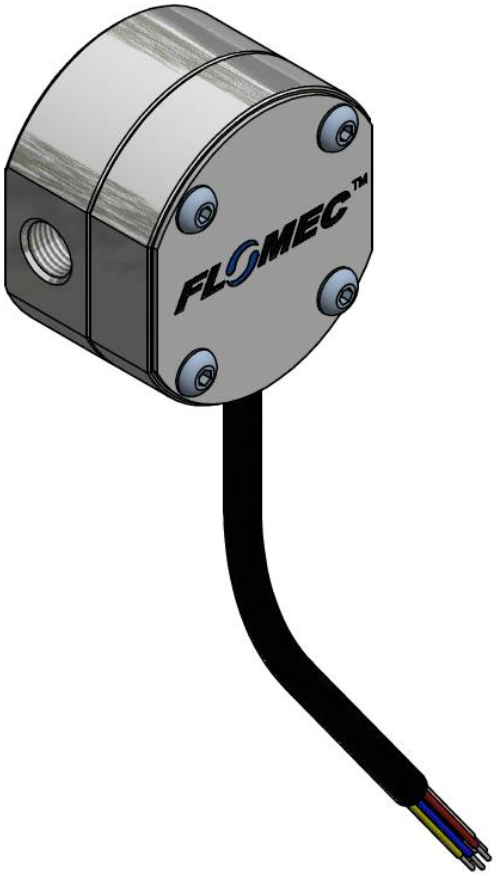
EGM Series Oval Gear Flow-meters

Operation Manual



Version 3216

General Information

This manual provides the necessary information for operation and maintenance of your Oval Gear flow-meter; for information on any integral electronics or accessories fitted to your flow-meter please consult the relevant electronics or accessory manual. Your Oval Gear flow-meter should only be installed and maintained by persons familiar with local regulations, particularly those for workplace Health and Safety.

For best results, please make yourself familiar with the contents of all relevant product manuals prior to installation and commissioning. If further assistance is required please consult the distributor from whom you purchased your flow-meter.

CAUTION
Your flow-meter and any associated electronics are precision instruments, to avoid unnecessary damage please treat them with care.

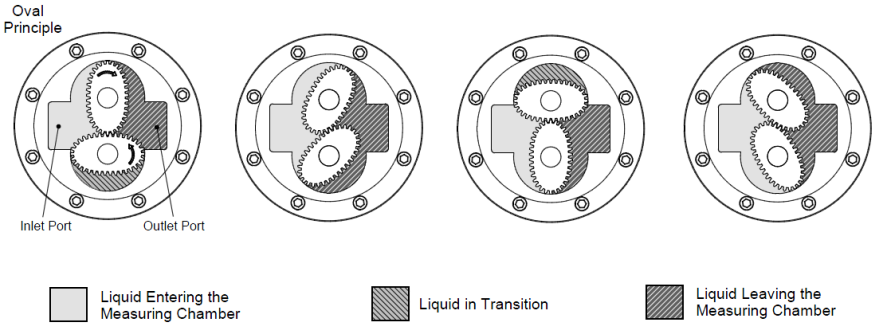
Table of Contents

1. Introduction

The Oval gear meter is a precise positive displacement flow-meter incorporating a pair of oval geared rotors. These meters are capable of measuring the flow of a broad range of clean liquids.
Stainless Steel flowmeters are suited to most liquid products and chemicals; including many water based liquids, acids, bases and salt solutions, and Aluminium meters are suitable for fuels, fuel oils & lubricating liquids.
EGM Series Oval Gear flow-meters provide a pulse signal output capable of interfacing to most monitoring and control systems, such as a PLC or DCS. The cable output from the flow-meter can also be wired to instruments such as totalisers, rate totalisers or batch controllers. These instruments are available from your Flomec distributor and can be purchased with monitoring and control output options including 4-20mA, scaled pulse, flow-rate alarms and batch control logic *(preset metering*).

1.1 Operating Principle

Oval Gear flow-meters are positive displacement devices where the passage of liquid causes two oval geared rotors to rotate within a precision measuring chamber. Each rotation of the Oval rotors will transmit 4 identical volumes of liquid from the meter inlet to outlet *(as shown in the diagram below)*; providing electronic pulses via magnetic sensors to a digital instrument.



1.2 Specifications

1.2.1 Small Capacity Models

Model	EGM004	EGM006	EGM008
Nominal Size	4mm / 1/8"	6mm / 1/4"	8mm / 3/8"
Nominal 3cP Flow range *(L/hr)*	1 ~ 36	2 ~ 100	15 ~ 550
Nominal 3cP Flow range *(GPH)*	0.26 ~ 9.5	0.5 ~ 26.4	4 ~ 145
Accuracy *(liquids ≥ 3cP)*	± 1% of reading		
Additional error for Uncalibrated Meters	± 1% of reading		
Repeatability *(liquids ≥ 3cP)*	Typically ± 0.03%		
Temperature Rating	-15°C ~ +80°C *(5°F ~ +176°F)*		
Pressure Ratings – Bar *(PSI)*			
Aluminium	34 (500)	34 (500)	34 (500)
Stainless Steel	55 (800)	55 (800)	34 (500)
Flow Ranges for Various Viscosity Liquids - L/hr (GPH)			
1cP [1]	2 ~ 24 (0.53 ~ 6.3)	5 ~ 80 (1.3 ~ 21.1)	18 ~ 440 (4.8 ~ 116.2)
7cP	0.5~36 (0.13 ~ 9.5)	1 ~ 100 (0.26 ~ 26.4)	15 ~ 550 (4.0 ~ 145.3)
200cP	0.4~36 (0.11 ~ 9.5)	0.7 ~ 100 (0.19 ~ 26.4)	6 ~ 550 (1.6 ~ 145.3)
500cP	0.25~27 (0.07 ~ 7.1)	0.5 ~ 100 (0.13 ~ 26.4)	2 ~ 550 (0.53 ~ 145.3)
1000cP [2]	0.12~16 (0.03 ~ 4.2)	0.3 ~ 45 (0.08 ~ 11.9)	1.5 ~ 360 (0.40 ~ 95.1)
Nominal Output Pulse Resolution – Pulses/Litre *(Pulses/USGallon)*			
Standard Hall Effect	2800 *(10600)*	1060 *(4012)*	720 *(2725)*
Fuel Consumption Option	2800 *(10600)*	1060 *(4012)*	180 *(681)*
Minimum Filtration	75 micron *(200 mesh)* [3]		

Notes:

1. *When operating on 1cP liquids the meters may be used up to the nominal (3cP) maximum flow rate rating for intermittent periods only.*
2. *For applications above 500cP the maximum flowrate must be reduced according to the table above, for applications above 1000cP the maximum flow rate must be reduced further in order to limit the maximum pressure drop across the meter to below 1Bar (14.5psi). Consult the manufacturer if you are unsure.*
3. *Filtration requirements are for soft particles only; hard particles of any size are not acceptable.*

1.2.2 Medium Capacity Models

Model	EGM015	EGM020
Nominal Size	15mm / 1/2"	20mm / 3/4"
Nominal 3cP Flow range *(L/min)*	1 ~ 40	3 ~ 80
Nominal 3cP Flow range *(GPM)*	0.3 ~ 10.6	0.8 ~ 21.1
Accuracy *(liquids ≥ 3cP)*	± 0.5% of reading	
Additional error for Uncalibrated Meters	± 0.5% of reading	
Repeatability *(liquids ≥ 3cP)*	Typically ± 0.03%	
Temperature Rating	-15ºC ~ +80ºC *(5ºF ~ +176ºF)*	
Pressure Ratings – Bar *(PSI)*		
Aluminium	20 (290)	20 (290)
Stainless Steel	20 (290)	20 (290)
Flow Ranges for Various Viscosity Liquids - L/min (GPM)		
1cP [1]	1.5 ~ 32 (0.40 ~ 8.45)	5 ~ 64 (1.32 ~ 16.9)
7cP	0.5 ~ 40 (0.13 ~ 10.57)	2 ~ 80 (0.53 ~ 21.1)
200cP	0.4 ~ 40 (0.11 ~ 10.57)	1.8 ~ 80 (0.48 ~ 21.1)
500cP	0.3 ~ 40 (0.08 ~ 10.57)	1.5 ~ 80 (0.40 ~ 21.1)
1000cP [2]	0.2 ~ 25 (0.05 ~ 6.60)	1 ~ 50 (0.26 ~ 13.2)
Nominal Output Pulse Resolution – Pulses/Litre *(Pulses/USGallon)*		
Standard Hall Effect	170 *(644)*	105 *(398)*
Fuel Consumption Option	42.5 *(161)*	26.3 *(99.5)*
Minimum Filtration	75 micron *(200 mesh)* [3]	

Notes:

4. *When operating on 1cP liquids the meters may be used up to the nominal (3cP) maximum flow rate rating for intermittent periods only.*
5. *For applications above 500cP the maximum flowrate must be reduced according to the table above, for applications above 1000cP the maximum flow rate must be reduced further in order to limit the maximum pressure drop across the meter to below 1Bar (14.5psi). Consult the manufacturer if you are unsure.*
6. *Filtration requirements are for soft particles only; hard particles of any size are not acceptable.*

1.2.3 Electrical Specifications

Standard Pulse Output		
Hall Effect Output	Output Type	NPN Open Collector
	Voltage Range	5 ~ 24VDC (±0.5%)
	Current Draw	20mA Maximum
	Switching Current	10mA Maximum
Fuel Consumption Option		
Hall Effect Output	Output Type	NPN Open Collector
	Voltage Range	5 ~ 24VDC
	Current Draw	20mA Maximum
	Switching Current	10mA Maximum
RTD Output	Sensor Type	Platinum Resistance According to IEC 60751
	Nominal Resistance	100 Ohm
	Temperature Coefficient	3850 ppm/K
	Tolerance Class	F0.3 / Class B
	Maximum Measurement Current	0.1mA ~ 1.0mA

2. Pre-Installation

All flow-meters are inspected and calibrated prior to shipment, and are sent out in perfect condition. Should damage be present on receipt of the product please inspect the delivery packaging for visible mishandling and contact the parcel service / freight forwarder. Flow-meters are shipped with protective plugs/caps in all openings; these should be maintained until the product is ready for installation, failure to do so will expose the precision internal components of the flow-meter to dust and dirt and may cause damage of the flow-meter.

CAUTION

Please note that all factory calibrated flow-meters are tested with ***Castrol Diesel Calibration Fluid 4113*** immediately prior to shipment, and while every effort is taken to adequately drain the product prior to packaging and shipment, some residual oil will be present. Please take the appropriate precautions that would be taken with any mineral oil, and should an MSDS be required this is available from the manufacturer or via an internet search.

Prior to installing your flow-meter it is recommended that the following application conditions are checked:

- That the fluid being metered is compatible with the materials of construction of the flow-meter: Aluminium meters are generally only suitable for fuels and oils, if you have purchased an Aluminium meter for a water based liquid please check suitability with your Flomec distributor prior to installation
- That the system pressure and temperature are within the limits shown on the flow-meter name-plate.
- That the maximum and minimum flow rates are within the specification of the flow-meter
- That the liquid being metered is free of any particles
- That the meter is not exposed to temperatures *(system or ambient)* that may cause the liquid to flash (convert to a gas) within the flow-meter
- If measuring a high viscosity liquid, confirm that the maximum flow-rate of the flow-meter has been appropriately de-rated so as to limit the maximum pressure drop across the meter to 100kPa (1bar, 14.5psi). ***For viscosities less than 1000cp please see the spec table in section 1.2***

2.1 Pre-Installation Testing

Testing of a flow-meter before installation is a common source of mistakes that has the possibility to permanently damage your flow-meter. Tests should always be carried out in conditions that match the operation parameters that the meter was selected for; most importantly flow rate and chemical compatibility. Testing of Aluminium meters on water is not recommended however it is possible without damage so long as all of the water is removed from the meter following the test. Aluminium meters tested on water should always be dried after testing, as stagnant water will cause corrosion of Aluminium.

CAUTION

Never test an Oval Gear flow-meter on compressed air; to do so will cause dry running and over speeding of bearings, leading to premature wear and failure.

Any flow-meter which is individually calibrated at the factory will be factory marked with its respective K-Factor (Pulses/Litre or Pulses/Gallon); there is typically no reason to carry out any pre-installation accuracy testing on these meters. For those users that wish to carry out pre-installation testing or calibration of a non-calibrated model, it is important that the test procedure be carried out scientifically or the results of the test will be meaningless. Particular cases that may benefit from field calibration or accuracy testing are those with liquids of very low viscosity (<1cP).

For any field calibration of your flow-meter it is important to consider the accuracy of your calibration procedure, and of your volume standard. Calibration of your flow-meter using a volume standard of unknown accuracy will produce poor results; a bucket or Intermediate Bulk Container (IBC) should never be used as a volume standard. Ideally your volume standard must be large enough to contain at least 2 minutes of flow at the nominal system flow rate, and the flow-meter should not be operated below its minimum flow-rate at any point during the calibration run.

3. Mechanical Installation

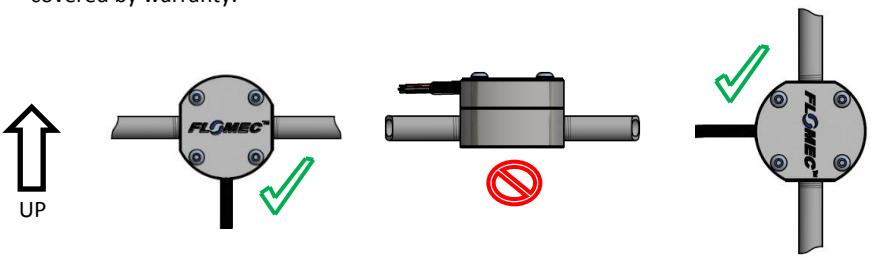
It is strongly advised that before installation of your meter, you thoroughly read and understand the information presented in this section, as failure to install your meter according to the guidelines below may cause permanent damage to your meter, or a reduction in system performance and reliability. Any damage to your flow-meter as a result of incorrect installation or start-up procedure will not be covered by the manufacturer's warranty.

Fluid entering the meter must remain a liquid at all times; avoid solidification or gelling of the metered medium. If meters are to be trace heated or jacketed in any way the maximum temperature rating of the meter must not be exceeded.

If hydraulic shock or pressure surges of any kind are possible, the system upstream of the meter must be fitted with a surge suppressor or pressure relief valve to protect the meter from damage. High frequency flow pulsations will create erroneous readings and in extreme cases may damage the meter; most pulsations are removed with the installation of a suitable pulsation dampener.

3.1 Installation Orientation

Almost all positive displacement flowmeters have a specific mounting orientation that must be adhered to in order to limit the loads on the rotor thrust bearings. Failure to mount your Oval Gear flow-meter in the correct orientation *(as shown in the diagrams below)* will cause the weight of the rotors to bear down on the thrust bearings, and on the floor of the measuring chamber. The short term effects of incorrect mounting orientation will be a loss in accuracy, with long term effects ranging from reduced lifespan to complete failure of the flowmeter. Damage caused by an incorrect mounting orientation is not covered by warranty.



Liquid can flow in a horizontal direction, or a vertical direction, but in each case the rotor shafts must be in a horizontal plane. The direction of flow is not important, as the output is non-directional; for any installations where pulses from reverse flow are not desired a check valve (or other suitable non-return valve) should be used.

3.2 Piping Construction

Pipe work design and construction is a factor that can have a significant impact on the operational performance of your flow-meter. A correctly designed piping system will protect the flow-meter from damage from pipe-stress, will limit external effects on system accuracy, and will provide a system that is easy and economical to maintain.

For best results follow the following guidelines:

- Avoid installing a flow-meter on the suction side of a pump; where this is unavoidable ensure there is a large positive suction head.

- It is preferred to install the flow-meter upstream of a flow control or shut-off valve, as the back pressure provided by the valve will be beneficial to system accuracy.

- Do not operate a flow-meter directly discharging to atmosphere.

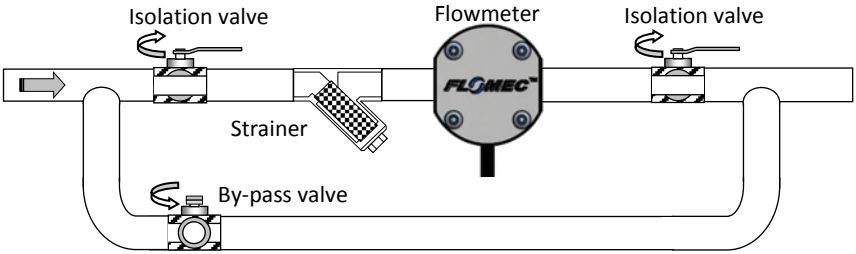
- Piping should be designed so that the flow-meter is full of liquid at all times, this is achieved by designing the inlet and outlet piping for the flow-meter to be lower than all surrounding piping.

- For vertical installations the liquid should travel from bottom to top, i.e. it should rise vertically through the flow-meter. This will ensure that the flow-meter remains full of liquid, and will stop air entrapment in the meter.

- Piping surrounding your flow-meter should be well supported, preferably at a point close to where the piping joins to the flow-meter; long sections of unsupported piping will cause pipe stress on the flow-meter which may effect accuracy. It is generally acceptable to hang your meter on the piping, provided the piping is well supported, however it is never acceptable to mount your flow-meter securely and use the meter as the only mounting point for long lengths of piping.

- If your flow-meter is installed in a section of piping that can be completely isolated between two shutoff valves, and that section of isolated piping is at risk of thermal expansion (e.g. is located outdoors in the sun) it will be necessary to install pressure relief valves, or thermal expansion joints.

- The best piping designs provide a bypass line, as shown in the following diagram, which allows isolation of the flow-meter and associated strainer from the main process line. The benefits of installing a bypass line are that your system can be purged before start-up, to remove any foreign particles or air slugs that would cause serious damage to your meter. Other benefits of this piping design are that maintenance and repairs on your flow-meter and strainer can be carried out quickly and economically without interrupting critical processes. Smaller installations, or non-critical processes may not see a benefit from installing a bypass line.



3.3 Filtration / Straining

All liquid products have the chance of solid particles being present, especially in any new installations, or in installations where the liquid is open to atmosphere at any point. Solid particles may come from dust settling on an unsealed storage tank, wear particles from upstream mechanical devices such as pumps or mixers, or even large metal particles from cutting or welding on new or modified installations.

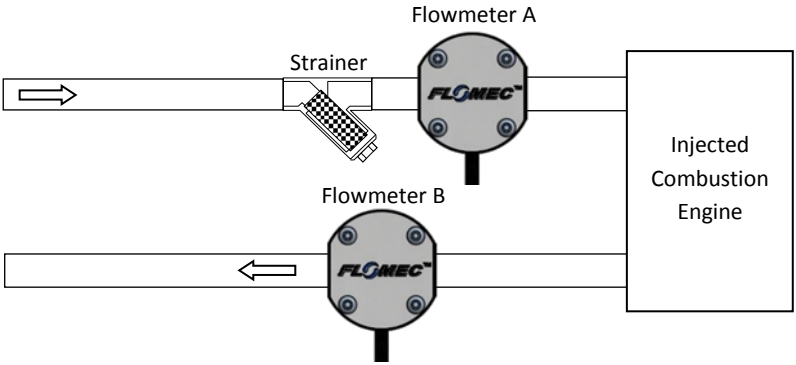
It is always advisable to fit the inlet side of any Oval Gear flow-meter directly to a strainer of appropriate pipe size and mesh size to suit the liquid being measured. The minimum mesh size as shown in the specifications section of this manual should be adhered to where ever possible. When metering medium or high viscosity fluids it may be necessary to use a strainer one pipe size larger than the flow-meter nominal size, in order to limit the pressure drop across the strainer basket and maintain strainer efficiency.

3.4 Pipe Connections

When installing a flow-meter it is important that no upstream pipe join between the flow-meter and the strainer are sealed using PTFE sealing tape. Lose pieces of PTFE tape are common causes of failure in new meter installations due to the tendency to wrap around the rotating components inside the meter. It is recommended that the sealing of pipe joins should be done with a sealing paste *(such as Loctite® 565 thread sealant paste), however care must be taken to avoid excess sealant entering the flowmeter when screwing in fittings.*

3.5 Fuel Consumption Measurement

When purchased with the 'Fuel Consumption' option the EGM Series flow meters are well suited to the measurement of fuel consumption on injected diesel or petrol/gasoline combustion engines. The flowmeters should be purchased and installed in pairs; with flowmeter 'A' installed prior to the inlet side of the fuel rail or injection pump, and flowmeter 'B' installed immediately after the fuel rail or injection pump – as per the diagram below. ***Electrical installation in a fuel consumption system is detailed in section 4.4.3***



Before installing your flowmeters it should be confirmed that they are suitable for the flowrate of the primary fuel pump, which will be significantly higher than the fuel consumption rate reported in the engine datasheet. As an example, an average 500HP marine diesel engine may have an approximate consumption of around 50L/Hr of diesel fuel but will have a fuel system flowrate of around 300L/Hr – check your meter specifications against the higher fuel system flowrate before installing.

Fuel consumption flowmeters should be installed according to the requirements in other sections of this manual; the inlet side of Flowmeter 'A' should be fitted with a strainer or filter of appropriate size *(see specification table, section 1.2)* - your existing fuel filter may be suitable if the filtration level meets the flowmeter specification. If your existing fuel filter is engine-mounted, it may be more practical to install the flowmeter prior to the fuel filter and fit a y-strainer to the inlet of flowmeter 'A'.

Due to the vibrations caused by a running engine it is recommended to avoid mounting the flowmeters directly to the engine. To ensure complete filling of the flowmeters it is best to mount them at a location which is physically lower than surrounding fuel lines.

4. Electrical Installation

Two types of output are available on an EGM Series Oval Gear flow-meter; the standard output is a single NPN Hall Effect sensor, providing a square wave frequency output signal which is linearly proportional to volumetric flow.

The optional Fuel Consumption model provides a similar NPN Hall Effect sensor output combined with a Platinum Resistance Thermometer output. The Fuel Consumption model has a specific magnetic sensor design which is tailored to produce accurate measurements on fuel injected combustion engines, which are typically prone to flow pulsations. In addition to the volume measurement, the Fuel Consumption option also provides a temperature measurement of the liquid inside the flowmeter; this allows for temperature compensation of liquid volumes between the inlet and outlet of an engine's fuel system.

4.1 Wiring

EGM Series flowmeters are equipped with quality shielded instrument cable; 3 twisted pairs of stranded wire (7/0.25mm), Mylar tape screened with a stranded (7/0.25mm) drain wire. Wire ends are provided stripped and tinned from the factory, ready to be terminated at the input terminals of a receiving instrument or control system.

For installations which require a longer length of cable than is provided from the factory (2 metres), an in-line connector kit and extra lengths of cable can be purchased from your Flomec distributor. Alternatively any good quality in-line connector with a suitable number of pins and a suitable IP rating can be used. For standard pulse output flow meters a 4 pin connector is advised (3 wires for the sensor, 1 wire for the cable drain), and for meters fitted with a PT100 a 7 pin connector is advised. All extended wiring should use high quality instrument cable; twisted pair low capacitance shielded instrument cable is recommended.

The cable drain or screen should be terminated on a DC common or a specifically assigned shield terminal at the readout instrument end; in order to protect the signal from mutual inductive interference.

The cable should not be run in a common conduit, or parallel with, power cables or high inductive load carrying cables, as power surges may induce erroneous noise transients onto the transmitted pulse signal or cause damage to the electronics. Run all instrument cables in their own separate conduit; where instrument cables must cross high power cables be sure that the cables intersect at 90 degrees in order to limit induced interference.

Do not install a meter in close proximity to any sources of strong magnetic fields, such as high power electric motors or solenoids, as these may affect the magnetic sensors within the meter. Likewise, it is recommended that instrument cables are not located close to sources of strong magnetic or electric fields due to the risk of induced interference in the cables.

4.2 Hall Effect Outputs

The NPN Hall Effect is a high resolution solid state 3 wire device which provides an un-sourced, open collector, NPN transistor output. The term unsourced means that no voltage is applied to the output from within the flow-meter. The output of the Hall Effect must be pulled to a 'high' state by an external voltage between 5-24VDC, this is achieved by fitting a pull-up resistor between the signal output *(white wire)* and the voltage supply *(red wire).* The pull up resistor ties the open collector output to the available DC voltage level, providing a square wave pulse output, which alternates between ground potential and the DC voltage available at the signal wire.

The NPN Hall Effect output is a reliable output type, producing a consistent output irrespective of supply voltage variations below the maximum voltage limit, temperature variations, or mechanical shock. The service life of the Hall Effect output is theoretically infinite, so long as it is protected from high energy voltage spikes. Hall Effect outputs are protected against reverse polarity, and against low energy voltage spikes; however they are not protected against constant over-voltage above the maximum limit of 24V (±5%).

Many secondary flow instruments are fitted with an integral pull-up resistor, but if connecting the Hall Effect output to an electronic device that does not contain an integral pull-up resistor, one **MUST** be fitted by the installer. The pull-up resistor is connected between the signal wire *(white)* and the +VDC wire *(red)*; recommended pull-up resistor value is 10kOhm, 2.4kOhm is the minimum value.

It is NOT recommended to combine any inductive loads on the same voltage supply as your flow-meter, as these components are commonly sources of high frequency interference that may affect the quality of the Hall Effect output signal. Another concern to do with inductive loads on a common voltage source is the potential for voltage spikes well in excess of the 24VDC limit of the Hall Effect sensors.

4.3 RTD Output (PT100)

The RTD (Resistance Temperature Detector) is a 3-wire 100 Ohm Platinum Resistance thermometer (PT100), built into the meter cap of the flow meter. The RTD is directly mounted to the PCB of the flowmeter, which is then encapsulated into the meter cap using a thermally conductive epoxy potting compound, ensuring quick thermal transfer from the process liquid to the temperature sensor.

The RTD has standardised characteristics according to IEC 60751, with a temperature coefficient of +3850 ppm/K (between 0°C and 100°C), and is a tolerance class B (F0.3) device.

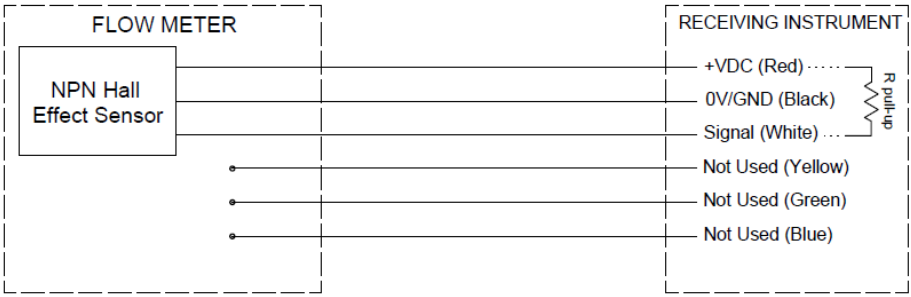
The RTD may be used in either a 2-wire or a 3-wire system; each have their own benefits, however for best accuracy it is recommended that a 3-wire system is used. When using the RTD in a 3-wire system the third wire is used to calculate the average resistance of the cable between the readout instrument and the RTD, this allows the readout instrument to subtract the resistance of the cable from the resistance of the RTD itself – giving a much more accurate measurement. The downsides of a 3-wire system is a small amount of extra cost.

For installations which cannot accept the extra cost of the additional wire in the cabling plus the more expensive receiving instrument, a 2-wire system can provide a reasonably accurate temperature measurement when cable lengths are less than 10 metres.

To avoid self-heating of the temperature sensor, the measurement current should be kept between 0.1mA ~ 1mA; this will limit the self-heating effect to less than 0.1°C and will maintain the accuracy of the device. Self-heating errors are proportional to the DC power at the RTD and are approximately equal to 0.8°C / mW.

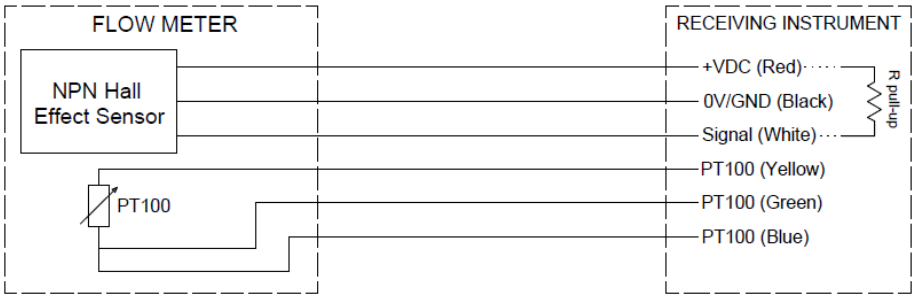
4.4 Wiring Diagrams

4.4.1 Standard Pulse Output Board



A Pull-Up Resistor must be installed between the signal and +VDC connections on the receiving instrument – unless the instrument has an integral pull-up

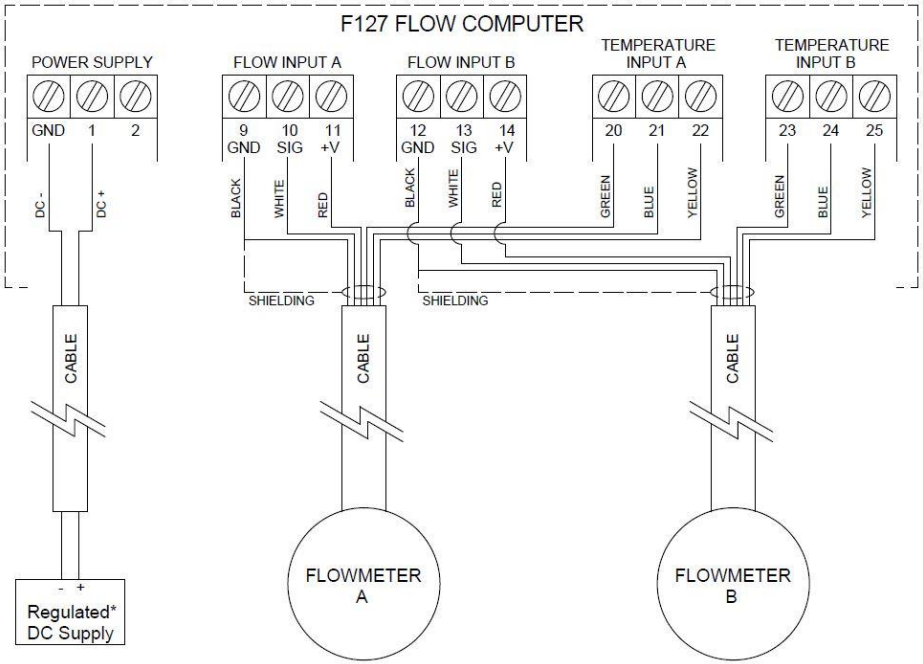
4.4.2 Fuel Consumption Option



A Pull-Up Resistor must be installed between the signal and +VDC connections on the receiving instrument – unless the instrument has an integral pull-up

For installations using 2-wire RTD/PT100 connections, use only the yellow + green wires.

4.4.3 Fuel Consumption Wiring with F127 Flow Computer



**** Regulated DC supply should be in the range of 8-30 Volts DC. When powering the flow computer from a vehicle charging system a DC-DC converter is recommended to protect the system from voltage spikes.***

4.5 Meter Calibration Factor *(K-Factor, Scale Factor)*

Each flow-meter is individually calibrated and is marked with the number of pulses per unit volume *(e.g. pulses/Litre)* which is characteristic to the particular meter. Nominal values are shown in the specification section of this manual. For meters ordered un-calibrated the nominal values shown in the specification section should be used; additional error should be expected for meters when using nominal K-factors on un-calibrated meters, this information can be found in the Specification Table (section 1.2). Field calibration of an un-calibrated meter removes this error; if you are measuring a high viscosity liquid, field calibration may actually achieve better levels of accuracy than can be obtained from the factory diesel calibration.

5. Commissioning

The most common cause of damage to Oval Gear meters is improper start-up procedure after an installation or piping modification. New or modified piping is generally full of large volumes of air, and possibility contains foreign matter. If your piping has been designed carefully as outlined in this manual, it will be an easy task to prepare your system for safe commissioning of your flow-meter.

The newly installed meter must NOT be run until the piping is completely flushed of foreign materials. The most common foreign matter that is present in new or modified piping is; welding slag, grinding dust, sealing tape/compound, and surface rust. If your piping has been designed with a bypass line it will be easy to isolate your meter from the remainder of the system in order to flush out the majority of the piping. If you have not installed a bypass line around the meter, the best solution is to replace the meter with a spool-piece for the duration of the flushing procedure; if this is not practical then the rotors must be removed from the meter prior to flushing.

The other critical concern when commissioning a meter is the presence of air slugs; this is also a concern for any systems that have been shut down for long periods of time. ***Do not start up your system for the first time by opening all valves and turning on the pump, or by quickly opening up the supply valve from a gravity feed tank; it is essential that the system is first purged of air***. Large volumes of air contained in the piping will be compressed very quickly between the oncoming liquid and the stationary flow-meter rotors and will spin the rotors at speeds many times that of their maximum rating which can very often completely destroy the meter.

To safely start a meter for the first time, and avoid any failure from air slugs, the best procedure is to eliminate the majority of the air volume in your piping system using the bypass line described earlier. After bleeding the majority of the air through the bypass line, the remainder of the air can be slowly passed through the meter by gently opening the flow control valve downstream of the meter. If a bypass line has not been incorporated into your system, and no alternative exists for bleeding air upstream of the meter, then the entire air volume of your piping will need to be bled very slowly through the downstream valve.

Following the start-up procedure, and during the period of initial operation, it is recommended that the inlet strainer on your meter be inspected regularly, and cleaned if necessary, as it is possible that not all foreign material will be completely removed from your system during the initial flushing.

6. Maintenance

Adhering to the installation instructions is the most important requirement to ensure that your Oval Gear meter provides the maximum level of operational performance. Oval Gear meters are a mechanical device, and so will be subject to some wear and tear over their operational life, except under ideal circumstances. The amount of normal wear that the meter will experience will be very dependent on the operational conditions such as; flow rate, temperature, cleanliness of the liquid, lubricity of the liquid, and the amount of continuous duty required of the meter.

In order to maximise the operational availability of your meter, and reduce system downtime, a periodic maintenance and inspection regime should be used. Frequency of maintenance depends on the operational conditions of the meter and the criticality of the system; it is the user's responsibility to determine inspection frequency however the manufacturer can provide guidance.

For any installations that require in-situ cleaning (CIP); it is important that the cleaning or flushing procedures do not produce operating conditions that are outside of the acceptable flow rate, pressure, or temperature ratings of the meter. Chemical compatibility of cleaning solutions should be checked against the materials of construction of the meter.

Before undertaking meter maintenance ensure the following:

Associated alarm(s) or control output(s) are isolated so not to affect the process

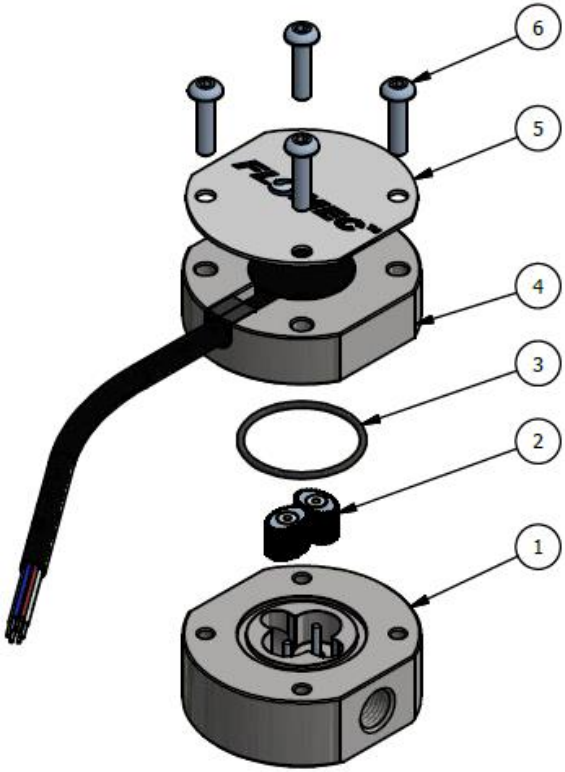
Voltage supply is isolated from the meter

Liquid supply to the meter is closed off

The meter is depressurised and liquid drained from the meter / pipeline

6.1 Parts Identification

For identification of the parts within your Oval Gear meter refer to the following image and parts identification table. Part numbers for replacement components are found in the next section of this manual.



Parts Identification Table

Item No.	Description
1	Meter Body
2	Rotors
3	Body O-Ring
4	Meter Cap Assembly
5	Cover Plate
6	Meter Cap Screws

6.2 Flowmeter Disassembly

To access the oval gear rotors, or to remove/replace the meter cap and pulse output board; undo the meter cap screws (6), and carefully separate the meter cap from the meter body (1), avoiding misplacing or damaging the O-ring (3) or the rotors (2) – when servicing an EGM004 meter please note that the rotors can stick to the underside of the meter cap due to liquid surface tension, making it very easy to drop and subsequently damage the rotors.

The rotors (2) can now be removed and inspected. Take special care to not drop the oval gear rotors during the service process, as the precision components are very sensitive to damage.

6.3 Flowmeter Inspection

Inspect O-rings for damage, chemical attack, deformity or any form of deterioration. Remove, inspect and gently clean the rotors, and check the measuring chamber for damage or scoring, the rotor shafts should NOT be loose or able to be rotated. Rotors should turn freely, and should spin without scraping or catching on any part of the meter body. Take care of the thrust face of the bearings, which protrudes from each end face of the rotors by a very small amount.

6.4 Re-assembly of Flowmeter

When re-installing the rotors the magnets MUST be correctly positioned so that they are facing the sensor located in the meter cap; the magnets are inserted from the underside of the rotor so will not be visible when the rotors are installed, if you can see the magnet holes with the rotors installed then they are upside-down. If you are unsure of magnet location it is easiest to test using a small steel object such as a paperclip, steel ruler or small screw driver.

Both rotors will only engage correctly if fitted precisely at an orientation of 90 degrees to each other. Rotate the rotors slowly by hand to ensure they are correctly fitted, at the same time check the rotor shafts & rotor bearings for wear. If you are able to rotate the engaged rotors through a complete 360, then you have installed them at the correct 90 degree angle.

Fit the O-ring into the groove and assemble the meter cap onto the meter body; it is recommended that new O-Rings be used whenever a meter is serviced, particularly if the

meter is fitted with PTFE encapsulated seals as the PTFE sheath is sensitive to damage from re-use.

Fit the cover plate (5) and the meter cap screws (6), and tighten the screws in a star sequence. Torque the meter cap screws in the same sequence to 4NM for 004/006/008 meters or 6NM for 015/020 meters. Reconnect wiring as appropriate.

7. Spare Parts

Refer to images in section 6 for identification of spare parts.

7.1 Small Capacity Models

Spare Parts	Description	EGM004	EGM006	EGM008
Meter Body Assembly	Aluminium BSP body assembly	1401206	1401210	1401214
	Aluminium NPT body assembly	1401207	1401211	1401215
	SS BSP body assembly	1401208	1401212	1401216
	SS NPT body assembly	1401209	1401213	1401217
Rotor Kit	SS Rotors with Bronze bushings – suits STD PCB	1524152	1524153	1524154
	SS Rotors with Bronze bushings – suits FC PCB	1524156	1524157	1524158
	SS Rotors with Carbon bushings – suits STD PCB	1524038	1524006	1524007
	SS Rotors with Carbon bushings – suits FC PCB	1524023	1524024	1524025
	PPS Rotors – suits STD PCB			1524163
	PPS Rotors – suits FC PCB			1524164
Meter Cap (inc. PCB)	Aluminium cap assembly with Standard PCB	1402198	1402200	
	Aluminium cap assembly with Fuel Consumption PCB	1402204	1402206	
	Stainless Steel cap assembly with Standard PCB	1402199	1402201	
	Stainless Steel cap assembly with Fuel Consumption PCB	1402205	1402207	
Cover Plate	FLOMEC Cover Plate	1306106	1306107	
Meter Cap Screws	A2-70 Button Head Cap Screws	M5x25 BHCS 304SS		
O-Ring	Viton / FKM	BS022V	BS026V	BS030V
	PTFE Encapsulated Viton	BS022T	BS026T	BS030T
	Buna-N / Nitrile	BS022B	BS026B	BS030B

7.2 Medium Capacity Models

Spare Parts	Description	EGM015	EGM020
Meter Body Assembly	Aluminium BSP body assembly	1401218	1401222
	Aluminium BSP body assembly	1401219	1401223
	SS BSP body assembly	1401220	1401224
	SS NPT body assembly	1401221	1401225
Rotor Kit	SS Rotors with Bronze bushings – suits STD PCB	1524155	
	SS Rotors with Bronze bushings – suits FC PCB	1524159	
	SS Rotors with Carbon bushings – suits STD PCB	1524022	
	SS Rotors with Carbon bushings – suits FC PCB	1524027	
	PPS Rotors – suits STD PCB	1524049	1524160
	PPS Rotors – suits FC PCB	1524082	1524161
Meter Cap (inc. PCB)	Aluminium cap assembly with Standard PCB	1402202	
	Aluminium cap assembly with Fuel Consumption PCB	1402208	
	Stainless Steel cap assembly with Standard PCB	1402203	
	Stainless Steel cap assembly with Fuel Consumption PCB	1402209	
Cover Plate	FLOMEC Cover Plate	1306108	
Meter Cap Screws	A2-70 Button Head Cap Screws	M6x25 BHCS 304SS	
O-Ring	Viton / FKM	BS142V	BS143V
	PTFE Encapsulated Viton	BS142T	BS143T
	Buna-N / Nitrile	BS142B	BS143B

8. Troubleshooting

8.1 Fault Finding

Pulse meters have two distinct sections: the mechanical wetted section housing the rotors and the electrical section housing the pulse output board. The aim of fault finding is to trace the source of the fault to one of these sections. If a fault is traced to an instrument section, refer to the relevant instruction manual. ***Below are basic fault finding steps.***

Step 1 - ***Check application, installation and set up;*** refer to installation sections for installation and application factors that may affect the meter operation including incorrect wiring. Check meter specifications for incorrect flow rate, temperature, pressure, or materials compatibility.

Step 2 - Check for blockages; The most common cause of fault/unsatisfactory meter operation, particularly for new or altered installations, is due to blockage within the system or meter caused by foreign particles such as weld slag, sealing tape or compound, rust, etc.

Step 3 - Ensure flow is present; No flow or lower than normal minimum flow may be attributed to a blocked strainer, jammed or damaged rotors within the flowmeter, malfunctioning pump, closed valves or low liquid level in feeder tank.

Step 4 - Ensure oval gears within meter are rotating; Rotation of the oval gears can be heard by holding a screw driver blade to the meter body and pressing the handle hard against the ear lobe.

Step 5 - Ensure pulses are being generated during flowing condition; a multimeter is often not fast enough to distinguish the pulse train from the Hall Effect sensor. An oscilloscope will allow you to view the output pulse train. When viewing the Hall Effect sensor pulse signal ensure a pull up resistor is installed between the pulse output wire and the supply voltage wire (refer electrical installation).

Step 6 - Confirm Instrument Operation; if an associated instrument is connected to the flowmeter confirm its operation by simulating a pulse input onto the flow input terminals. In most instances a contact closure on the flow input terminals is an adequate simulation.

8.2 Troubleshooting Guide

Symptom	Possible Cause	Solution
Meter Readings are High	Output Signal Interference	- confirm shielded cable has been used - ground cable shield at instrument end - re-route cabling from high electrical energy sources, or power carrying cables.
	Entrained air or gas	- Remove source of air or gas entrapment - Install an upstream air-eliminator
	Pulsating Flow from reciprocating style pump	- Increase back pressure on pump - Install a fast response one-way (check) valve or a surge arrestor between pump and meter - Change pump style to a smooth delivery pump - Retro-fit the 'Fuel Consumption' option *(contact flowmeter distributor)*
Meter Readings are Low	Damaged or worn rotors	Inspect, repair, clean, or replace rotors
	Damage or worn measuring chamber	Inspect measuring chamber for damage and consult manufacturer for advice.
	Output signal interference	- Confirm correct wiring with shielded cable - Check all electrical connections for firmness and continuity
No Output from Flowmeter	Rotors jammed	- If meter has been recently field serviced, check that rotors are not installed upside-down or incorrectly meshed - Check for obstruction due to foreign particles - Clean, repair, or replace rotors
	Meter incorrectly reassembled	See instructions for reassembly of meter with particular emphasis on positioning of rotors and magnets
	No signal from Pulse Output Board	***- Ensure a pull-up resistor is fitted*** - Check terminal connections for accuracy - Check power supply polarity - Ensure DC voltage is available at the terminated flowmeter cable - Ensure receiving instrument is configured correctly and is suitable for an NPN signal - Check voltage/current are within maximum ratings
Not Reading on Receiving Instrument	Faulty receiving instrument	- Check hardware and software settings; DIP switches, terminal connections, and programming settings - Repair or replace receiving instrument

Notes:

Wichita , Sydney , Mexico City

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