FILL-RITE®

TS SERIES V ASSEMBLY ANODIZED ALUMINUM MECHANICAL DRIVE

Installation and Operation Manual

MADE IN USA
WITH GLOBAL MATERIALS

GORMAN-RUPP COMPANY

Table of Contents

Thank You!

Thank you for your loyalty to the Fill-Rite brand. Your safety is important, so please read and thoroughly understand the procedures set forth in this manual. Protect yourself as well as those around you by observing all safety instructions and adhering to all danger, warning, and caution symbols. Please save these instructions for future reference and record the model, serial number, and purchase date of your Fill-Rite meter.

IMPORTANT RETURN POLICY

For all warranty and product questions, please contact Fill-Rite Technical Support at 1 (800) 720-5192 or via email at FillRiteTech@fillrite.com (M-F, 8 AM – 5 PM ET).

MODEL #	
SERIAL #	
PURCHASE DATE:	

FILL-RITE
A GORMAN-RUPP COMPANY

About This Manual

From initial concept and design through its final production, your Fill-Rite product is built to give you years of trouble-free use. To ensure it provides that service, and to avoid injury or death, it is critical that you read this entire manual prior to attempting to install or operate your new product. Become familiar with the terms and diagrams, and pay close attention to the highlighted areas with the following labels:

⚠ DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
⚠ WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a hazardous situation which, if not avoided, could result in moderate or minor injury.
NOTICE	Indicates information considered important but not directly hazard related.

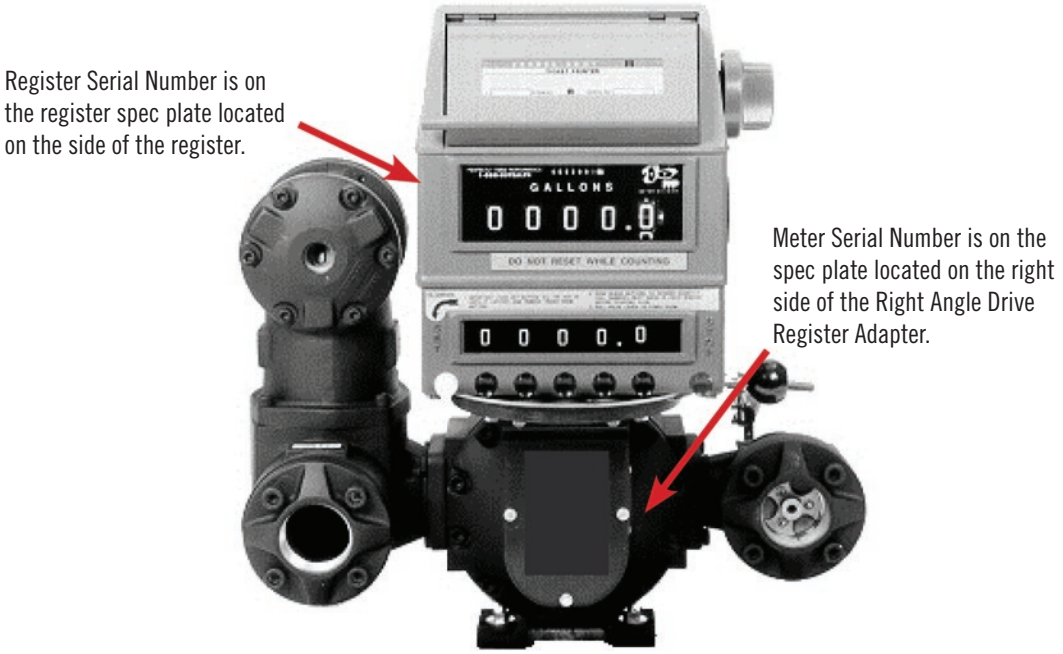
At Fill-Rite, your satisfaction with our products is paramount to us. If you have questions or need assistance with your product, please contact us at 1 (800) 720-5192 or via email at FillRiteTech@fillrite.com (M-F, 8 AM – 5 PM ET).

Flow Meter Components

Serial Number

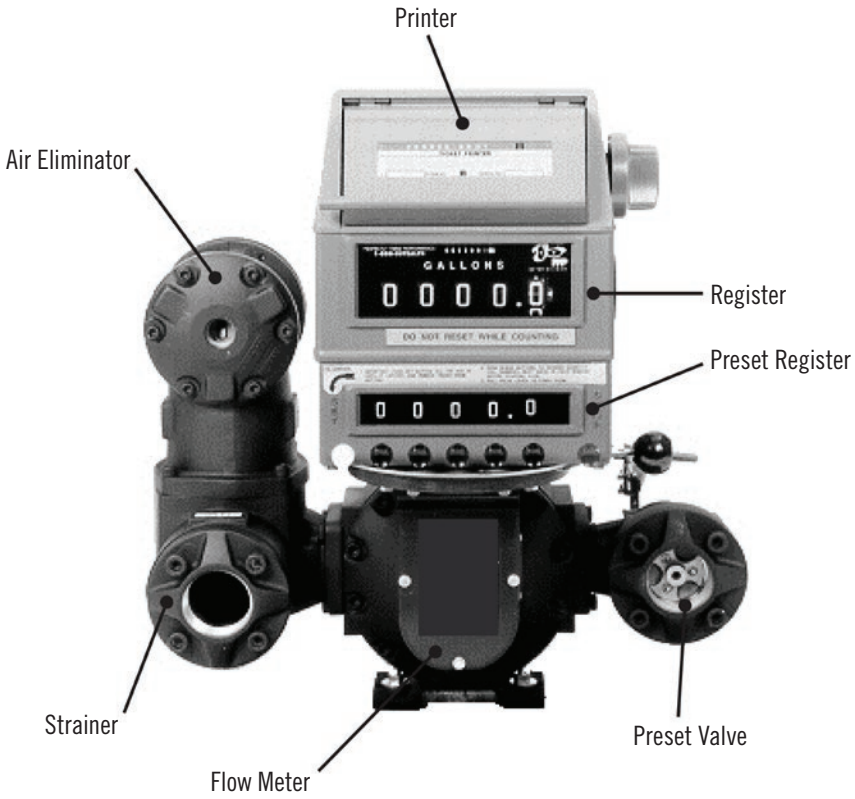
This flow meter is the subject of a continuing improvement program.

To ensure correct supply of replacement parts, every parts inquiry must include the Serial No. from the original flow meter assembly.



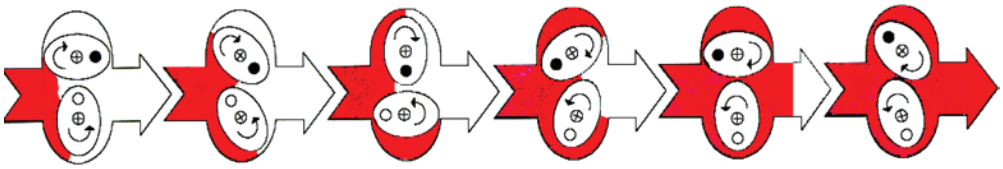
Terminology

The components of the flow meter are*:



*Some components shown are optional.

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.**

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 turndown ratio. Oval gear meters are largely unaffected by changes in liquid viscosity (see page 9).

The TS Series meter is designed to provide:

V••Assy: Drive to a mechanical register (this manual).

Fluid Compatibility

Fill-Rite 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 and operating conditions. If in doubt about compatibility with a specific fluid or the operating conditions, please refer to the liquid compatibility on the Sotera Systems website (sotera.com). Please consult with your authorized Fill-Rite Meter distributor, or Fill-Rite Technical Support at 800-720-5192.

While most refined petroleum products can be handled with the same flow meter, some require different rotors and/or seals. *Do not change service liquid, without consulting with your authorized Fill-Rite Meter distributor.*

Fluid compatibility information is located in the chart on page 5.

TS Series, Anodized Aluminum & Stainless Steel

Materials

Case: Anodized aluminum
Oval gears: PPS with carbon bearings, (oval gears) PTFE bearings optional.
Posts:
Aluminum Meters:
Hard Chrome Stainless Steel HC303SS
Stainless Steel Meters:
Hard Chrome Stainless Steel HC316SS
Seals: Viton® standard, PTFE optional.

Connections

Bolted companion flanges with NPT or BSP port;
Optional: SS 150# ANSI adaptors
Carbon steel welding flanges
Carbon steel 150# RF ANSI adaptors

Pressure Rating at 100°F (38°C) *with 3:1 Safety Factor*
Meter/Strainer: 150 PSI/100°F = 10.3 BAR/40°C
Air Elim/Valves: 150 PSI/100°F = 10.3 BAR/40°C

Temperature Rating
V assy: -15°F to +180°F (-26°C to +82.°C)
Use HT or HV oval gears if temp. can exceed 120°F = 50°F

Meter Performance
When field calibrated on actual liquid of service.

Linearity
Refer to S&E date sheets for specific models and measurement approvals.

Nominal Capacity
Refer to S&E date sheets for specific models and measurement approvals.

Viscosity
- With LV oval gears 100% capacity to 1,500 SSU/300 cP.
- With HV oval gears 100% capacity to 5,000 SSU/1,000 cP.
- With HV oval gears, the flow meter may be used to 1,500,000 SSU/350,000 cP at reduced flow rates (see meter viscosity/coefficient table in next column).

Opt. Pulsers on mechanical register

	10:1 pulser	100:1 pulser
1/10 gallon register	10 PPG	100 PPG
Whole gallon register	1 PPG	10 PPG
1/10 liter register	10 ppl	100 ppl
Whole liter register	1 ppl	10 ppl

- Normal operation range is with 10:1 turn-down from model nominal capacity.
- On low viscosity liquids best performance (linearity/service life) is between 50% and 85% of model nominal capacity.
- On diesel fuel, TS20A and TS30A models with mechanical register only may be operated to 125% of nominal capacity in ***intermittent service (<6 hours per day / deliveries not to exceed 15 - 20 minutes). This does not apply to models with preset and / or printer.***
- On higher viscosity liquids, model nominal capacity is reduced per table below.

	Carbon Bearings		PTFE Bearings	
Viscosity (cSt)	LV Rotors	HV Rotors	LV Rotors	HV Rotors
1	1.00	1.00	1.00	1.00
10	1.00	1.00	1.00	1.00
50	1.00	1.00	1.00	1.00
100	1.00	1.00	1.00	1.00
200	1.00	1.00	0.90	1.00
300	0.86	1.00	0.73	0.98
400	0.77	1.00	0.62	0.96
500	0.71	1.00	0.57	0.94
600	0.66	1.00	0.53	0.92
700	0.63	1.00	0.50	0.90
800	0.60	1.00	0.48	0.85
900	0.56	1.00	0.45	0.80
1,000	0.54	1.00	0.43	0.75
2,000	-	0.77	-	0.65
3,000	-	0.65	-	0.55
4,000	-	0.58	-	0.46
5,000	-	0.53	-	0.42
6,000	-	0.49	-	0.39
7,000	-	0.47	-	0.37
8,000	-	0.44	-	0.35
9,000	-	0.42	-	0.34
10,000	-	0.41	-	0.32
20,000	-	0.30	-	0.24
30,000	-	0.24	-	0.19
40,000	-	0.20	-	0.16
50,000	-	0.18	-	0.14
60,000	-	0.17	-	0.13
70,000	-	0.14	-	0.11
80,000	-	0.13	-	0.10
90,000	-	0.12	-	0.10
100,000	-	0.11	-	0.09
200,000	-	0.08	-	0.06
300,000	-	0.07	-	0.05
400,000	-	0.06	-	0.05
500,000	-	0.06	-	0.04
600,000	-	0.06	-	0.04
700,000	-	0.05	-	0.04
800,000	-	0.05	-	0.04
900,000	-	0.05	-	0.04
1,000,000	-	0.05	-	0.04

TS Series, Anodized Aluminum & Stainless Steel (Continued)

TS = Oval Gear , 1" and up
Mechanical

TS	15	A	Assembly Number	Flange	Calibrator	Pressure Rating	Rotor & Bearing	Drive	Pulse Output	Seals	Strainer	Basket Mesh

Model Number

TS

15

	Size	Nominal Capacity	GPM	GPH	lpm	m^3/h
10	1"	25 mm	40	2,400	150	9
15	1½"	40 mm	60	3,600	230	14
20	2"	50 mm	150	9,000	570	35
30	3"	80 mm	200	12,000	760	46

A

Material

A	Anodized Aluminum
C	316 Stainless Steel

Assembly Number

Flange

A	NPT
B	BSP
C	150# ANSI
	Adaptors

Register Calibration

Mechanical Register

T	1/10 US gallons
U	1/10 Imperial
G	gallons
I	1/1 US gallons
Y	1/1 Imperial gallons
L	1/10 liter
	1/1 liter

Pressure Rating

C	150 PSI (10 BAR)

Rotor & Bearing

	Type	Mat'l	Bearing
B	LV	PPS	Carbon
I	HV	PPS	Carbon
C	LV	PPS	PTFE
J	HV	PPS	PTFE

Drive

M	Mechanical

Pulse Output

X	none
D	10:1 dry reed
S	100:1 solid state

Seals

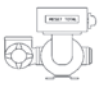
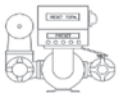
A	Viton™ (std. in Anodized Aluminum Models)
B	PTFE (std. in SS, opt in AA)

Strainer

S	Fill-Rite 90° Strainer
H	Fill-Rite High Capacity

Basket Mesh

4	40 Mesh Basket (standard with LV & HT rotors)
2	20 Mesh Basket (standard with HV rotors)

V03		Meter Only - No Register (Register Ready), Calibrator, RAD Adaptor, No Ratio Gear Plate (Distributor to Add)
V04		Meter Only - Calibrator, RAD Adaptor, Ratio Gear Plate & Register
V05		V04 + Strainer
V06		Calibrator, RAD Adaptor, Ratio Gear Plate, Register, Strainer & Air Eliminator
V07		V04 + Zero Start Ticket Printer
V09		V06 + Zero Start Ticket Printer
V11		V04 + 2-Stage Preset Counter & Preset Valve
V13		V06 + 2-Stage Preset Counter & Preset Valve
V17		V06 + 2-Stage Pre-set Counter, Preset Valve & Zero Start Ticket Printer

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. Additionally LPG meters must be installed in accordance with the requirements of ANSI-NFPA 58.

Operating Temperature

TS Series assemblies are rated for:

V•• assy -40°F/+180°F (-40°C/+80°C)

However:

- *They are not suitable for cryogenic service.*
- *When operating temperature exceeds +150°F (+66°C), pressure rating is reduced. Please refer to Fill-Rite Technical Manual for details.*

Operating Pressure

Maximum non-shock operating pressure is:

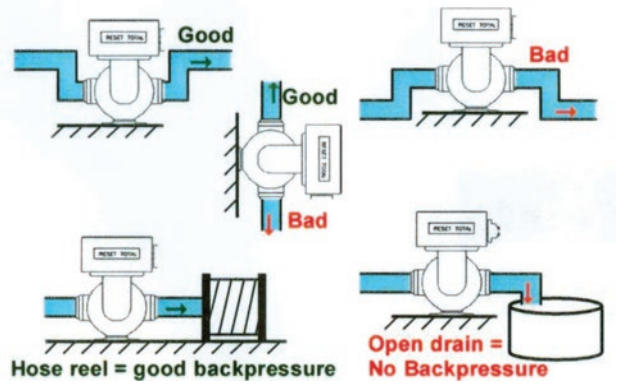
Flow Meter/Strainer : 150 PSI (10 BAR) (= +38°C)
Air Eliminator/Valves : 150 PSI (10 BAR) (= +38°C)

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 the flow meter's Maximum Working Pressure rating.

Installation

- 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.
- The ***meter should always be supported*** by bolting firmly to a solid platform or foundation. Never use the connecting pipe as the sole means of support.
- For most accurate measurement, the flow meter should operate with some backpressure (avoid delivering into an open vessel).
- The flow meter can operate with liquid going Left-to-Right, Right-to-Left (see page 1.8) 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.



- ***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.
- Protective caps installed in flow meter flanges prior to shipment should remain in place until you are ready to install in the piping system.
- Flow meters are designed to withstand a certain level of ***vibrations***, such as might be experienced 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.
- 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.
- 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.
  - If no fluid is specified, strainer basket comes standard with 40 mesh. We also offer: 20 mesh (std. with HV rotors) for use on 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.

Installation (Continued)

- 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.
- 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.
- 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.
- In critical installations a ***bypass line is recommended***, so flow can continue while flow meter is being serviced.
- 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).
- If an Air Check Valve is included in the flow meter assembly, a modified air eliminator is used. One of the air eliminator vents must be connected to the port on the air check valve, using pipe, tubing or a flexible hose. This connection must be made in the field, as we do not know what would be a convenient/practical path for the connection. Similarly, we do not know whether local regulations or codes dictate materials to be used for this connection.
- ***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.

The ideal installation incorporating all of these recommendations is shown at the bottom of the page.

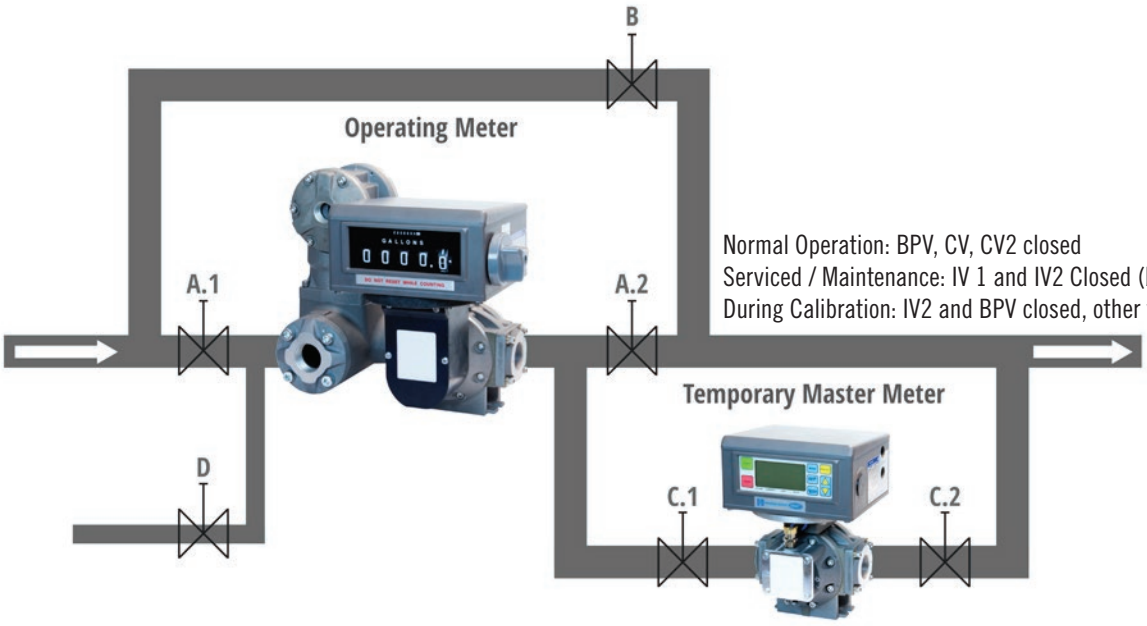
Start-Up & Operation

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. Gently open the outlet valve. Start the pump, and then gradually 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.*



Normal Operation: BPV, CV, CV2 closed
Serviced / Maintenance: IV 1 and IV2 Closed (by-pass open).
During Calibration: IV2 and BPV closed, other valves open

Start-Up & Operation (Continued)

TS Series flow meters can operate in either direction. Standard assembly, when facing the flow meter, has the flow going Left-to-Right, unless specified differently at time of the order. A label with the word INLET is placed on the inlet flange, as assembled at the factory.

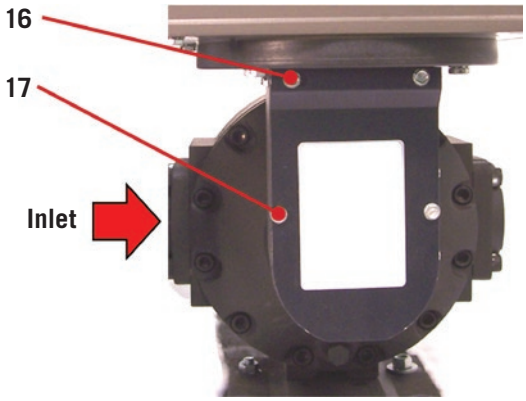
When the meter is first installed, check that the register is turning correctly when you start the flow. If it is not (or it is attempting to run backwards), check position of the face gear (11E) on the calibrator drive shaft (21A), and if necessary correct the position of the face gear versus the packing gland pinion (11D) as explained below.

Left-to-Right flow = Face gear below packing gland pinion

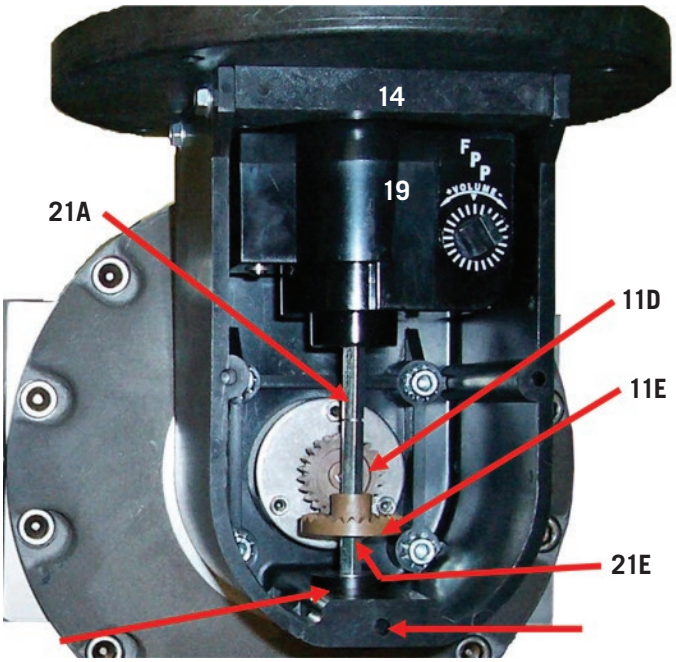
Right-to-Left flow = Face gear above packing gland pinion

The direction of flow can be changed in the field. This requires the following steps:

- Any accessories (strainer and/or preset valve) attached to the flow meter must be moved to the opposite side.
- Strainer inlet is standard from the front. When moving the strainer to Right-to-Left position, switch the inlet flange and strainer basket cover. If rear inlet is preferred, leave flange & basket cover as is, when moving the strainer.
- Standard outlet on Preset Valve or Air Check Valve is towards the front. When moving the valve to Right-to-Left position:
- Air Check Valve: Rotate the valve 180º, then install tubing connecting air eliminator to the valve.
- Preset Valve: Rotate the valve 180º. Disassemble the linkage, and reassemble mirror image to original assy.

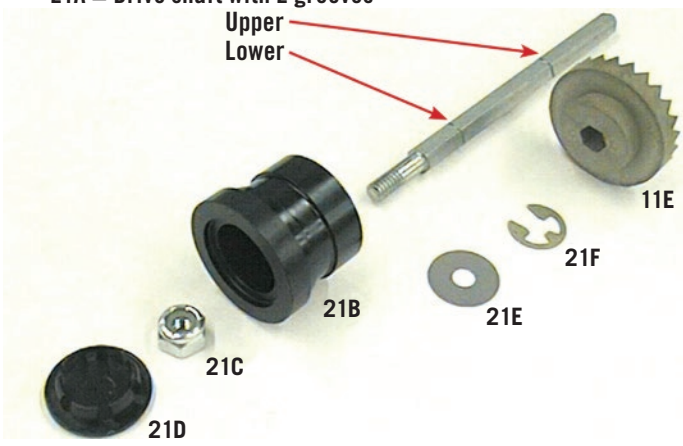


- Reverse the position of the face gear (11E) on the calibrator drive shaft (21A).
- First remove screws (16 & 17) to detach the dust cover (15) from the RAD (14 = Right Angle Drive) adaptor. Now refer to photo in next column.
- Notice position of the face gear (11E) on the calibrator drive shaft (21A) in relation to the packing gland pinion (11D).
- Remove E-ring (21F) with a screwdriver or small pliers. As shown, the E-ring is installed below the face gear, where it is not visible in the photo.



- Now loosen the set screw (18) with a 3/32" Allen wrench, to release the calibrator drive shaft bushing (21B).
- Slide the calibrator drive shaft bushing (21B) out of the bottom of the RAD (14).
- Pull the calibrator drive shaft assembly out of the RAD.
- Remove the face gear (11E), and turn it 180º, so that the gear teeth are facing in the opposite direction from the original installation.
- Reassemble the parts in reverse order.
- Make sure that the calibrator drive shaft bushing flange (21B), is tight against the RAD (14).
- Tighten the hex nut (21C).
- Reinstall the E-ring (21F) in the appropriate grove (in the above example, the E-ring now goes into groove above the pinion).
- Inspect to make sure that there is slight backlash between the pinion gear (11D) and the face gear (11E). They must engage without binding or slipping.

21A = Drive shaft with 2 grooves



Calibration, Mechanical Flow Meters

W&M Certifications:

TS10A	US
TS15A	US & Canada
TS20A	US, Canada, EU & Australia
TS30A	US, Canada, EU & Australia

Certifications are liquid specific. Please refer to national certificates for liquid categories covered.

Flow Meter Accuracy

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.

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

Accuracy curves of individual flow meters vary slightly. Such minor variations are corrected in the mechanical calibrator. In our calibration procedure, the meter calibrator is set for zero error, when operating at 95-100% of capacity on 1 cSt viscosity fluid.

Flow Meter Calibration in The Field

Since we cannot test on actual fluid of operation, it is the responsibility of the buyer to field calibrate:

- In place of service
- On actual operating liquid.

This will minimize errors arising from:

A. Operation at a different flow rate.

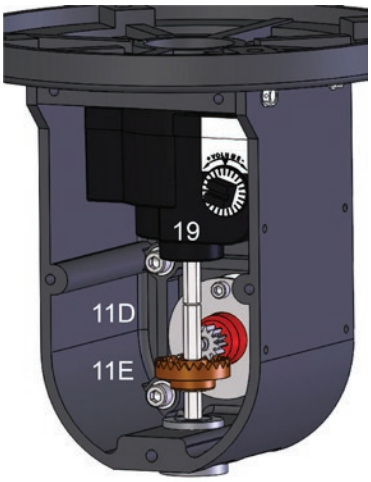
B. Operation on a fluid with different viscosity

It is recommended that written records be maintained on all flow meters. These records should include:

- Supplier and Service Department phone number.
- Date of installation.
- Details of maintenance performed.
- Date & result of each recalibration, with % change made on flow meter calibrator assy.

Mechanical TS Series meters have a mechanical drive train directly from the oval gears (oval gears) to the register. To convert oval gears movement to volume reading on the register, this drive train includes 3 calibration components:

- Packing gland pinion (11D) can have 12 or 24 teeth, while the face gear (11E) always has 24 teeth, resulting in a 1:1 or 2:1 ratio. The appropriate ratio depends upon flow meter model size & specific unit of calibration selected for the register.



- Mechanical calibrator (19). This component makes minute adjustments to final calibration to compensate for individual flow meter characteristics, viscosity of fluid being metered, and flow meter wear factor.
- A ratio gear plate installed below the mechanical register. Gearing on this gear plate is specific to flow meter model & unit of calibration selected. Optimum ratio is between 0.5000 & 5.0000 for best service life.

The mechanical register is common to all flow meter models, so it is possible to move registers from one flow meter to another. **Do NOT move the ratio gear plate from one flow meter to another.**

Frequency of Recalibration

- In installations subject to local Weights&Measures regulations, frequency of recalibration must conform to such regulations.
- If local authorities issue regulations for non-W&M flow meters, such regulations must be observed.

When no regulations or standards apply, our recommendations are:

- Calibrate immediately after installation.
- Recalibrate after 15-30 days.
- Recalibrate after 180 days and again after 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.

Flow Meter Calibration

Procedures & Methods

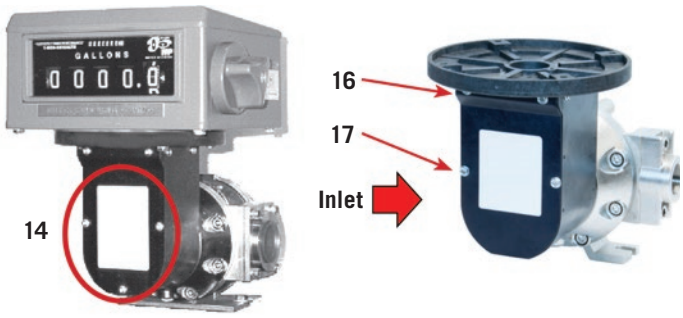
Flow meters subject to Weights&Measures regulations, or used in systems where the flow rate can fluctuate, should be tested at minimum, intermediate & maximum flow rates. In non-W&M service, a flow meter always operating at a steady flow rate, can be tested at that flow rate only.

All tests should be repeated 3 times to confirm repeatability. All tests should be of at least 60 second duration, to minimize the effect of flow meter error during start-up and shut-down.

- After calibrating a known volume (X) into an accurate prover, or through a Master Meter (MM), compare with register reading (Y) and calculate correction:

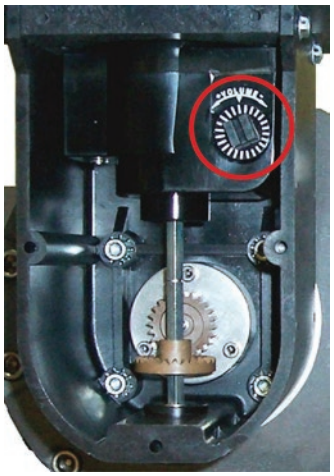
$$\frac{X - Y}{X} \times 100 = \%\ \text{correction}$$

- When re-calibration has established that a correction is required, remove the dust cover (15) from the RAD (14 = right angle drive adaptor), by detaching screws (16 & 17).

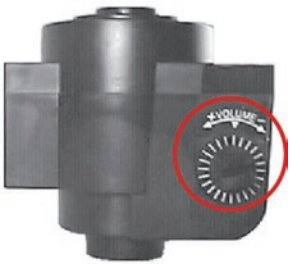


This provides access to the calibrator assembly (19), which has a dial on the front, and is marked with directions for + and - Volume. Each graduation of this dial represents approx. 0.06% change.

The dial has a slot for a screw driver in the center, so the setting can be changed. As you turn the center, you will hear two 'clicks' for each graduation mark. Each 'click' represents approximately 0.03% change in the setting.



Do NOT change setting, unless recalibration of the flow meter has established the need for correction.



- When prover/master meter reading is less than flow meter register reading, add percentage calculated by turning the calibrator in the + volume direction.
- When prover/master meter reading is more than flow meter register reading, subtract percentage calculated by turning the calibrator in the - volume direction.

After correcting calibrator setting, circulate product through the flow meter for a few minutes. Then perform at least 3 more tests, to confirm flow meter accuracy & repeatability.

- If the flow meter does not repeat, it will likely require a new set of oval gears.
- Before ordering new gears, inspect the measuring chamber for scratches or wear. If the measuring chamber is scratched or scored beyond what can be smoothed with emery paper, flow meter case should be replaced.

Finally:

- Re-seal the flow meter.
- Enter date and % correction on the permanent flow meter record.

As long as degree of change is moderate, the flow meter is in good condition.

If there is a sudden significant jump in correction required, the oval gears are likely about worn out. Oval gear replacement should be considered now, rather than letting further wear cause oval gears to start rubbing on flow meter housing.

Flow Meter Service

SAFETY INSTRUCTIONS

- REMOVE ALL INTERNAL PRESSURE BEFORE OPENING THE FLOW METER.
- DRAIN & RINSE THE FLOW METER BEFORE SERVICING.
- IF IT IS NECESSARY TO TRANSPORT OR SHIP THE FLOW METER TO A DIFFERENT LOCATION FOR SERVICE, IT MUST BE RINSED 3 TIMES WITH A NEUTRAL FLUID PRIOR TO TRANSPORTATION/SHIPMENT.

Installation, Maintenance & Service must be performed by personnel who are:

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

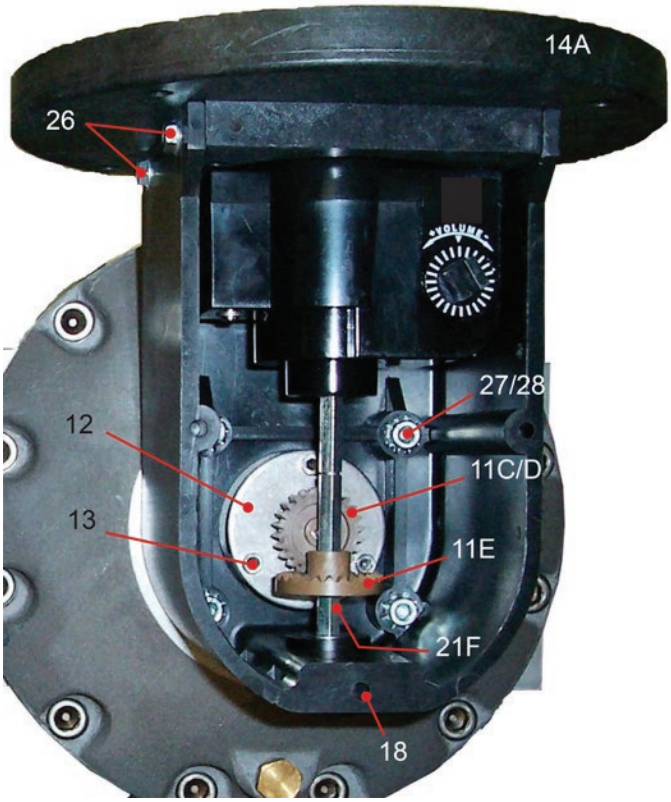
Avoid pipe strain and stress when making flow meter repairs. The weight of piping and the flow meter should be supported independently. This means that the meter can be serviced without affecting piping alignment.

Avoid prying or exerting heavy pressure on precision parts, as this could 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 to prevent thread damage, and to assure proper torque values are applied when reassembling.

If flow meter threads are damaged, repair using inserts.



Servicing the Mechanical Drive Components

Flow meter wear depends upon several variable factors (flow rate vs model capacity, lubricity of the liquid, total volume being metered annually and maintenance of mechanical register, preset and/or printer), so it is impossible to predict the expected life for each component.

There are 8 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. Face Gear (11E) & Packing Gland Pinion (11D)
B. Packing Gland O-ring (11B)

Longer Term Wearing Components (2-5 years)

C. Calibrator Drive Shaft Assembly (21)
D. Gear Plate, internal (4)

Very Long Term Wearing Components (3-10 years)

E. Packing Gland (11)
F. Oval Gears (2), or inspection of measuring chamber

Longest Term Wearing Components (5-20 years)

G. Post Plate assembly (3)
H. Calibrator Assembly (19)

Of these, only A, C & H can be performed without taking the pressure off the system and draining the flow meter. The remaining all require opening of flow meter interior.

The first step is to remove the dust cover (see pages 9) from the RAD (14 = Right Angle Drive adaptor).

A. Face Gear (11E) & Packing Gland Pinion (11D)
C. Calibrator Drive Shaft Assembly (21)

Always replace Face Gear & Packing Gland Pinion together. They can be ordered under a single P/No. (see page 18).

- Remove E-ring (21F) from the drive shaft assembly (21) with a screwdriver or small pliers.
- Loosen the set screw (18) with a 3/32" Allen wrench, to release the calibrator drive shaft bushing (21B).
- Slide the calibrator drive shaft bushing (21B) out of the bottom of the RAD (14), and pull the calibrator drive shaft assembly out of the RAD.
- Replace Face Gear (11E) on the calibrator drive shaft assembly.
- Remove E-ring (11C) from the packing gland (11) with a screwdriver or small pliers, and replace the Packing Gland Pinion (11D).
- Reassemble in reverse order.

Flow Meter Service (Continued)

B. Packing Gland O-ring (11B)
E. Packing Gland Assembly (11)

First relieve system pressure and drain the flow meter.

Then follow instructions for above for removal of calibrator drive shaft assembly. Remove E-ring (11C) from the packing gland assembly, and pull off the pinion (11D).

- Remove three screws (13) from the packing gland retainer (12). Remove the retainer.
- Packing Gland O-ring and/or Packing Gland assembly can now be replaced.
- When replacing the Packing Gland, the drive dog must be aligned with the slot in the gear on the gear plate.
- Reassemble in reverse order.

D. Gear Plate, Internal (4)
F. Oval Gears (2), or inspection of measuring chamber.

The wearing parts in the Gear Plate assembly are the reduction gears. On a longer time scale, the bushing in the gear plate will wear out. The gear plate assembly can be rebuilt or replaced in one of 3 ways, with d.3 being what is most commonly required:

d.1 Complete gear plate assembly
d.2 Gear plate/bushing assembly only, reusing gears.
d.3 Repair kit, with reduction gears & fasteners.

First relieve system pressure and drain the flow meter.

Also, detach the mechanical register stack, to take the weight off of flow meter front cover.

If the mechanical register stack includes a preset counter, detach the linkage from the trip ring (see top of next column) prior to taking the register stack off.

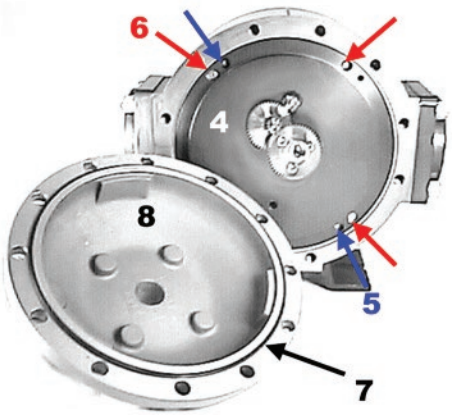
Register stack attaches to the RAD with 4 screws, 2 front and 2 rear.


Valve linkage connects to preset trip ring at the rear.

Slide the sleeve towards the shaft to release the mounting stud.

- Remove dust cover & calibrator drive shaft as explained above.
- Remove 4 screws/washers (27/28) holding the RAD to the front cover (8).
- Remove the cover bolts (10) from the front cover (8), now remove the front cover from the flow meter and inspect the cover O-ring (7) for flaws. PTFE fitted meters: Always replace seals when opening the flow meter.

You now have access to the Gear Plate assembly (4). If rebuilding with repair kit, no further disassembly is required.

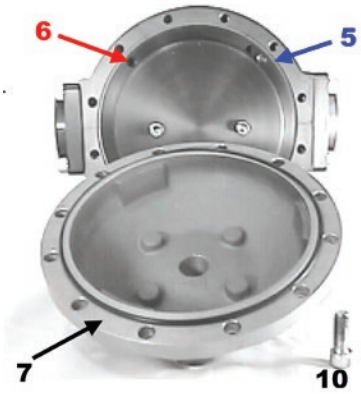


If replacing the oval gears, inspecting the measuring chamber or replacing the complete gear plate:

- Remove 4 screws (6) from the gear plate. The gear plate can now be pulled off dowel pins (5), using a 5/16-8 x 1" jack bolt if necessary.
- The gear plate assembly can now be rebuilt or replaced as required.
- Prior to removing the oval gears (oval gears), use a soft pencil to make an alignment mark where the gears engage. This will make reassembly easier.
- The oval gears can now be inspected or replaced as required. When placing the oval gears back on the posts, make sure that they are aligned and spin freely on the posts. If they are not aligned correctly, they will disengage.
- The measuring chamber can now be inspected. Remove any deposits using a fine emery cloth or wire brush. Be careful to remove any particulate material, which can cause the meter to jam.
- A minor scratch in chamber surface can be carefully smoothed out, but be careful not to cause scoring or to change the dimensions. If the measuring chamber shows signs of scoring from oval gears rubbing, it should be replaced.
- Reassemble in reverse order.
- G. Post Plate assembly (3)

First relieve system pressure and drain the flow meter.

- Remove the cover bolts (10) from the rear cover (9), now remove the rear cover from the flow meter and inspect the cover O-ring (7) for flaws. PTFE fitted meters: Always replace seals when opening the flow meter.



Flow Meter Service (Continued)

- Remove 4 screws (6) from the post plate (3). The post plate assembly can now be pulled off dowel pins (5), using a 5/16-8 x 1" jack bolt if necessary.

The posts are expected to last through several sets of oval gears. When the posts show signs of wear, or if they have been bent due to hydraulic shock, the complete postplate assembly must be replaced.

If hydraulic shock is suspected, the cause should be identified and eliminated.

If the posts show uneven wear (bearings cutting grooves into the post), the differential pressure across the flow meter is too high, due to a combination of excessive flow rate & viscosity. Solutions are:

- Reduce the flow rate.
- Increase the temperature to reduce the viscosity.
- Use a larger flow meter.

Re-assemble in reverse order.

H. Calibrator Assembly (19)

The calibrator assembly is a mechanical device, which will wear out eventually. Calibrator wear can be accelerated by failure to clean and lubricate the components in the mechanical register stack (refer to separate manuals). If flow meter recalibration gives erratic results (nonrepeating), it is likely that the calibrator is worn out.

To replace the calibrator:

- Remove dust cover, drive shaft assembly and register stack, as explained under A and D.
- Remove 2 screws (20) holding the Calibrator Assembly to the Veeder-Root register flange (14B), using a Phillips screwdriver.
- Reassemble in reverse order.

For optional flow meter accessories:

Strainer
Air Eliminator
Backpressure Valve
Air Check Valve

} Please see Section 2

For optional control valves:

Mechanical Preset Valve
1-Stg solenoid operated Valve
2-Stg solenoid operated Valve

} Please see seperate Fill-Rite manual

For mechanical register stack:

Register
10:1 pulser
100:1 pulser
Preset Counter
Micro Switch kit
Ticket Printer

} Please see seperate Veedor-Root manuals

Flange Kits and Parts for Flanges

Fill-Rite TS Series flow meters come standard with bolted companion flanges, with either NPT or BSP threaded ports. Other options are welding flanges (aluminum or steel), and 150# RF ANSI adapters (steel).

Since meter (square) & accessory (round) flanges differ, a new flange is required when adding to or deleting accessories from an existing flow meter. When adding accessories to TS10A & TS15A models, an adapter might be required. Single flange kits & adapters, and relevant seals & screws, are identified below.

Model	Materials of Construction	Flow Meter, Inlet / Outlet Flange	Strainer or Valve Adaptor	Standard Strainer Inlet Flange	Air Check and Preset Valve Outlet Flange	Electronic Preset Valve Outlet Flange
TS10A, 1"	NPT/Viton	FK1110-1	na	na	na	na
	BSP/Viton	FK1111-1	na	na	na	na
	Viton O-ring	SL1223				
	NPT/PTFE	FK2110-1	na	na	na	na
	BSP/PTFE	FK2111-1	na	na	na	na
	PTFE O-ring	SL2223				
	Flange screw	FS2950				
TS15A, 1½"	NPT/Viton	FK1160-1	FK1215[2]	FK1154-1	FK1156-1	FK1156-S1
	BSP/Viton	FK1161-1	same	FK1155-1	FK1157-1	FK1157-S1
	ANSI/Viton	FK5160-1	same	FK5154-1	FK5156-1	FK5156-S1
	Viton O-ring	SL1233	SL1233	SL1334	SL7500	SL7500
	NPT/PTFE	FK2160-1	FK1215-T[2]	FK2154-1	FK2156-1	na
	BSP/PTFE	FK2161-1	same	FK2155-1	FK2157-1	na
	ANSI/PTFE	FK5161-1	same	FK5155-1	FK5157-1	na
	PTFE O-ring	SL2233	SL2233	SL2334	SL2500	na
	Flange screw/stud	FS9902	FS5201	FS2960	FS2960	1123413
	Flange washer	FS5008	FS5203			
	Flange nut	na	FS5202			
TS20A, 2"	NPT/Viton	FK1200-1	na	FK1204-1	FK1106-1	FK1106-S1
	BSP/Viton	FK1201-1	na	FK1205-1	FK1107-1	FK1107-S1
	ANSI/Viton	FK5200-1	na	FK5204-1	FK5106-1	FK5106-S1
	Viton O-ring	SL1233	na	SL1334	SL7500	SL7500
	NPT/PTFE	FK2200-1	na	FK2204-1	FK2106-1	na
	BSP/PTFE	FK2201-1	na	FK2205-1	FK2107-1	na
	ANSI/PTFE	FK5201-1	na	FK5205-1	FK5107-1	na
	PTFE O-ring	SL2233	na	SL2334	SL2500	na
	Flange screw	FS2950	na	FS2960	FS2960	1123413
TS30A, 3"	NPT/Viton	FK1300-1	na	FK1304-1	FK1106-1	FK1106-S1
	BSP/Viton	FK1301-1	na	FK1305-1	FK1107-1	FK1107-S1
	ANSI/Viton	FK5300-1	na	FK5304-1	FK5106-1	FK5106-S1
	Viton O-ring	SL1240	na	SL1350	SL7501	SL7501
	NPT/PTFE	FK2300-1	na	FK2304-1	FK2106-1	na
	BSP/PTFE	FK2301-1	na	FK2305-1	FK2107-1	na
	ANSI/PTFE	FK5301-1	na	FK5305-1	FK5107-1	na
	PTFE O-ring	SL2240	na	SL2350	SL2503	na
	Flange screw	FS1951	na	FS2965	FS2965	FS5210

1 = Used for both strainer & air check valve when assembled to TS10A model.

2 = Used for strainer only when assembled to TS15A model (valves fit directly to meter body).

Troubleshooting the Flow Meter

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 liquid) inside the measuring chamber. Clean the flow meter (see D & F on page 13), and inspect for damage.
- Meter jammed on a particle, that has passed through a damaged strainer basket. Remove particle (see D & F on page 13) and replace oval gears if necessary. Replace strainer basket, see page 20).

Reduced Flow Rate

- Strainer basket partially blocked. Clean the basket (see page 20).
- Pump not functioning correctly. Repair pump.
- Valve stuck in partially closed position. Check valves and repair.
- Meter oval gears (oval gears) partially 'salted' with chemical deposits, slowing the movement. Clean the meter (see D & F on page 13).

Product Flows, but the register does not record

- Check packing gland pinion (11D) & face gear (11E).
- If disengaged, reassemble the drive shaft assembly correctly.
- If worn, replace pinion & face gear as a set.
- If the calibrator drive shaft turns, the problem is either in the calibrator assembly (19) or in the mechanical register.
- Remove the calibrator assembly (see H on page 14). Insert the drive shat and turn by hand. If it turns smoothly without binding, the problem is in the register.
- Refer to Veeder-Root register manual & parts list.
- If the calibrator drive shaft does not turn, the problem is either in the packing gland or in reduction gears on the bearing plate.
- Check the connections between the pulser and the electronic register.
- 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:

- 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:
- 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 substandard cables.

Broken Oval gears (Oval Gears = #2)

- System started on air/vapors. Replace oval gears and inspect meter case (#1) for damage; repair/replace as necessary.
  Slowly fill the system with liquid before starting the pump. Gradually increase flow rate to full capacity.
- Oval gears jammed on a foreign particle (welding slag, part broken off other equipment, etc.). Replace oval gears and inspect meter case (#1) for damage; repair/replace as necessary. Add a strainer in front of the flow meter. Slowly fill the system with liquid before starting the pump. Gradually increase flow rate to full capacity.

Breaking Teeth on Oval gears (Oval Gears = #2)
Breaking Teeth/shaft on Reduction Gears (#4D/F/G)

These are signs of hydraulic shock conditions in the system.
Common sources:

- Starting or stopping flow too rapidly. Replace damaged components and correct operational practices.
- Pump bypass not adjusted properly. Readjust as necessary.
- Open connection to another portion of the system with higher flow rates. Close connection prior to use.

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.

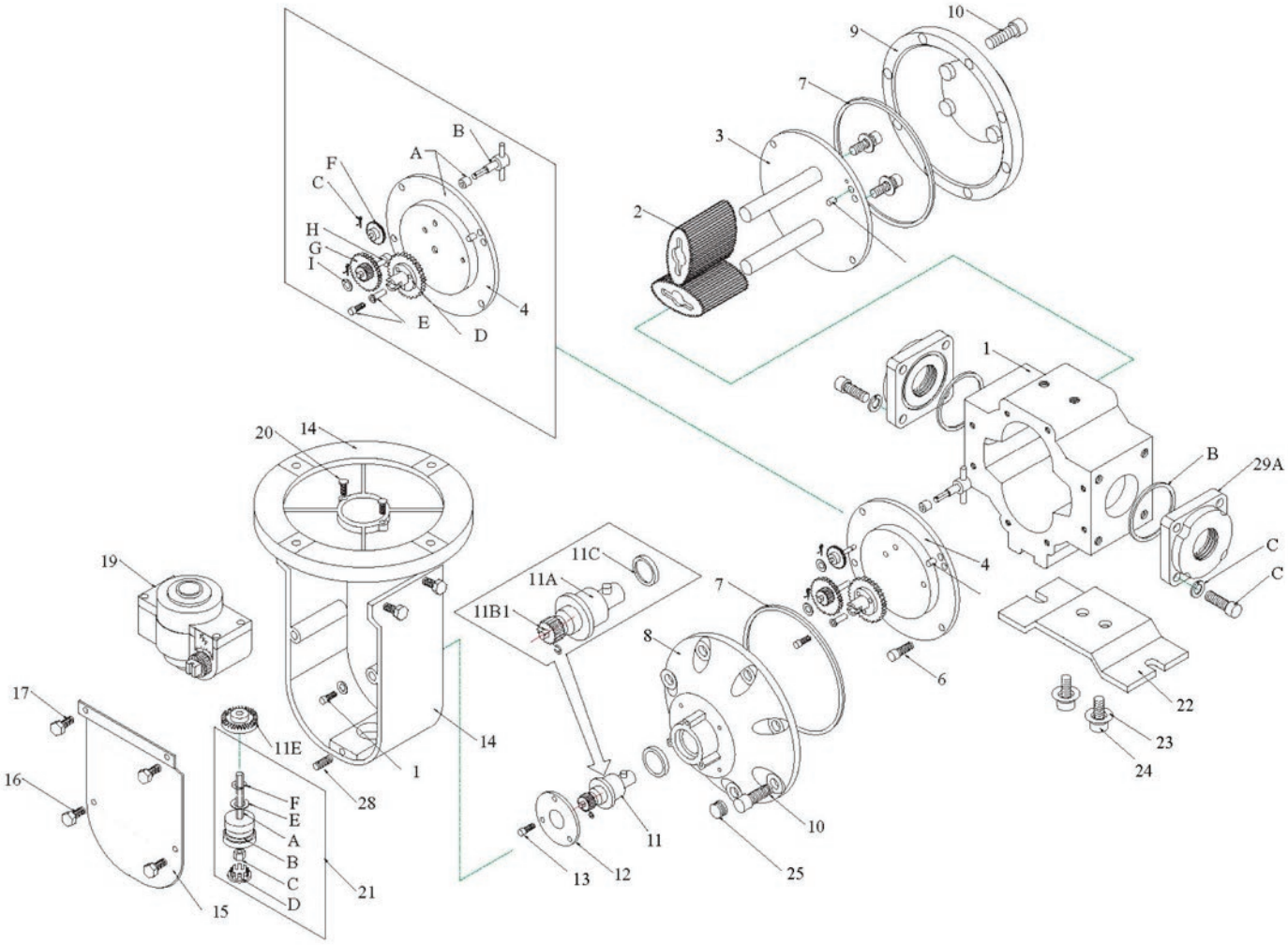
Parts List

Item	Description	TS10A Part Number	TS15A Part Number	TS20A Part Number	TS30A Part Number	Qty
1	Meter body	MB2565	MB2575	MB2395	MB5201	1
	Depth across body:	1.97" (50 mm)	3.46" (88 mm)	3.46" (88 mm)	4.96" (126 mm)	
2	**Gear Set: PPS/carbon, LV	GS10RC	GS15RC	GSTS2HRC	GS5201HRC	1
	PPS/Carbon, HT	GS10RC-MV	GS15RC-MV	GSTS2HRC-MV	GS5201HRC-MV	
	PPS/Carbon, HV	GS10RC-HV	GS15RC-HV	GSTS2HRC-HV	GS5201HRC-HV	
	PPS/PTFE, LV	GS10RT	GS15RT	GSTS2HRT	GS5201HRT	
	PPS/PTFE, HT	GS10RT-MV	GS15RT-MV	GSTS2HRT-MV	GS5201HRT-MV	
	PPS/PTFE, HV	GS10RC-HV	GS1RC-HV	GSTS2HRT-HV	GS5201HRT-HV	
3	***Post Plate Assembly	CP25801	CFP25802	CP2396-2	CP23961	1
4	***Gear Plate Assembly internal	CP25532	CP25532	CP23162	CP23172	1
4a	Gear Plate with Bushing	CP25531	CP25531	CP23161	CP23171	
4b-l	**Repair Kit, replacement of combination gear set	RKCP1	RKCP1	RKCP1	RKCP1	
5	Dowel Pin	MS902118-8	MS902118-8	MS902118-8	MS902118-8	4
6	Screw, for post/gear plates	FS9661	FS9661	FS9661	FS9661	8
7	*O-Ring Cover, Viton™	SL1157	SL1157	SL1167	SL1167	2
	O-Ring Cover, PTFE (option)	SL2157	SL2157	SL2167	SL2167	
8	Front Cover	CP2550	CP2550	CP2398	CP2398	1
9	Rear Cover	CP2551	CP2551	CP2397	CP2397	1
10	Cover Screws	FS2900	FS2900	FS2928	FS2928	16
11	**Packing Gland: AA/Viton	RK2001	RK2001	RK2003	RK2003	1
	SS/PTFE (optional)	RK8002	RK8002	RK80031	RK80031	
11b	*O-ring: Viton	SL1212	SL1212	SL1212	SL1212	
	PTFE (optional)	SL2212	SL2212	SL2212	SL2212	
11cde	*For 1/10 gallon	GS2001	GS2002	GS2002 (std.)	N/A	
+21f	Whole gallon	N/A	N/A	GS2001 (opt.)	GS2002	
	1/10 liter	GS2002 (std.)	N/A	N/A	N/A	
	Whole Liter	GS2001 (opt.)	GS2001 (opt.)	GS2002 (std.)	GS2002 (std.)	
	Whole Dekaliter	N/A	N/A	GS2001 (opt.)	GS2001 (opt.)	
12	Retainer, Packing Gland	MP9601	MP9601	MP9601	MP9601	1
13	Screws, PG retainer	FS9515	FS9515	FS9515	FS9515	3
14	RAD (Right Angle Drive)	RD15911	RD15911	RD15911	RD15911	1
15	RAD Dust Cover	MP2505	MP2505	MP2505	MP2505	1
16	Screws (with seal wire hole)	FS59121	FS59121	FS59121	FS59121	2
17	Screws (plain)	FS5912	FS5912	FS5912	FS5912	2
18	Set Screw (for drive shaft)	FS9652	FS9652	FS9652	FS9652	1
19	***Calibrator Assembly	CA6000	CA6000	CA6000	CA6000	1
20	Screws (calibrator to RAD)	FS2501	FS2501	FS2501	FS2501	2
21	**Drive Shaft Assembly (A-F)	RD15912	RD15912	RD15912	RD15912	1
22	Meter Pedestal	N/A	N/A	MP2526	MP2529	1
23	Split Lock Washers	N/A	N/A	N/A	N/A	
24	Screws (for Pedestal)	N/A	N/A	FS9923	FS9923	2
25	Drain Plug	MS4019	MS4019	MS4019	MS4019	2
26	Screws, RAD (with seal hole)	FS59121	FS59121	FS59121	FS59121	2
	Screws, RAD (plain)	FS5912	FS5912	FS5912	FS5912	2
27	Screws, RAD (to cover)	FS2800	FS2800	FS2800	FS2800	4
28	Lock Washer, 1/4"	FS3602	FS3602	FS3602	FS3602	4
29	Flange or Adapter Assembly	See Page 15	See Page 15	See Page 15	See Page 15	
30	Register Mounting Bolt	FS0856	FS0856	FS0856	FS0856	4

Time frame for replacement of regular maintenance items and long term consumables (rotors, packing gland & calibrator) varies a great deal. Factors include user maintenance schedule, fluid lubricity, flow rate versus model capacity, intermittent versus continuous duty & total volume. In heavy duty service, rotors may last from 2-5 years, while in lighter duty service, they may last from 10-20 years or more.

* Indicates recommended Spare Parts (regular maintenance items).
** Indicates suggested Spare Parts (longer time frame, but should be on hand if meter is in a location where service is not readily available).
*** Indicates very long term wearing component (should be on hand if meter is in a location where service is not readily available).

TS Series - Exploded View, Mechanical



#4 = Gear Plate Assembly (Internal)

Can be replaced complete, or as two sub-assemblies (the individual parts are not sold separately, as they must be replaced as a set):

- Gear plate with bushing (4A)
- Rebuild kit (items 4B-4I)

#29 = Companion Flanges

Companion flange assemblies (A+B+C) vary, depending on whether the flange attaches to:

- Flow meter body
- Inlet strainer
- Preset valve or air check valve on flow meter outlet

A complete list of companion flange assemblies, seals and screws is found on page 15.

11 = Packing Gland

The packing gland ratio (D = 12 or 24 tooth pinion) depends upon flow meter model, and unit of calibration selected on the mechanical register. A list of packing gland ratios can be found in FPP Technical Manual (see list of ratio gear plates).

Pinion/Face Gear (11D/E) can be replaced separately:

- GS2001 2:1, metal/PPS
- GS2002 1:1, PPS/PPS (standard)
- GS2003 1:1, metal/PPS (for tank truck service)

The packing gland is replaced as a kit under the P/No. shown in the parts list, which includes both GS2001 & GS2002.

#21 = Calibrator Drive Shaft Assy.

This assembly is replaced as a kit containing all components (A-F). Except for the E-ring (F) and face gear (11E), parts are not sold separately.

Torque Chart

Item	Description	TS10A	TS15A	TS20A	TS30A
6	Post / Bearing Plate	10/32 20 in-lbs	10/32 20 in-lbs	10/32 20 in-lbs	10/32 20 in-lbs
10	Cover Screw	5/16-18 80 in-lbs	5/16-18 80 in-lbs	3/8-16 143 in-lbs	3/8-16 143 in-lbs
13	Packing Gland Retainer Screw	8/32 11 in-lbs	8/32 11 in-lbs	8/32 11 in-lbs	8/32 11 in-lbs
16 17	Dust Cover Screws	10/14 11 in-lbs	10/14 11 in-lbs	10/14 11 in-lbs	10/14 11 in-lbs
18	Calibrator Brush Screw	10/32 20 in-lbs	10/32 20 in-lbs	10/32 20 in-lbs	10/32 20 in-lbs
20	Calibrator Mounting Screw	Sheet Metal Screws	Sheet Metal Screws	Sheet Metal Screws	Sheet Metal Screws
24	Pedestal Screw	N/A	N/A	3/8-16 143 in lbs	3/8-16 143 in lbs
25	Cover Drain Plug	Hand Tighten	Hand Tighten	Hand Tighten	Hand Tighten
26	RAD Housing / Flange Screw	Sheet Metal Screws	Sheet Metal Screws	Sheet Metal Screws	Sheet Metal Screws
27	RAD to Meter Cover Screw	1/4-20 46 in-lbs	1/4-20 46 in-lbs	1/4-20 46 in-lbs	1/4-20 46 in-lbs
30	Companion Flange Screw	3/8-16 143 in-lbs	5/16-18 80 in-lbs	3/8-16 143 in-lbs	N/A

Warranty Information

Terms and Conditions of the warranty on your Fill-Rite Precision Meter are available on:

fillrite.com

or

sotera.com

Notes

Strainer

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

A strainer must be installed on the inlet side of all positive displacement flow meters, irrespective of other strainers or filters upstream.

- The primary purpose of the strainer, is to protect the flow meter against jamming on foreign particles, such as welding slag, pipe scale or parts breaking off upstream equipment.

  The Fill-Rite strainer is strictly an insurance policy. For cleaning of contaminated fluids, larger straining or filtration equipment is required.
- The secondary purpose of the strainer, is to provide a convenient location for the air eliminator required in many systems. When no air eliminator is required, a blind cover is used on the strainer.

Functionality

The liquid enters the from the front (or rear), through the center of the basket. The liquid flows through the fine mesh screen, and turns 90 to enter the flow meter. Baskets are available with:

20 mesh	For high viscosity fluids (lube oil, etc.)
40 mesh	Diesel fuel, general purpose.
100 mesh	For gasoline/solvents.
200 mesh	For LPG service.

Assembly

The strainer can be assembled with the inlet from the front (standard) or the back (optional). Bolt pattern of the inlet flange and the basket cover are identical, so inlet position can easily be reversed in the field.

Installation

See page 7 for installation recommendations for the flow meter (& strainer). When installing the flow meter, allow sufficient space at strainer inlet, so that basket cover can be removed, and the basket extracted for cleaning. Space required is:

TS10A, TS15A & TS20A models:	Min. 10" (250 mm)
TS30A model . . . . . :	Min. 11" (275 mm)

Maintenance

Failure to follow Maintenance instructions may lead to damage to the strainer basket, and possible failure of the flow meter!

Prior to opening or disassembly of any accessory, 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.

- Check the strainer daily during the first week, or until no more debris is found in the basket.
- After the system has been thoroughly flushed, the strainer should be checked at least quarterly. The recommended frequency depends upon total volume, cleanliness of the product and specific operating conditions.

Troubleshooting & Service

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

Decreasing Flow Rate/No Flow

- Check strainer basket, it may be partially or fully clogged by sediment, particles or chunks of dried out product.
- Check pump & upstream valves if the basket is clean.
- Leaks around strainer basket cover
- Worn O-ring seal. Replace. Replace PTFE O-rings every time the basket is cleaned.
- Damaged O-ring seal due to hydraulic shock in the system. Replace and eliminate source of hydraulic shock conditions.

Meter locking up (oval gears do not turn)

- Inspect the strainer basket for possible particle penetration. Screen may have ruptured; this is commonly caused by failure to flush system adequately prior to startup, or be a part breaking off other equipment. Replace the strainer basket.
- If caused by powdery particles settling out of suspension during idle periods, the system may need to run 24 hours per day (circulating back to storage when not metering out).
- If rotors jammed on a particle:
- Inspect meter case for damage. Minor scratches can be smoothed with a fine grit sand paper. Major scratches may require replacement of meter case.
- Inspect oval gears for damage. Replace if necessary.
- Unidentifiable cause of flow meter calibration error
- Check strainer basket for particle penetration (ruptured mesh). If found, check meter case & rotors for damage.
- If no damage is found to the strainer basket, please contact the Fill-Rite Meters distributor for assistance.

Disassembly

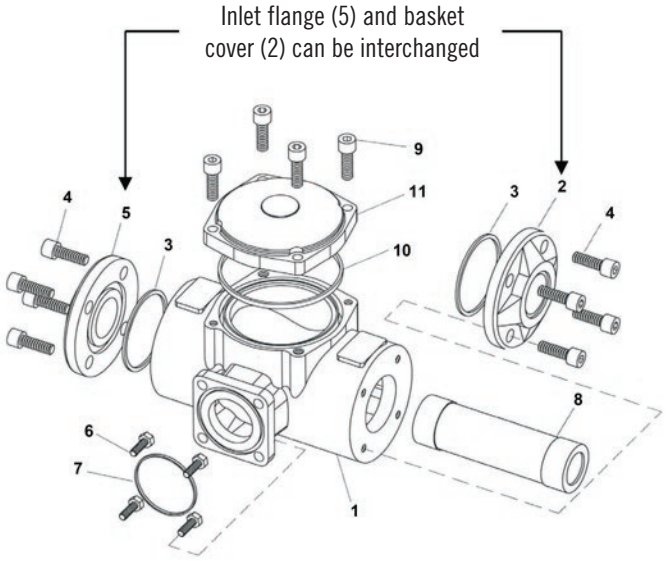
1. Clean the basket cover plate, so no external particles will fall into the strainer after opening. Remove 4 screws (4) from the basket cover plate (2).
2. Remove basket cover plate (2) and the O-ring (3) from the cover plate.
3. Carefully pull the strainer basket (8) straight out. If any dirt falls back into the strainer, clean it up so that it does not migrate into the flow meter. Wipe the strainer clean with a soft, lint free cloth.
4. Clean the basket by flushing with a cleaning agent compatible with the operating fluid. Use compressed air, or a soft brush, to release particles from the screen.

   Do NOT bang the basket against anything hard. This will dent the basket, and may cause problems with reinstallation and failure to seal.
5. Clean the inside of basket cover with a clean, lint free cloth.
6. Remove the O-ring (3) from basket cover (2), and inspect for wear or brittleness. Replace the O-ring if necessary (always replace PTFE O-rings).

Strainer (Continued)

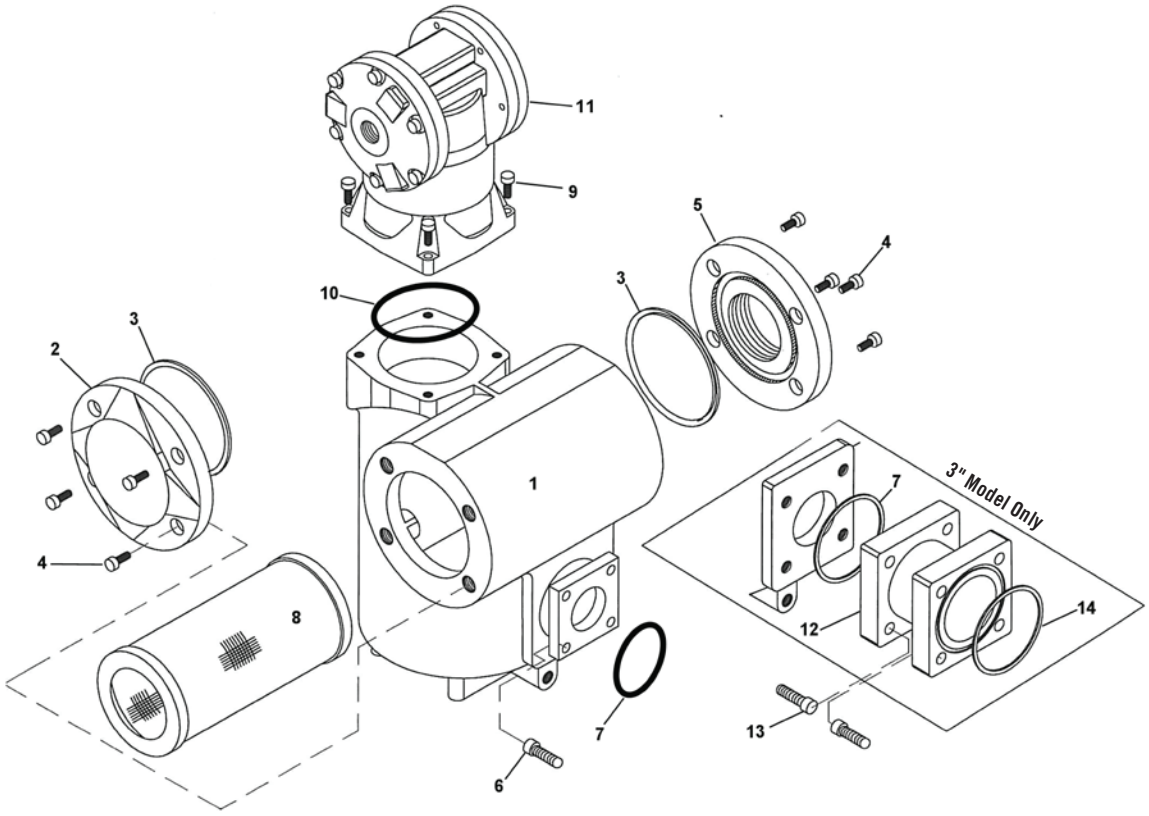
Re-Assembly

1. Replace the strainer basket (8) into strainer housing (1).
2. Inspect the O-ring and replace if necessary (always replace PTFE seals). Insert the O-ring (3) in the groove in the basket cover (2).
3. Attach basket cover (2) with 4 screws (4). Tighten the screws evenly.



ITEM	QTY	DESCRIPTION	2"/Viton	2"/PTFE	3"/Viton	3"/PTFE
1	1	Strainer housing w ith basket cover (#2, 1x#3 & 4x#4)	AC2505	AC2505-T	AC2515	AC2515-T
	Opt.	with Thermowell in basket cover	AC2510	AC2510-T	AC2520	AC2520-T
2	1	Basket cover, standard	MP2212	MP2212	MP2538	MP2538
	Opt.	Basket cover assembly with Thermowell	MP2212-1	MP2212-1	MP2538-1	MP2538-1
3	2	O-ring, strainer flanges	SL1334	SL2334	SL1350	SL2350
4	8	Screws, strainer flanges	FS2960	FS2960	FS2960	FS2960
5	1	Strainer **inlet flange** assy., incl. 1x#3 & 4x#4				
	Std.	**NPT** For model TS10A, 1"	FK1104-1	FK2104-1	na	na
		For model TS15A, 1½"	FK1154-1	FK2154-1	na	na
		For model TS20A, 2"	FK1204-1	FK2204-1	na	na
		For model TS30A, 3"	na	na	FK1304-1	FK2304-1
	Opt.	**BSP** For model TS10A, 1"	FK1105-1	FK2105-1	na	na
		For model TS15A, 1½"	FK1155-1	FK2155-1	na	na
		For model TS20A, 2"	FK1205-1	FK2205-1	na	na
		For model TS30A, 3"	na	na	FK1305-1	FK2305-1
6	4	Screw , mounting strainer to flow meter/adaptor	FS2960	FS2960	FS0920	FS0920
7	1	O-ring, strainer outlet flange	SL1233	SL2233	SL1233	SL2233
8	1	Strainer basket, 40 mesh	SA3008-040		SA3010-040	
	Opt.	20 mesh for high viscosity liquids	SA3008-020		SA3010-020	
	Opt.	100 mesh for gasoline/alcohols	SA3008-100		SA3010-100	
	Opt.	200 mesh for LPG service	SA3008-200		na	
9	4	Screws, attaching cover (or Air Eliminator assy)	FS9925	FS9925	FS9925	FS9925
10	4	O-ring, cover/air eliminator assy	SL1248	SL2248	SL1248	SL2248
11	1	Cover assy., incl. 9 & 10	FK1214	FK1214-T	FK1214	FK1214-T
	Opt.	Complete Air Eliminator assembly	See page 33		See page 33	
Not shown	1	Spacer to fit 2" strainer to TS15A model	FK1215	FK1215-T	na	na
	1	Adaptor to fit 2" strainer to TS10A model	FK1209	FK1209-T	na	na

Optional High Capacity Strainer for Enhanced Air Elimination



ITEM	QTY	DESCRIPTION	2"/Viton	2"/PTFE	3"/Viton	3"/PTFE
1	1	Strainer housing w ith basket cover (#2, 1x#3 & 4x#4)	AC2705	AC2705-T	AC2720	AC2720-T
	Opt.	with Thermowell in basket cover	AC2715	AC2715-T	AC2725	AC2725-T
2	1	Basket cover, standard	MP2538	MP2538	MP2538	MP2538
	Opt.	Basket cover assembly with Thermowell	MP2538-1	MP2538-1	MP2538-1	MP2538-1
3	2	O-ring, strainer flanges	SL1350	SL2350	SL1350	SL2350
4	8	Screws, strainer flanges	FS2960	FS2960	FS2960	FS2960
5	1	Strainer **inlet flange** assy., incl. 1x#3 & 4x#4				
	Std.	**NPT** For model TS20A, 2"			na	na
		For model TS30A, 3"	na	na	FK1304-1	FK2304-1
	Opt.	**BSP** For model TS20A, 2"			na	na
		For model TS30A, 3"	na	na	FK1305-1	FK2305-1
6	4	Screw , mounting strainer to flow meter/adaptor	FS2960	FS2960	FS0920	FS0920
7	1	O-ring, strainer outlet flange	SL1233	SL2233	SL1233	SL2233
8	1	Strainer basket, 40 mesh	SA3010-040			
	Opt.	20 mesh for high viscosity liquids	SA3010-020			
	Opt.	100 mesh for gasoline/alcohols	SA3010-100			
9	4	Screws, attaching cover (or Air Eliminator assy)	FS9925	FS9925	FS9925	FS9925
10	1	O-ring, cover/air eliminator assy	SL1248	SL2248	SL1248	SL2248
11	1	Complete Air Eliminator assembly	See page 33			
12	1	Spacer to fit HC strainer to TS30A model	na	na	FL5300	
13	8	Spacer to fit 2" strainer to TS15A model	na	na	FS1952	FS1952
14	1	Adaptor to fit 2" strainer to TS10A model	na	na	SL1233	SL2233

Air Eliminator (Vapor Eliminator for LPG Service)

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

Positive displacement meters cannot distinguish between liquid, and air/vapors. If air or vapors reach the flow meter, the rotors will turn and an inaccurate measurement results.

The first step towards avoiding flow meter error due to air or vapors, is to design the system so that air/vapors cannot enter the lines. In some systems (tank trucks, flow meters connected to multiple lines via hoses, etc.) this is not possible. In those systems an air or vapor eliminator becomes a necessary component.

- The air or vapor eliminator is designed to allow free air/vapors arriving ahead of the liquid to escape before entering the measuring chamber.
- Venting of entrained air/vapors depends upon these rising out of the liquid during passage of the strainer. Since release of entrained air/vapors is slowed on medium & high viscosity liquids, efficiency depends upon:
  - Size of the strainer below the air/vapor eliminator.
  - Flow rate versus line size.

  Reduced efficiency can be seen in high speed diesel fuel service. On higher viscosity liquids, such as lubricating oil and heavy fuel oils, the air/vapor eliminator efficiency is essentially limited to free air only.

Depending upon system design, type of service and how much air/vapors are present, additional components might be necessary to eliminate all air/vapors present:

- **Backpressure Valve** between strainer & flow meter.
- **Air Check Valve** *(**Differential Valve** in LPG service)* on flow meter outlet.

Functionality

The Air/Vapor Eliminator is installed in place of a blind cover on the Fill-Rite strainer assembly. It works on a gravity principle, with a float riding on a guide (shaft). The float is connected to two valve reeds, which block the eliminator vent ports when the float is in the UP position (when no air/vapors are present).

Any air/vapors separating from the liquid during passage of the strainer will rise into the air/vapor eliminator housing. As air/vapors accumulate, the float drops. In the DOWN position it pulls the two valve reeds away from the vent ports. System pressure now forces the air/vapors out, after which the float rises and valve reeds again block the vent ports.

When the Air/Vapor Eliminator vents, it is possible that a few drops of product will exit together with the air/vapors. *This is normal operation*, so vent ports should be piped back to storage, or to a collection tank, with piping sloping towards the tank.

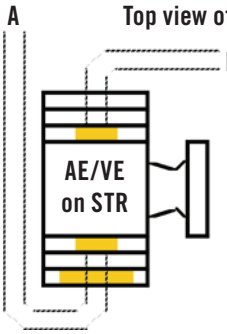
Assembly

With a square bolt pattern, the Air/Vapor Eliminator can be indexed on top of the Strainer in 90 increments. Normal installation is with vent ports facing front/back.

Installation

The Air/Vapor Eliminator is supplied installed on the strainer. The only field installation required is piping of vent ports, and possible connection to the Air Check Valve (if ordered).

Top view of AE or VE on Fill-Rite strainer



A: Vent line to collection tank or to storage. LPG service (Vapor Eliminator) always back to storage.

B: To Air Check Valve, if incl. in meter assy. LPG service (Vapor Eliminator) to the Differential Valve.

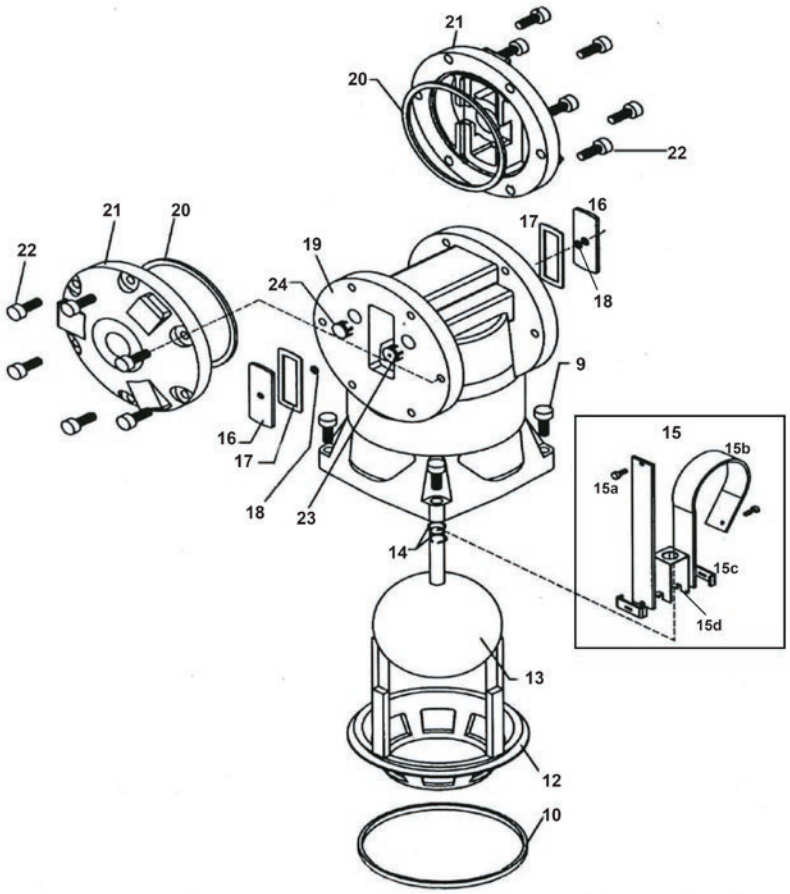
For flow meters without Air Check Valve, pipe one port to collection tank (or storage), and plug the other port. Piping should always slope towards the collection tank.

Maintenance

Prior to opening or disassembly of any accessory, 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.

- To replace orifice plates (16) and seal ring (20, 17 & 18):
  - Remove cover screws (22), and take off cover plates.
  - Replace orifice plates.
  - Replace seals (& gasket in PTFE fitted AE).
  - Reassemble, tighten cover screws to ft-lbs torque.
- To replace valve reeds (15), float assembly (13) and/or float guide (12):
  - Remove mounting screws (9), and lift the air eliminator away from the strainer.
  - You now have access to the float guide (12). Replace if necessary.
  - To replace valve reeds (RKAE21) or float assembly (RKAE20), remove the covers as explained above.
  - Release screws (15a) through the vent ports in the air eliminator housing (19). The float/valve reed assy (13/15) can now be removed through the bottom of the air eliminator.
  - Replace with RKAE20 or RKAE21 as needed.
  - Reassemble, tightening mounting screws to ft-lbs torque.

Air Eliminator (Vapor Eliminator for LPG Service) [Continued]



			Standard		for Air Check Valve	
ITEM	**QTY**	**DESCRIPTION**	**Viton**	**PFTE**	**Viton**	**PFTE**
	1	Complete Air Eliminator assembly	AE2010	AE2010-T	AE2015	AE2015-T
9	4	Screw , AE to STR, 3/8-16 X 1¼" SHCS, SS	FS2925		FS2925	
10	1	O-ring, strainer cover/air eliminator base	SL1248	SL2248	SL1248	SL2248
12	1	Float Guide, air eliminator	PL9400		PL9400	
13	1	Float assembly, air eliminator	SA3006		SA3006	
14	2	Spiral retaining ring	MS5005		MS5005	
15	1	Repair Kit, complete w ith 2 valve reeds, mounting block, 2 retainers & 2 screw s	RKAE21		RKAE21	
13/15	2	Same as RKAE21 + float assembly	RKAE20		RKAE20	
16	2	Orifice reed plate	ST9064-1	MF001100-001	ST9064-1	MF001100-001
17	2	Gasket, orifice reed plate	na	SL6010	na	SL6010
18	6	O-ring, orifice reed plate	na	SL001099-000	na	SL001099-000
19	1	Air eliminator housing, anodized aluminum	MP2205		MP2205	
20	2	O-ring, cover plate assy.	SL1155	SL2155	SL1155	SL2155
21	2	Cover plate, anodized aluminum	MP2207		MP2207	
22	12	Screw , cover plate, 5/16-18 x 1" PL SHCS	FS2900		FS2900	
23	1	Plug, limited bleed (for use w ith Air Check Valve)	na	na	MS2010-1	MS2010-1
24	1	Plug (for use w ith Air Check Valve)	na	na	MS2010	MS2010

Control Valves

A number of different control valves are required in most liquid handling systems. Some valves have direct bearing on flow meter operation or functionality; other valves serve system oriented purposes.

Fill-Rite can supply most control valves required for proper flow meter operation/functionality. Other valves for **the system** must be supplied by the company responsible for system design, the local equipment distributor, or the contractor responsible for system installation.

Fill-Rite currently manufactures:

- Backpressure Valve
- Air Check Valve
- Differential Check Valve (LPG service)
- Mechanical Preset Valve, max. 1,000 cSt
- Solenoid operated valve, 1-stage; max. 50 cSt
- Solenoid operated valve, 2-stage; max. 50 cSt

By-pass, Check, Isolation, Thermal Relief and other system control valves must be supplied by others.

Mechanical Preset (see separate manual)

2-stage shut-off must be used in preset (batching) service, whenever the flow rate exceeds 20 GPM (75 lpm). It must **always** be used when batching water directly from municipal supply line, regardless of flow rate.

When preset/batching function is required on liquids ***with viscosity exceeding limits shown above***, the common solution is a ball valve or butterfly valve, with a 2-stage pneumatic operator and 'Fail Safe' option (valve closes in case of power failure). While Fill-Rite can source such valves, local sourcing is strongly recommended. This ensures:

1. The most economical price to the buyer.
2. Ready access to service.
3. Local supply of spare parts in the future.

Electronic Preset (see separate manual)

These valves are based on the same valve body as the mechanical preset valve, with 1 or 2 solenoids added for single or dual stage shut-off. Single stage solenoid valves are intended as system security (on/off) valves only. For preset operation dual stage should always be used. Both single & dual stage solenoid valves are limited to viscosities around 50 cSt (225 SSU).

2-stage shut-off must be used in preset (batching) service, whenever the flow rate exceeds 20 GPM (75 lpm). It must **always** be used when batching water directly from municipal supply line, regardless of flow rate.

When preset/batching function is required on liquids with viscosity exceeding limits shown above, refer to above.

For loading rack service, preset valves with additional functions (Rate-of-Flow Control, Check, Pressure reducing or sustaining, etc) are available from OCV.

In loading rack service, always check pump capacity. *If one pump supplies product to multiple flow meters with lower capacity, then the flow meters must be protected against the full flow from the pump when only a single flow meter is in use. This usually requires a combination preset/ rate-of-flow control valve.*

Preset & Solenoid Control Valves are covered by a separate manual, while the Differential Check Valve is covered in the LPG meter manual. Parts lists for Backpressure & Air Check valves follow below.

Differential Check Valve (LPG Service)

The differential check valve (DCV) used in LPG service remains closed, until system pressure is high enough to ensure that only product in liquid phase will pass the flow meter.

For TS15A, TS20A & TS30A models, this is a straightthrough valve, which mounts directly on flow meter outlet.

For TS06A & TS10A models, this is a right-angle valve. It can be installed with outlet facing down, up, front or rear.

A 3-way solenoid valve is often included on the tubing between the vapor eliminator and the DCV. This valve serves as a system security valve.

Backpressure Valve

When a flow meter assembly includes an air eliminator, and there is limited system backpressure on the outlet of the flow meter, air eliminator efficiency is less than optimum. Some free air might pass through the flow meter. Adding a backpressure valve with 8- 10 PSI (0.6 BAR) spring tension between strainer outlet and flow meter inlet will improve on the air eliminator efficiency.

This valve is installed with the stem pointing into the strainer, with the disc assembly towards the flow meter. It is available in two sizes:

VP1901 Used in 2" strainer, with TS10A, TS15A & TS20A

VP1930 Used in 3" strainer with TS30A

The relevant repair parts are:

	VP1901	
Replacement spring	MS9050	Please
Washer	MS9056	consult for
Cotter pin	MS9055	3" valve

Air Check Valve

Air Check Valve

The air check valve (ACV) is a mechanical valve, which can be added to flow meters with air eliminator. A connection (pipe, hose or tubing, to conform to local codes) must be made between one of the air eliminator vent ports (1" NPT), and the port on the ACV (3/8" NPT). This connection must be made at time of installation.

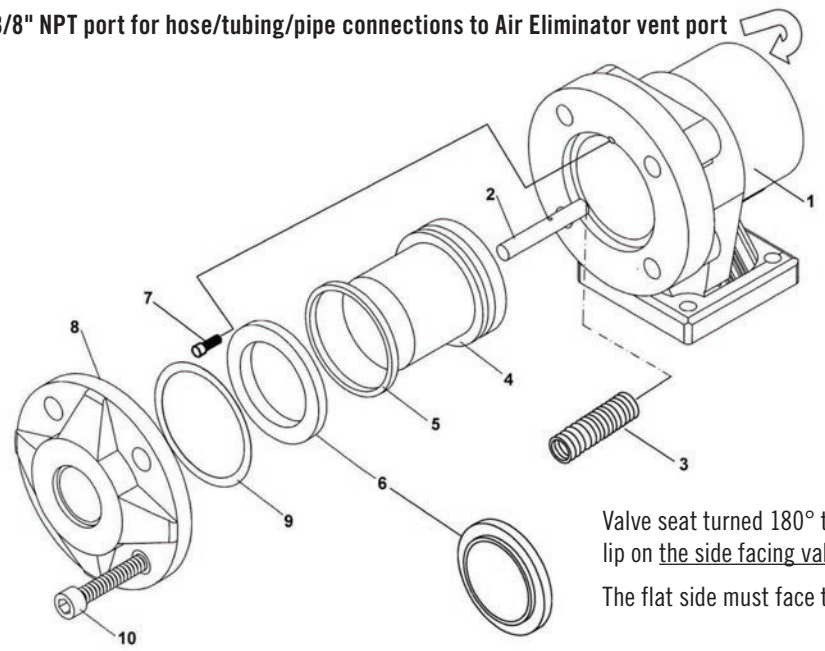
If this valve is added to an existing flow meter in the field, add items 23 & 24 (see page 33) to the air eliminator.

In normal operation system pressure overcomes the spring behind the piston in the ACV, forcing the valve to open position. When the air eliminator vents, system pressure is connected to the back of the piston. With pressure equalized across the piston in the ACV, the spring behind the piston now moves the piston into closed position.

When the air has been vented and the air eliminator closes, system pressure is bled off the back of ACV piston. At this point, system pressure again overcomes the spring in the ACV, and the valve opens again.

- If there is no preset valve, the air check valve is installed with outlet toward the FRONT, unless otherwise specified.
- If the flow meter includes a preset valve (mechanical or solenoid), the air check valve is installed with outlet facing DOWN, unless otherwise specified.

3/8" NPT port for hose/tubing/pipe connections to Air Eliminator vent port



Valve seat turned 180° to show the lip on the side facing valve body.

The flat side must face the flange.

REF	DESCRIPTION	2" Air Check Valve for TS10A, TS15A & TS20A			3" Air Check Valve for TS30A		
		QTY	VP2250-1 Viton	VP2257-1 PTFE	QTY	VP2310-1 Viton	VP2313-1 PTFE
-	**Mounting adaptors:**				-	not applicable	
	1" x 2" adaptor for **TS10A** only	1	FK1209	FK1209-T			
1	Valve body	1	MP2450-1	MP2450-1	1	MP2332	MP2332
2	Shaft/guide for piston	1	MP8050	MP8050	1	MP8038	MP8038
3	Spring	1	MP9207	MP9207	1	MS9211	MS9211
4	Piston	1	MP2451	MP2449	1	MP2654	?
5	U-cup seal	1	SL1332-U	SL2230-U	1	SL1419-U	SL2419-U
6	Seat ring	1	MP8052	MP8052	1	MP2653	MP2653
7	Screw, seat ring	2	FS0658	FS0658	2	FS0658	FS0658
8	Companion Flange	1	See page 15		1	See page 15	
9	Gasket, companion flange	1			1		
10	Screw, companion flange	4			4		
11	Plug to retrofit Air Elim. (#25)	1	MS2010	MS2010	1	MS2010	MS2010
12	Plug to retrofit Air Elim. (#26)	1	MS2010-1	MS2010-1	1	MS2010-1	MS2010-1

Notes

FILL-RITE®

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