28 \text{ VDC})}{\text{Desired Sink Current (0-}20 \text{ ma)}}$$

Supply voltage (VDC)	4 to 28
Supply current (mA max.)	13.5
Output type	sink
Output voltage (V) @ 20 ma : . .	0.40max
Output current (mA max.)	20
Leakage current (µA max.)	10
Magnetics type	Bipolar



4 conductor blue cable with 24 AWG leads, 18" (45 cm) standard

TS Series - Pulse Pick-Ups, continued

Hall Effect Sensor (standard pulser)

TESTING FOR HALL EFFECT PULSER OPERATION

There are three system components, which must be examined, to determine whether lack of pulse signal is caused by:

- The flow meter.
- The pulser.
- The electronic register.

1. Verify that there is power to the electronic register.
2. Confirm that the system is filled with liquid, and that liquid is flowing.
3. The functionality of the Hall Effect pulser can be confirmed with a volt meter and a permanent magnet. Remove the sensor from the flow meter (refer to Flow Meter - Disassembly & Repair, part A). Expose the black and white (green) wires in the sensor cable. Do this at a clean and dry location (table or service counter).

Measure the voltage between the white (green) wire, and the black wire; it should be nearly equal to the power supply voltage provided on the red wire.

Pass the magnet across the tip of the sensor. The voltage must switch to nearly zero (less than 0.2 volts). If the magnet will not actuate the sensor, then the sensor has failed. For two channel sensors, repeat the test with the green wire and the black wire.

4. If the pulser works, then the failure is in the transfer gear (10)/disc magnet (11) on the bearing/gear plate (4). This can be due to wear, or possibly due to excessive hydraulic shock conditions in the system.

Reed Switch Sensor, available with Intrinsically Safe certification

Optional pulser strictly for use with battery powered stand-alone registers. In 'pulse meter' service, either Hall Effect or Quadrature Hall Effect pulser must be used (depending upon requirements of the receiving instrument).

The Reed Switch pulser consists of a set of contacts hermetically sealed in a glass tube, protecting the contacts from dirt and corrosion of the outside world. Contacts are actuated by an external magnetic field, provided by permanent magnets in an internal multi-pole disc magnet.

Contact Rating:

- Volts DC max. : 30 VDC
- Amps DC max. : 0.01 A
- Watts DC max. : 0.25 W
- Initial Resistance : 1.0 Ω
- Operating Temperature range: -40°F to +300°F = -40°C to +150°C
- D-Must Operate : 0.125" (3.2 mm)
- D-Must Release : 0.400" (10.2 mm)
- Cable specifications : 24 AWG, 18" (45 cm) leads std.,
2 conductor (Red & Black)



TESTING FOR PULSER OPERATION - ***WARNING: Do Not use an Ohm-Meter to test the Reed Switch Sensor***

Remove the sensor from the flow meter (refer to Flow Meter - Disassembly & Repair, part A). Expose the red and black wires. Do this at a clean and dry location (table or service counter), or at the electronic register. Measure the voltage between the red and black wires. It should be equal to the voltage provided by the register. Pass a magnet across the tip of the sensor, and observe that the voltage switches to zero (less than 0.2 volts). If the magnet cannot activate the switching of the sensor, then the sensor has failed.

Flow Meter Calibration

TS Series meters in E●● & S●● assembly have an internal pulser. The pulse signal generated by the flow meter, can be fed directly to most electronic registers. In such assemblies, flow meter calibration (or re-calibration) is through correction of the K Factor (number of pulses/unit volume) in the electronic register.

In some cases, an optional signal conditioner is added on the pulse signal:

PIA-300 pulse isolator/amplifier/splitter

- Provides 2 identical signals out, sinking or sourcing.
- Required when signal travels more than 100' (30 m).
- Recommended if signal goes to non-FPP electronics.

SCL pulse scaler/calibrator/linearizer

- If pulse frequency exceeds register capacity at maximum flow rate. This can occur at surprisingly low flow rates (see below).
- If electronic register requires a scaled pulse value (1, 10, 100 or 1000 pulses/volume unit).
- If local authorities demand a mechanical calibration device. The SCL includes two dials with setting from 00 to 99. Changing the setting by 1 unit, represents approx. 0.03% correction to the pulse signal.

Register model:	ELNC	EMR³	LCR-II™
Frequency limit:	400 Hz	1667 Hz	1500 Hz

Pls consult with register manufacturer for other registers

METER MODEL	GPM	PPG	LPM	ppl	Frequency at 100% of model capacity.
TS10C	40	136	150	35.9	=> 91 Hz
TS15C	60	108	230	28.5	=> 108 Hz
TS20C	100	101	380	26.7	=> 168 Hz
	150	72	570	19.0	=> 180 Hz
TS30C	200	51	760	13.5	=> 170 Hz
<i>Interm. duty</i>	250		945		=> 213 Hz
<i>Interm. duty</i>	300		1135		=> 255 Hz

Flow Meter Calibration

All TS Series meters are accuracy tested prior to shipment. Data from accuracy testing is not supplied with flow meters, since results achieved on our test fluid do not apply to actual liquid of operation, unless the two liquids have identical viscosity characteristics.

When calibrated on a liquid with 1 cP viscosity, if the flow meter is not field recalibrated on actual liquid of service, we expect that the flow meter will be:

- Under by 1-2% on a liquid with 0.5 cP viscosity.
- Over by 0.35% to 0.6% on a liquid with 10 cP viscosity.
- Over by 0.7% to 1.2% on a liquid with 100 cP viscosity.

The accuracy curve will not shift significantly at higher viscosities, even if the actual operating liquid has viscosities up to 500,000 cP.

These shifts in the accuracy curve illustrate the need for field recalibration of new flow meters after installation in place of service.

Frequency of Calibration

If the flow meter is used in Custody Transfer service (subject to Weights&Measures regulations), it must obviously be re-calibrated in accordance with local W&M regulations. In most cases these regulations call for annual re-calibration, though different time periods apply in some territories.

If the user is ISO9000 certified, user ISO standards will indicate frequency of re-calibration for instrumentation. Those rules should be observed.

If neither W&M regulations, nor internal standards apply, our recommendations are:

- Calibrate immediately after installation.
- Re-calibrate after 15-30 days.
- Re-calibrate after 180 & 360 days.

After the run-in calibration (B) and follow-up calibrations (C), it is possible to evaluate degree of change under normal operating conditions. Based on values found, and total volume being metered under normal operating conditions, decide whether a 6, 12 or possibly 24 month schedule should be adopted.

Procedures & Methods

Flow meters subject to Weights&Measures regulations, or used in systems where the flow rate can fluctuate, should be tested at minimum, intermediate & maximum flow rates. In non-W&M service, a flow meter always operating at a steady flow rate, can be tested at that flow rate only.

All calibration tests should be:

- Of at least 60 second duration, to minimize the effect of flow meter error during start-up and shut-down.
- Repeated 3 times to confirm flow meter repeatability.

Flow meters can be calibrated against a prover tank, a pipe prover, a master meter or a scale. Please consult with your distributor and/or local regulatory agencies to determine methods available (or required).

When X = known volume dispensed, and Y = volume shown on the register, use this formula to calculate the correction required:

$$\frac{X - Y}{X} \times 100 = \% \text{ correction}$$

When the register is showing **less** than the volume actually dispensed, the K Factor (number of pulses/unit of volume) must be **decreased** accordingly. This is programmed in the register, or possibly corrected via the mechanical calibrator if the SCL signal conditioner is included in the assembly.

Repeat the test 2-3 times, to confirm flow meter accuracy and repeatability.

If calibration is now correct, enter % correction on the permanent flow meter record, and re-seal the flow meter.

Flow Meter Specifications

Model Nominal Pressure Rating¹ at 100°F (38°C):

Flow Meter²	400 PSI	28 BAR	2750 kPa
Strainer²	400 PSI	28 BAR	2750 kPa
Air Eliminator	150 PSI	10 BAR	1035 kPa
Solenoid Valve	depends upon valve type/model		

- (1) Pressure rating is reduced at higher operating temperatures.
 (2) With optional 150# RF ANSI flanges pressure rating is 285 PSI = 20 BAR = 1965 kPa.

Model Nominal Temperature Rating:

Design temperature:	-40°F/+300°F	-40°C/+150°C
Pulsar ATEX listing :	-4°F/+140°F	-20°C/+60°C

If the operating temperature can exceed +120°F (+50°C), use high temperature (HT) rotors, code L (or M).

Model Nominal Capacity on low viscosity liquids (1 cP):

TS10C	40 GPM	150 lpm	9 m ³ /h
TS15C	60 GPM	230 lpm	14 m ³ /h
TS20C	150 GPM	570 lpm	34 m ³ /h
TS30C	250 GPM	1000 lpm	60 m ³ /h

- Optimum performance (accuracy & service life) is between 50% and 85% of nominal capacity.
- On low viscosity, lubricating liquids, intermittent service to 125% of nominal capacity is acceptable.
- NTEP approvals are with 5:1 turn-down.
- OIML approvals are with 10:1 turn-down.
- Meters may be used at lower flow rates, but meter error increases below 10% of capacity on low viscosity liquids.
- On higher viscosity liquids, error at low flow rates diminishes progressively. Over 100 cP performance should be acceptable to 3-5% of capacity, over 1000 cP performance should be acceptable to 1-2% of capacity.

Liquid Viscosity³:

With standard LV rotors, meters may be used to full nominal capacity up to 300 cPs (1500 SSU). When viscosity can exceed 300 cPs (1500 SSU), high viscosity (HV) rotors, code I (or J) are strongly recommended.

With HV rotors, meters may be used to full nominal capacity up to 1000 cPs (4700 SSU). In high viscosity service, flow meter capacity is reduced according to this table:

		Flow Meter Coefficient						Liquid Viscosity	
		Standard			Teflon brgs.				
		Rotor Code			Rotor Code				
Liquid Viscosity	cP	B	L	I	C	M	J	SSU	
		1	1.00	1.00	1.00	1.00	1.00		1.00
10	1.00	1.00	1.00	1.00	1.00	1.00	60		
50	1.00	1.00	1.00	1.00	1.00	1.00	240		
100	1.00	1.00	1.00	1.00	1.00	1.00	475		
200	1.00	1.00	1.00	0.90	0.90	1.00	925		
300	0.86	0.86	1.00	0.73	0.73	0.98	1,425		
400	0.77	0.77	1.00	0.62	0.62	0.96	1,875		
500	0.71	0.71	1.00	0.57	0.57	0.94	2,350		
600	0.66	0.66	1.00	0.53	0.53	0.92	2,825		
700	0.63	0.63	1.00	0.50	0.50	0.90	3,300		
800	0.60	0.60	1.00	0.48	0.48	0.85	3,775		
900		0.56	1.00		0.45	0.80	4,250		
1,000		0.54	1.00		0.43	0.75	4,725		
5,000			0.53			0.42	23,600		
10,000			0.41			0.32	47,200		
100,000			0.11			0.09	472,000		
1,000,000			0.05			0.04	4,720,000		

- (3) Teflon bearings are used primarily on shear sensitive liquids, such as many resins & adhesives.

Meter body & covers:

316 (CF8M) Stainless Steel

Carbon	0.08%
Manganese	1.50%
Phosphorous	0.04%
Sulfur	0.04%
Silicon	1.50%
Chromium	18.0-21.0%
Nickel	9.0-12.0%
Molybdenum	2.0-3.0%
Iron	remainder

Shafts for oval gears:

316 Stainless Steel

Carbon	0.10% max.
Manganese	2.0% max.
Silicon	1.0% max.
Chromium	16.0-18.0%
Nickel	10.0-14.0%
Molybdenum	2.0-3.0%
Iron	remainder

Rotors : PPS (polyphenylene sulfide resin), carbon bearings standard, Teflon™ bearings optional

Rotor shafts : HC316SS

Internal fasteners: 300 Series SS

Seals : Teflon™ standard,

Trouble Shooting the Flow Meter

Installation, Maintenance & Service must be performed by personnel:

A. Qualified to work on this type of equipment.

B. Familiar with all applicable local codes and ordinances covering the type of service, where the flow meter is used (gasoline, LPG, etc.).

Purpose

This high accuracy electronic positive displacement flow meter is designed to provide reliable liquid measurement with a minimum of service requirements.

Functionality

The liquid moves the rotors, which in turn drive a multi-pole disc magnet. Each 360° turn of the magnet generates 4, 6 or 12 pulses depending upon flow meter model, Quadrature or single channel.

Assembly

The flow meter can be assembled for Left-to-Right, Bottom-to-Top or Right-to-Left flow. The flow meter performs equally well in all directions. When Quadrature pulse signal is used, it might be necessary to reverse leads if used for a different flow direction from that originally intended.

Installation: See page 1.4

Maintenance

Electronic TS Series flow meters have no parts, which require replacement in the short term. The flow meter should be re-calibrated periodically, and when meter wear factor increases beyond the norm, the rotors should be replaced.

During service, also inspect the transfer gear/disc magnet for wear. If worn, replace as a set.

Trouble Shooting & Service

Prior to opening or disassembly of any flow meter, all internal pressure must be relieved and all liquid must be drained. This must be done in accordance with applicable company and local codes & ordinances.

Make sure that all necessary safety precautions have been taken, including proper clothing, personal safety equipment and fire safety equipment if required.

No Flow

- Blocked strainer basket. Clean the basket.
- Faulty or non-functioning pump. Repair pump.
- Valve stuck in closed position. Check and repair valves.
- Flow meter 'frozen' due to build-up of chemical salts (or frozen water) inside the measuring chamber. Clean the flow meter (see page), and inspect for damage.
- Meter jammed on a particle that has passed through a damaged strainer basket. Remove particle and replace rotors if necessary, replace strainer basket.

Reduced Flow Rate

- Strainer basket partially blocked. Clean the basket.
- Pump not functioning correctly. Repair pump.
- Valve stuck in partially closed position. Check valves and repair.
- Meter rotors (oval gears) partially 'salted' with chemical deposits, slowing the movement. Clean the meter (see page).

Product Flows, but the register does not record

- Check power supply to the register.
- Check the connections between the pulser and the electronic register.
- Check pulser output. Replace pulser (or SCL) if needed.
- If product is flowing, and the flow meter is generating a pulse signal, the problem is in the electronic register. Please refer to the manual for the electronic register.

Product Flows, register does not record correctly

If the **error factor is constant**, the flow meter is fine. The likely cause is either:

- Incorrect K Factor in the electronic register. Re-calibrate the meter and correct the K Factor.
- A constant problem with air getting into the system. Review system design and control valves.

If the **error is random**, the likely cause is either:

- Poor cable connections (insulation not trimmed, or stray strands getting close to incorrect contacts). Inspect and correct connections as necessary.
- Valve leaking, allowing a portion of the system to drain. Check & repair valves.
- An intermittent problem with air in the system, combined with inadequate air elimination. Review system design and control valves.
- Interference from other electrical equipment nearby, possibly combined with sub-standard cables.

Breaking Teeth on Rotors (Oval Gears)

This is a sign of hydraulic shock conditions in the system. Common sources:

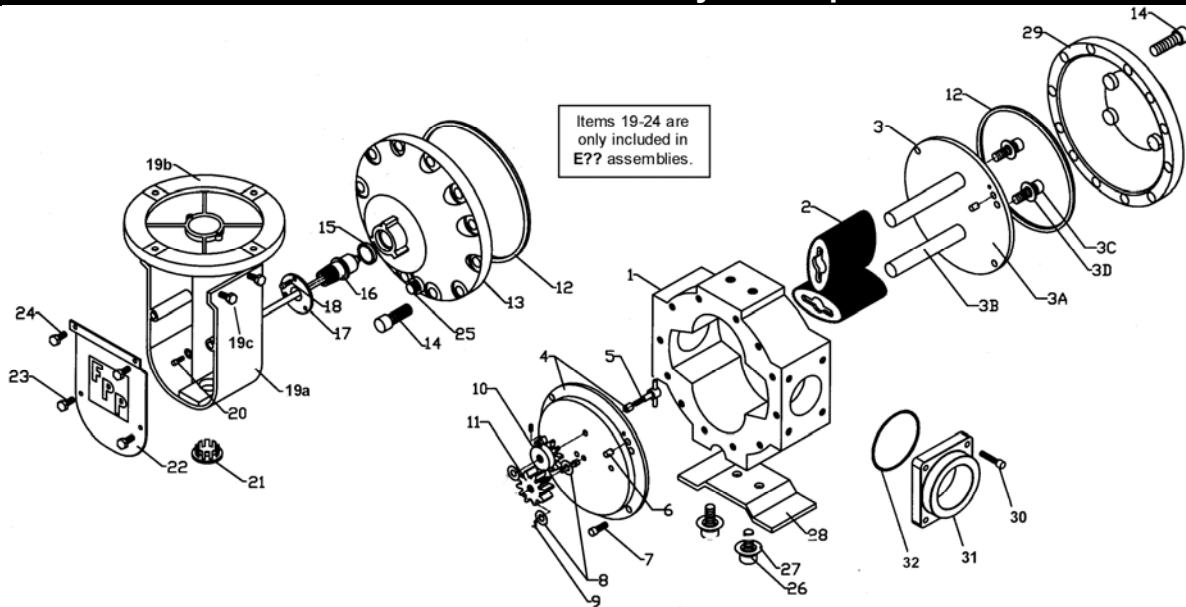
- Starting or stopping flow too rapidly. Replace damaged components and **correct operational practices**.
- Pump by-pass not adjusted properly. Re-adjust as necessary.

Leakage from End Covers

The seals (and possibly end covers) have been damaged due to excessive pressure. There are two possible sources:

- Starting or stopping flow too rapidly. Replace damaged components and **correct operational practices**.
- The flow meter is in a system, where it can be isolated between two valves. Add a Thermal Relief Valve to bleed off excess pressure when the temperature rises.

Flow Meter - Disassembly and Repair



Installation, Maintenance & Service must be performed by personnel:

- A. Qualified to work on this type of equipment.**
- B. Familiar with all applicable local codes and ordinances covering the type of service, where the flow meter is used (gasoline, LPG, etc.).**

Avoid pipe strain and stress when making flow meter repairs. The weight of the pipe and the flow meter must be supported independently. This allows the flow meter to be serviced without affecting the alignment of piping.

Avoid prying or exerting heavy pressure on precision parts, as this can affect the performance of the flow meter. Assure that all machined parts are free of burrs and nicks. Stone all machined surfaces if necessary to remove burrs.

Always coat bolt threads with an anti-seize or an appropriate lubricant. This prevents thread damage, and assures that proper torque values are applied during re-assembly.

If threads are damaged, repair using inserts.

**Relieve All Internal Pressure Prior to Opening
Drain Liquid prior to Working on Flow Meter
(drain plug = #25)**

Rinse with Neutral Liquid prior to Seasonal Storage

**Triple Rinse with Neutral Liquid
prior to Shipment for any reason.**

Servicing the Electronic Flow Meter

There are only 5 parts or components, which will require inspection and/or replacement at some point. In the order they are likely to occur, these are:

Regular Maintenance (1-3 years)

- A. Pulsar O-ring (15)

Very Long Term Wearing Components (3-10 years)

- B. Transfer Gear/Disc Magnet repair kit (10 & 11)
- C. Oval Gears (2)

Longest Term Wearing Components (5-20 years)

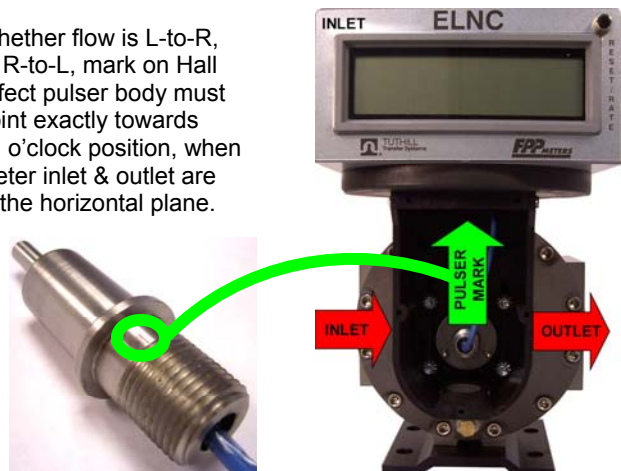
- D. Post Plate assembly (3, a-d)
- E. Bearing/Gear Plate (4)

Electronic Components

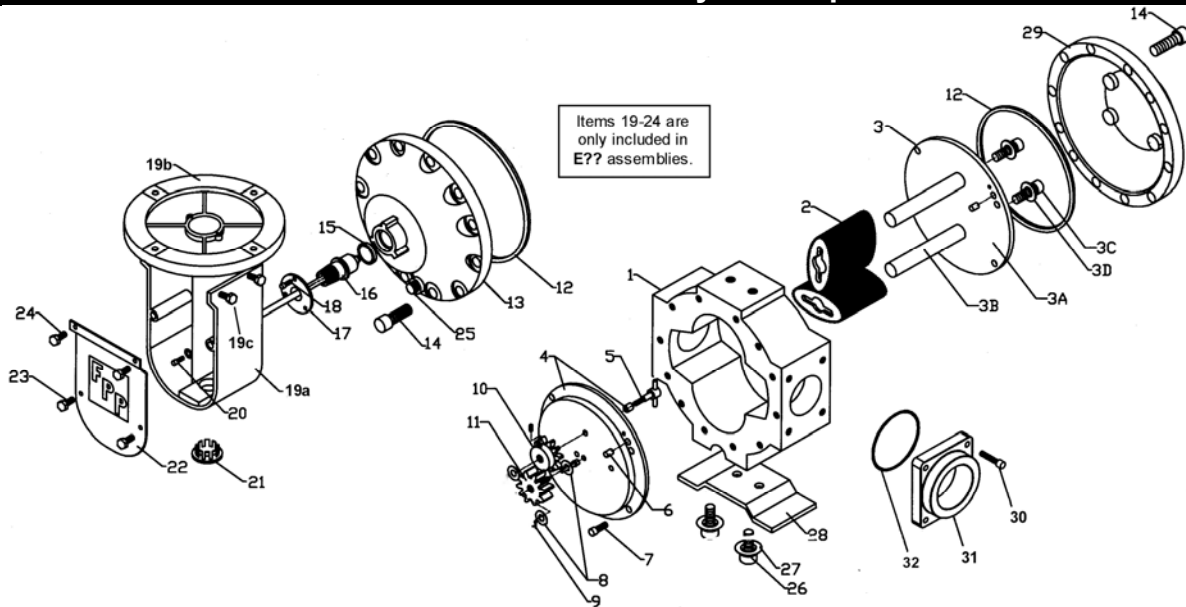
The electronic components have an indefinite life expectancy, but can fail if the system is wired incorrectly, poorly grounded, or cables used are not to minimum standard required.

While we do not expect that these components will need replacement, instructions are provided in case it should become necessary. **Any time a pulsar has been removed or replaced, it is critical, that it be aligned correctly when re-installed:**

Whether flow is L-to-R, or R-to-L, mark on Hall Effect pulsar body must point exactly towards 12 o'clock position, when meter inlet & outlet are in the horizontal plane.



Flow Meter - Disassembly and Repair



A. Pulsar O-ring (15), or Pulsar (16)

First relieve system pressure and drain the flow meter.

1. If included, remove 4 screws (**23 & 24**) from the dust cover (**22**), and detach the dust cover.
 2. Remove 3 retainer screws (**18**), and detach the retainer (**17**). The pulsar (**16**) can now be removed, so the O-ring (**15**) can be replaced. The pulsar can be placed at this time if necessary.
- Reassemble in reverse order, checking all O-ring seals for damage. Make sure that the pulsar is installed with mark in 12 o'clock position and that seal plug (**25**) is replaced and securely tightened.

B. Transfer Gear/Disc Magnet (10 & 11, repl as set)

C. Oval Gears (2)

E. Bearing/Gear Plate assembly (4)

First relieve system pressure and drain the flow meter.

1. If included, remove 4 screws (**23 & 24**) from the dust cover (**22**), and detach the dust cover. Next remove the pulsar as above; finally remove 4 screws (**20**) while supporting the register, and detach the RAD adaptor/register as a complete assembly.
2. Remove front cover screws (**14**), and take the front cover off. Discard the old cover O-ring (**12**). You now have access to the bearing/gear plate assembly (**4**).
3. All the parts required to replace the transfer gear (**10**) & the disc magnet (**11**) are supplied in a replacement kit (see parts list). If the bearing is worn, replace the bearing/gear plate assembly (**4**) also.
4. Remove 4 screws (**7**) from the bearing/gear plate assembly (**4**). If it does not slip free, gently tap with a rubber mallet, or use a 5/16-8 x 1" jack blot to push it free.
5. Once the bearing/gear plate assembly (**4**) is removed, you can inspect, remove and/or replace the oval gears (**2**). Before removing the oval gears, make a mark across

both gears with a soft pencil for easy alignment when re-installing the gears.

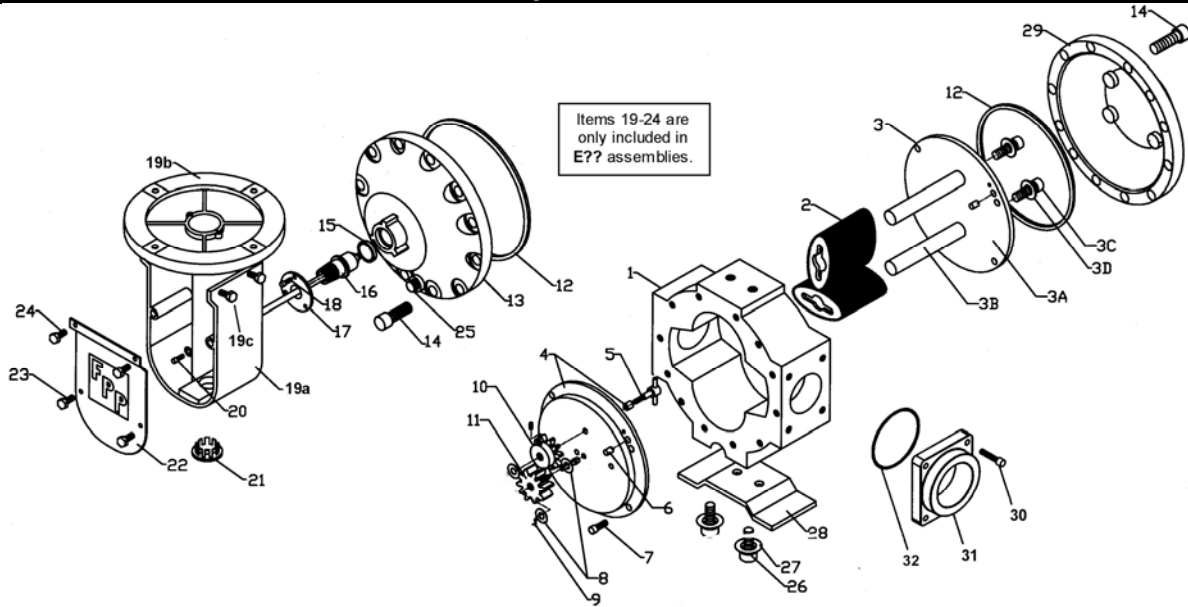
6. When re-installing the oval gears (**2**), place the upper gear so that the slot for the coupling is horizontal.
7. Align the coupling in the bearing/gear plate (**4**), so that the coupling is horizontal. Replace bearing/gear plate assembly on dowel pins (**6**); reattach with 4 screws (**7**).
8. Replace cover O-ring (**12**), and reattach front cover (**13**), pulsar (**16**) and drain plug (**25**).
9. If included, re-attach RAD adaptor (**19**) with register, replace the dust cover (**22**) and re-seal the flow meter assembly..

D. Post Plate assembly (3)

First relieve system pressure and drain the flow meter.

1. Remove cover screws (**14**) from flow meter rear cover (**29**), and take the rear cover off. Discard the old cover O-ring (**12**).
2. Remove 4 screws (**7**) from the post plate assembly (**3**), and pull the post plate assembly straight back. If the post plate assembly is stuck to meter body, gently tap with a rubber mallet, or use a 5/16-8 x 1" jack bolt to push it free. **Do not use a hammer on the posts!**
3. Inspect the inside of the post plate assembly (**3**) for scoring (minor markings are acceptable). If the post plate assembly is scored, or posts are worn, it must be replaced as a complete assembly.
4. Re-assemble in reverse order. Attach the post plate assembly (**3**) to meter housing (**1**); it must attach to the side marked with a dimple on the flat side. Align on dowel pins (**6**) and fasten with 4 screws (**7**).
5. Next replace rear cover O-ring (**12**), and re-install the rear cover (**29**). Make sure that the drain plug (**25**) is located at the bottom of the flow meter and that it is securely fastened.

TS Series - Exploded View, Electronic



Torque & Tool Chart

ITEM	DESCRIPTION		TS10C	TS15C	TS20C	TS30C
23	Dust cover screw	Tool	1/4" nut driver	1/4" nut driver	1/4" nut driver	1/4" nut driver
24			Hand tight	Hand tight	Hand tight	Hand tight
18	Retainer plate screw	Tool	Impact Battery Tool	Impact Battery Tool	Impact Battery Tool	Impact Battery Tool
	Torque specification		8/32 19.8in-lbs	8/32 19.8in-lbs	8/32 19.8in-lbs	8/32 19.8in-lbs
14	Cover screw	Tool	1/4" Allen	1/4" Allen	5/16" Allen	5/16" Allen
	Torque specification		5/16-18 132in-lbs	5/16-18 132in-lbs	3/8-16 236in-lbs	3/8-16 236in-lbs
7	Post/Bearing plate screw	Tool	5/32" Allen	5/32" Allen	5/32" Allen	5/32" Allen
	Torque specification		10/32 31.7in-lbs	10/32 31.7in-lbs	10/32 31.7in-lbs	10/32 31.7in-lbs
26	Pedestal screw	Tool	Build-in pedestal	Impact Battery Tool	Impact Battery Tool	Impact Battery Tool
	Torque specification		N/A	1/4-20 75.2in-lbs	3/8-16 236in-lbs	3/8-16 236in-lbs
25	Cover drain plug	Tool	1/4" Allen	1/4" Allen	1/4" Allen	1/4" Allen
	Torque specification		Hand tight	Hand tight	Hand tight	Hand tight
30	Companion flange screw	Tool	5/16" Allen	1/4" Allen	5/16" Allen	N/A
	Torque specification		3/8 236in-lbs	5/16-18 132in-lbs	3/8 236in-lbs	



Parts Lists – TS10C, TS15C, TS20C & TS30C

Parts Lists

		TS10C		TS15C		TS20C		TS20C		TS30C	
		Single piece rear cover & body		2.95" 75 mm		3.19" 81 mm		3.46" 88 mm		4.96" 126 mm	
		40 GPM 150 lpm		60 GPM 230 lpm		100 GPM 380 lpm		150 GPM 570 lpm		200-250 GPM 760-1000 lpm	
Item	DESCRIPTION	qty	Part No.	qty	Part No.	qty	Part No.	qty	Part No.	qty	Part No.
1	Meter Body & Post assy.	1	MB9320								
	Meter Body			1	MB8580	1	MB9310	1	MB9200	1	MB9350
2	Std. Gear set , PPS/carbon, LV code B	1	GS560RC	1	GS580RC	1	GS590RC	1	GSTS2HRC	1	GS5201RC
	Opt. PPS/carbon, HT code L		GS560RC-MV		GS580RC-MV		GS590RC-MV		GSTS2HRC-MV		GS5201RC-MV
	PPS/carbon, HV code I		GS560RC-HV		GS580RC-HV		GS590RC-HV		GSTS2HRC-HV		GS5201RC-HV
	PPS/Teflon™, LV code C		GS560RT		GS580RT		GS590RT		GSTS2HRT		GS5201RT
	PPS/Teflon™, HT code M		GS560RT-MV		GS580RT-MV		GS590RT-MV		GSTS2HRT-MV		GS5201RT-MV
	PPS/Teflon™, HV code J		GS560RT-HV		GS580RT-HV		GS590RT-HV		GSTS2HRT-HV		GS5201RT-HV
3	Post Plate assembly		none	1	CP9852-1	1	CP90601	1	CP90602	1	CP90521
4+5	Gear/Bearing Plate assembly	1	CP9853-1	1	CP9853-1	1	CP93161	1	CP93161	1	CP93161
8	Washer										
9	Cotter pin										
10	Transfer Gear		RKGP04		RKGP06		RKGP12		RKGP12		RKGP12
11	Multi-pole disc magnet										
6	Dowel pin	2	MS9021	4	MS9021	4	MS9021	4	MS9021	4	MS9021
7	Screw, for post plate & gear plate	4	FS9654	8	FS9654	8	FS9654	8	FS9654	8	FS9654
12	O-ring, front & rear cover, Teflon™	1	SL2157	2	SL2157	2	SL2167	2	SL2167	2	SL2167
13	Front cover	1	CP9560	1	CP9560	1	CP9399		CP9400	1	CP9400
29	Rear cover		none	1	CP9561	1	CP9398		CP9401	1	CP9401
14	Cover screws	8	FS9901	16	FS9901	24	FS2928	24	FS2928	24	FS2928
15	Pulser O-ring, Teflon	1	SL2212	1	SL2212	1	SL2212	1	SL2212	1	SL2212
16	Std. Hall Effect pulser	1	EL5569-HE	1	EL5569-HE	1	EL5598-HEHT	1	EL5201SSHE-50F	1	EL5201SSHE-50F
	Opt. Reed Switch pulser		EL5569-RS		EL5569-RS		EL5598-100-RS		EL5201SSRS-50F		EL5201SSRS-50F
17	Retaining plate, pulser	1	MP9061	1	MP9061	1	MP9061	1	MP9061	1	MP9061
18	Screws, pulser retaining plate	3	FS9515	3	FS9515	3	FS9515	3	FS9515	3	FS9515
25	Drain plugs	1	MS4019	2	MS4019	2	MS4019	2	MS4019	2	MS4019
26	Screws, pedestal to meter body		none	2	FS9813	4	FS9928	4	FS9928	4	FS9928
27			none		no longer used		no longer used		no longer used		no longer used
28	Meter pedestal		none	1	MP9110	1	MP9112	1	MP9116	1	MP9113
30-32	Flange kit*** (set of 2)	1		1		1		1			
	Std. NPT, stainless steel/Teflon™		FK9100		FK9150		FK9200		FK9200		none
	Opt. BSP, Anod. aluminum/Teflon™		FK9101		FK9151		FK9201		FK9201		none
	1/2" RF ANSI adaptor, SS/Teflon™		FK9104		FK9154		FK9204		FK9204		Integral
30	Screws for companion flanges	4	FS2928	8	FS9901	8	FS2928	8	FS2928		none
32	O-ring, meter comp flg., Teflon™	2	SL2122	2	SL2228	2	SL2233	2	SL2233		none

Items below are included only when flow meter P/No. has an **E** in position 6.

19	RAD adaptor (E?? assy only)	1	RD15911	1	RD15911	1	RD15911	1	RD15911	1	RD15911
20a	Screws, RAD to meter front cover	4	FS2800	4	FS2800	4	FS2800	4	FS2800	4	FS2800
20b	1/4" external lockwasher	4	FS3602	4	FS3602	4	FS3602	4	FS3602	4	FS3602
21	Nylon plug	1	MS5521	1	MS5521	1	MS5521	1	MS5521	1	MS5521
22	RAD dust cover (E?? assy only)	1	MP2505	1	MP2505	1	MP2505	1	MP2505	1	MP2505
23	Screws, dust cover, plain	2	FS5912	2	FS5912	2	FS5912	2	FS5912	2	FS5912
24	Screws, dust cover, w seal wire hole	2	FS59121	2	FS59121	2	FS59121	2	FS59121	2	FS59121

* = Recommended Spare Parts (regular maintenance items).

** = Suggested Spare Parts (required over a longer time frame; should be on hand if meter is in a location where service is not readily available).

Warranty

Tuthill Transfer Systems ("Manufacturer") warrants to each buyer of its FPP Meters products (the "Buyer") for a period of 12 months from date of invoice or sales receipt, but in no event more than 18 months from date of manufacture, that goods of its manufacture ("Goods") will be free from defects of material and workmanship. Manufacturer's sole obligation under the foregoing warranties will be limited to either, at Manufacturer's option, replacing or repairing defective Goods (subject to limitations hereinafter provided) or refunding the purchase price for such Goods theretofore paid by the Buyer, and Buyer's exclusive remedy for breach of any such warranties will be enforcement of such obligations of Manufacturer. If Manufacturer so requests the return of the Goods, the Goods will be redelivered to Manufacturer in accordance with Manufacturer's instructions F.O.B. Factory. The remedies contained herein shall constitute the sole recourse of the Buyer against Manufacturer for breach of warranty. IN NO EVENT SHALL MANUFACTURER'S LIABILITY ON ANY CLAIM FOR DAMAGES ARISING OUT OF THE MANUFACTURE SALE, DELIVERY OR USE OF THE

GOODS EXCEED THE PURCHASE PRICE OF THE GOODS. The foregoing warranties will not extend to Goods subjected to misuse, neglect, accident or improper installation or maintenance, or which have been altered or repaired by anyone other than Manufacturer or its authorized representative. THE FOREGOING WARRANTIES ARE EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES OF MERCHANTABILITY, FITNESS FOR PURPOSE OF ANY OTHER TYPE, WHETHER EXPRESS OR IMPLIED. No person may vary the foregoing warranties and remedies except in writing signed by a duly authorized officer of Manufacturer. Warranties or remedies that differ from the foregoing shall not otherwise be binding on Manufacturer. The Buyer's acceptance of delivery of the Goods constitutes acceptance of the foregoing warranties and remedies, and all conditions and limitations thereof.

Tuthill Transfer Systems (TTS) warranty does not extend to damage due to corrosion, salt deposits or separation of chemicals - whether occurring during periods of operation or storage.

Non-TTS items, such as electronic registers, are covered by the original manufacturer warranty, but will be handled through TTS.

Components added after shipment from TTS, such as hose, nozzles & similar, are the responsibility of the distributor or contractor selling the installation.