FILL-RITE®

A GORMAN-RUPP COMPANY

FILL-RITE OVAL GEAR METERS™

TS SERIES ELECTRONIC - SCL & TBB

Installation and Operation Manual

MADE IN USA WITH GLOBAL MATERIALS

JME ELLSWORTH
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MODEL #	
SERIAL #	
PURCHASE DATE:	

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About This Manual

From initial concept and design through its final production, your Fill-Rite Oval Gear Meter 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).

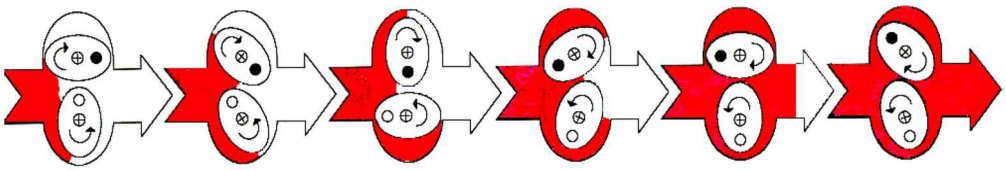
About Electronic Oval Gear Meters

Fill-Rite Oval Gear Meters are supplied with a TBB (Terminal Block Board) for meters with an unscaled pulse output. The TBB board provides a quadrature output as well as an index pulse that is 1/64th the resolution of the A and B quadrature channels.

The SCL board is supplied with all Fill-Rite Oval Gear Meters with a scaled pulse output. The SCL may also be used as an alternative to the Terminal Block Board (TBB) depending on supply voltage requirements and if the electric register is sensitive to quadrature jitter. The SCL can also function as an electronic calibrator if desired.

The TBB and SCL boards provide Intrinsic Safety if used with an appropriate Safety Barrier.

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.

The flow meter is 100% glandless with static O-ring seals only. Internal magnets are detected by a sensor (pulser) mounted in flow meter case. The pulser generates an electrical on/off signal, which can be used to drive a signal conditioner or an electronic register.

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.

General Wiring Information - Cable & Field Wiring

- Use quality stranded copper wire of 24 AWG minimum. Do not use copper plated steel wire.
- A cable with foil or braided shielding is recommended with an optional drain wire.
- The use of crimp ferrules is recommended at the screw terminals to protect against shorts from stray strands of wire.
- If using an Intrinsically Safe Barrier, the board specific control drawing defines additional cable and barrier requirements.
- If using a drain wire, **DO NOT** terminate it to the SCL or TBB Ground terminal as this can induce unwanted electrical noise into the meter. It is always best to clip the drain wire close to the cable jacket after the entry into the meter's junction box.
- Do not exceed the rated voltage or damage to the electronics can occur.
- The SCL board has onboard protection against reverse voltage but will be damaged if incorrectly connected for an extended period.
- Cable length should not exceed 200 feet (60 meters) unless a larger gauge heavily shielded cable is used, or an external pulse amplifier is used.
- A power supply of 100mA minimum is recommended.
- In high ambient temperature conditions > 40°C / 104°F, limit maximum supply voltage to 12 Vdc to maximize the life of the electronics.

General Wiring Information - Connection Tips

- The connections to the A & B terminals or at the electronic register may be switched if the system incorrectly indicates reverse flow.
- For single channel applications such as a PLC with simple counter or a basic fuel management system, Channel A or Channel B connections may be used. Only one must be connected for correct operation. Do not connect both Channel A and B together into the same input to prevent damage.
- Typical electronic registers will accept a connection to Terminals (Channels) A and B. This provides a true quadrature signal capable of registering positive and negative flow through the meter. Use of 1X, 2X, or 4X quadrature decoding is acceptable if the register provides the option. 1X decoding will be less sensitive to quadrature jitter.
- If the Junction Box is wired using conduit, take care to ensure condensation cannot accumulate within. Avoid a direct air path in the conduit between a warm or humid environment and a cold environment such as under a truck. Use a proper conduit seal off or vapor barrier such as an expanding polyurethane foam within a section of the conduit close to the meter.

⚠ WARNING

Electrical wiring should be performed ONLY by a licensed electrician in compliance with local, state, and national electrical code NEC/ANSI/NFPA 70, NFPA30, and NFPA 30A, as appropriate to the intended use of the meter. The meter must be properly grounded. Improper installation or use of this meter can result in serious bodily injury, or death.

Electronics Access / Junction Box

The TBB or SCL board are contained within a junction box similar to what is shown to the right. When removing the cover, take care not to scratch or damage the mating surfaces as these are environmental and flame proof joints. These joints are not intended to be repaired. If the cover is stuck after removal of the screws, light taps with a soft faced mallet will free the cover. **DO NOT ATTEMPT TO PRY THE COVER OFF.**

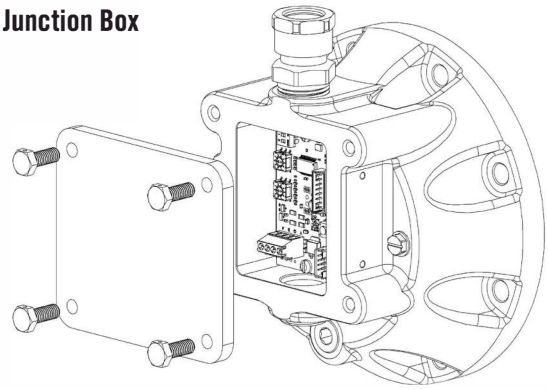
Always clean the surfaces using a clean towel prior to reassembly.

The meter is supplied with an Explosion Proof cable gland for Explosion Proof applications or a cord grip for Intrinsically Safe application. Both cord grips have a 1/2 -14 NPT thread and an IP65 rating.

If replacing the Explosion Proof cable gland for service, it must be replaced with an equivalent gland that meets the local requirements. Alternatively rigid conduit will local approved seal offs may be used. Always use a thread sealant or tape at the threaded entry into the junction box to ensure a watertight seal.

Any suitable cable gland may be used for Intrinsically Safe applications as well as rigid conduit. All replacement glands must have a collapsible ID of 0.12 / 0.32 in (3.0 / 8.0 mm) when using the supplied cable. Always use a cable gland rated for Class I, Division I, Group C AEx d II B T4 1/2 - 14 NPT with a minimum IP65 rating for the application that meets locale safety requirements. Replacement glands must have a minimum service temperature range of -20°C / -4°F to +75°C / 167°F. The cable gland nut is typically torqued to 22 ft-lb (30 N/m) to ensure a watertight seal.

Junction Box



TBB Board

TBB Specifications

- Input Voltage: 5 Vdc to 12 Vdc or 24Vdc (24Vdc connection is not Intrinsically safe)
- Input Current: 25ma @ 5 Vdc
- Regulatory Operating Temperature: -20°C / -4°F to +60°C / 140°F
- Non-Regulatory Operating Temperature: -40°C / -40°F to +70°C / 158°F
- Input signal: Quadrature sensor
- Intrinsically safe when used with an approved Intrinsically safe barrier per drawing CD1008.

TBB Customer Connections (TB1)

A 6-position screw terminal is provided for customer connections.

A: *Current Sinking Quadrature Channel A*

B: *Current Sinking Quadrature Channel B*

I: *Current Sinking Quadrature Index Channel*

G: *Vdc ground*

12: *5 Vdc to 12 Vdc supply*

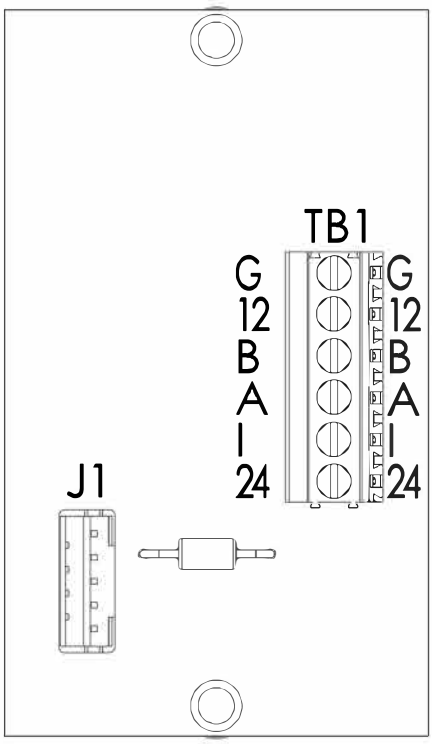
24: *24 Vdc supply (must not be used for intrinsically safe applications)*

- The output levels of Channel A, Channel B, and Channel I are typically 0.5 to 0.7 Vdc less than the supply voltage applied to terminal 12.
- The output levels of Channel A, Channel B, and Channel I are typically 14-16 Vdc when 24Vdc is applied to terminal 24.
- The meter sensor will be connected to J1.

TBB Output (A, B, I Channels)

- Quadrature Pulse
- Current sinking 20mA Max with 10k ohm internal pull up resistors.
- Duty Cycle: Symmetrical Quadrature with 50/50 duty cycle
- Output pulse on-time: Varies with flow rate.
- Output Frequency: Equivalent to natural resolution of the meter

TBB Board



SCL Board

The quadrature output from the SCL board is scaled to how the meter was ordered and configured. The SCL board provides 1K internal pull up resistors. Typically, external pull up resistors are not required

SCL Specifications

- Input Voltage: 5 Vdc to 24 Vdc
- Input Current: 35ma @ 5 Vdc
- Regulatory Operating Temperature: -20°C / -4°F to +60°C / 140°F
- Non-Regulatory Operating Temperature: -40°C / -40°F to +70°C / 158°F
- Input signal: Quadrature sensor
- Diagnostic LEDs for the input and output channels
- Intrinsically safe when used with an approved Intrinsically safe barrier per drawing CD1007.

SCL Output

- Quadrature Pulse
- Current sinking 20mA Max with 1k ohm internal pull up resistors.
- Output Voltage: 0.5 to 0.7 Vdc less than the supply voltage
- Output pulse on-time: Fixed based on the meter flow rate unless specifically requested.
- Duty Cycle: Symmetrical Quadrature with 50/50 duty cycle
- Output Frequency: (Input Frequency) X (ECF) Scaled to application.
- Calibrator Range: +/- 3.0%

SCL Switches

S1: Allows choice of either single channel or quadrature decoding. If the electronic register is sensitive to dithering, switching S1 **"ON"** will ignore one input channel and produce a pseudo quadrature output. If S1 is **"ON"**, meter will not indicate reverse flow. The meter ships with S1 turned **"OFF"** by default.

S2: Used in conjunction with S3 and S4. If in the minus (-) / **"ON"** position, an increase in S3 and S4 switch settings will decrease pulse output. A decrease in pulse output will increase volume in a prover vessel. If in the plus (+) / **"OFF"** position, an increase in the S3 and S4 will increase the pulse output. An increase in pulse output will decrease the volume in the prover vessel.

S3/S4: Adjust the SCL pulse output up or down +/-3.0%. S3 and S4 will allow for 00-99 settings. Each increment changed in this setting changes the SCL pulse output by approximately 0.03%.

S5/Reset Button: Pressing the button will reboot the SCL board after a change to the S1 – S4 switches. Optionally, the SCL may be power cycled for a minimum of 2 seconds to initiate a reboot.

SCL Customer Connections (TB1)

A 4-position screw terminal is provided for customer connections.

A: *Current Sinking Quadrature Channel A*

B: *Current Sinking Quadrature Channel B*

G: *Vdc ground*

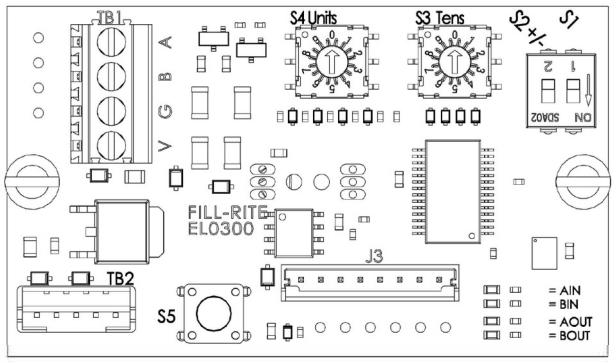
V: *5 Vdc to 24 Vdc supply*

- The output levels of Channel A and Channel B are typically 0.5 to 0.7 Vdc less than the supply voltage applied to terminal V.
- The meter sensor will be connected to TB2.

SCL LEDs

- The SCL board has LEDs to indicate when the board is receiving counts from the sensor and when it is sending counts to the receiving electronic registration device.
- The intensity and speed at which the LEDs blink change with the speed of the meter. At higher flow rates, it is normal for the LEDs to appear solid. At low flow rates, the LEDs will blink in an alternating pattern.
- The AIN and BIN LEDs are the incoming sensor signal from the meter. If during normal meter operation, the LEDs are not blinking, then the SCL board is not receiving power, or the sensor has failed. It is normal for one or both LEDs to remain lit after fluid flow has stopped.
- The AOUT and BOUT LEDs flash with each quadrature signal sent to the receiving electronics. It is normal for the rate and intensity of the blinking to be different than the rate and intensity of the AIN and BIN LEDs.

SCL Board



Meter Calibration

After installation, the meter should be calibrated as part of the commissioning process. Always keep records of the initial and any subsequent calibrations including date and any percent change in calibration.

The meter specification plate will have the original number of counts per gallon or liter marked as delivered from the factory. Use this value as a starting point for a new installation.

Depending on the register manufacturer the tagged pulse rate may need to be multiplied by 4 for correct registration using 4X quadrature decoding.

Meter Calibration Tips:

- Flow meter calibration should be performed using a minimum volume equal to 1 minute of flow at maximum flow rate.
- All tests should be performed 3 times under identical conditions to confirm repeatability.
- Do not switch between different proving vessels or methods for the calibration process.
- Maintain a permanent file for each flow meter, and record % change each time the meter is recalibrated. When the change is significantly higher than that was recorded in previous recalibrations, it may be time to rebuild the flow meter (replace the oval gear set).
- If there is a significant jump in the needed correction factor versus the as commissioned or prior state, the oval gears are likely worn or damaged. Replacement of the oval gear set should be considered, rather than letting further wear cause rubbing of flow meter housing.

Meter Calibration using the TBB Board

- Any changes to the Meter K-Factor will have to be performed within the electronic register. The TBB board does not allow adjustment of the K-Factor.

Meter Calibration using the SCL Board

- The calibrator switches allow you to adjust the output of the SCL up or down +/- 3% in increments of 0.03%. Alternatively, you can still adjust the Meter K-Factor at the electronic register.
- After calibrating a known volume (X) into an accurate prover (or through a master meter with adequate resolution), compare with register reading (Y) and calculate correction:

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

To reduce the volume in a prover vessel (can), place switch S2 in the plus (+) position.

- Adjust the S3 and S4 switches to the position required for the necessary volume reduction in the prover can. Switch S3 and S4 represent readings of 00 to 99, and each increment will adjust the output approximately 0.03%.

SCL Board Meter Calibration Example

Using a 20 gallon (75.7 liter) can, the can reads 113.5 ml high. The meter error is (113.5/75700) = 0.0015 or 0.15%. To adjust the meter output, place S2 in the positive position, and set S3 and S4 to read 05. This is approximately a 0.15% adjustment. Press the Reset push button (S5) to enter the new calibration settings. Retest the flow meter.

To increase the volume in the prover vessel. Place switch S2 in the negative (-) position and set switches S3 and S4 to the proper settings to adjust the output. Press the Reset push button switch to read the new switch positions.

Note: If S2 is in the plus (+) position, and S3 and S4 are at 15 as an example, then moving the position of S3 and S4 to 00 will provide a (0.03 x 15) = 0.45% increase in the prover volume. To obtain a greater increase in the prover volume, S2 must be placed in the minus (-) position and S3 and S4 rotated to the proper position to obtain the desired change in pulse resolution. The opposite is true if S2 is already in the minus (-) position at the beginning of calibration.

Lastly, re-seal the flow meter junction box. Enter date and % correction on the permanent flow meter record.

Safety Testing Approvals – Flame-Proof / Explosion-Proof

All models except the TS06 Series.

FILL-RITE

Intertek 3138124

Conforms To UL STDS 1203, 50, & 50E

Certified To CSA STDS C22.2 # 60079-0, 60079-1, 94.1, & 94.2

WARNING - DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.

ADVERTENCIA - NO SE ABRE CUNANDO UNA ATMOSFERA EXPLOSIVA PUEDE ESTAR PRESENTE

CONDUIT SEAL REQUIRED WITHIN 18" (0.45 METER) OF ENCLOSURE (US AND CAN)

Ex II 2 G CE 2809 ITS07ATEX15709X

CLASS I, ZONE 1, GROUP 11B

CLASS I, DIVISION 1, GROUP C T4

-20°C < TA < +60°C TYPE 4X / IP65

Ex db IIB T4 Gb Ta=60°C

IECEx ITS 08.0045X

ETL23CA105357868X

MODEL # _____

SERIAL # _____

THE FOLLOWING STANDARDS WERE USED TO SHOW COMPLIANCE IN THE EUROPEAN UNION:

EN IEC 60079-0:2018

EN 60079-1 :2014

Directive 2014/34/EU

THE FOLLOWING STANDARDS WERE USED TO SHOW COMPLIANCE FOR IECEX CERTIFICATION:

IEC 60079-0:2017

IEC 60079-1 :2014

SPECIFIC CONDITIONS OF USE: JOINTS ARE NOT INTENDED TO BE REPAIRED.

WARNING - DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.

CONDUIT SEAL REQUIRED WITHIN 18" (0.45 METER) OF ENCLOSURE (US AND CAN)

Safety Testing Approvals – Intrinsically Safe

TS06A and TS06C Models

FILL-RITE

Ex II 1 G CE 2809

Ex ai IIA T4 GA

WARNING - DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.

ADVERTENCIA - NO SE ABRE CUNANDO UNA ATMOSFERA EXPLOSIVA PUEDE ESTAR PRESENTE

CONDUIT SEAL REQUIRED WITHIN 18" (0.45 METER) OF SP (US AND CAN)

THE FOLLOWING STANDARDS WERE USED TO SHOW COMPLIANCE IN THE EUROPEAN UNION:

EN IEC 60079-0:2018

EN 60079-11 :2012

SPECIFIC CONDITIONS OF USE: JOINTS ARE NOT INTENDED TO BE REPAIRED.

WARNING - DO NOT OPEN WHEN AN EXPLOSIVE ATMOSPHERE MAY BE PRESENT.

CONDUIT SEAL REQUIRED WITHIN 18" (0.45 METER) OF SP (US AND CAN)

Warranty

Fill-Rite Warranty does not extend to damage due to corrosion, salt deposits, or separation of chemicals – whether occurring during periods of operation or storage. Non-Fill-Rite items, such as electronic registers, are covered by the original manufacturer warranty, but will be handled through Fill-Rite if the register was supplied by Fill-Rite. Components added after shipment from Fill-Rite, such as hose, nozzles & similar, are the responsibility of the distributor or contractor selling the installation.

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GR GORMAN-RUPP COMPANY The Pump People