



FLOWMETERS FOR LIQUID MEASUREMENT

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## OVAL GEAR

Medium capacity positive displacement flowmeter

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### INSTRUCTION MANUAL

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*Model: (1") 025P PPS Meter*





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## 1.0 General

### 1.1 Overview

The Oval gear meter is a precise positive displacement flowmeter incorporating a pair of oval geared rotors. These meters are capable of measuring the flow of a broad range of clean liquids.

The flowmeter is available as a blind meter with pulse output capable of interfacing to most monitoring and control instrumentation or the meter can be fitted with or supplied with instruments such as totalisers, rate totalisers or batch controllers. These instruments also have monitoring and control output options including 4-20mA, scaled pulse, flow rate alarms and batch control logic (*preset metering*).

If your flowmeter is fitted or supplied with an instrument please also refer to the relevant instrument instruction manual.

### 1.2 PPS Chemical Compatibility

PPS plastic flowmeters are suited to most water based products, selected types of chemicals (see below) and are also suitable for most fuels, fuel oils & lubricating liquids.

PPS is resistant to chemical attack from all non-aromatic (containing benzene), non-halogenated (containing halogens such as chlorine, bromine) organic solvents at any concentration.

PPS is also resistant to most water based solutions of acids, bases or neutral salts with the **exception of** strong oxidizing acids such as **nitric acid**, **hydrofluoric acid** and **hydrochloric acid**. It is **not suitable** for use with any strong acids of any kind (  $\text{pH} < 2$  ) at temperatures above normal ambient.

Strong bases do not degrade PPS, however strong bases at higher temperatures may cause long term damage to the flowmeter.

PPS is **not generally suitable** for use with oxidizing chemicals in high concentrations; however use with these chemicals under mild conditions may be suitable depending on the particular application. Hydrogen Peroxide, Chlorine and Sodium Hypochlorite will cause swelling and plasticizing of PPS with extensive exposure above 5% concentration or even lower concentrations at higher temperatures. PPS can withstand mild solutions of these chemicals used in common cleaning or disinfectant products if temperatures are kept at or below normal ambient temperature.

PPS can be used with hot water up to the maximum temperature rating of the meter of 80°C, including heated sea-water, and water containing low concentrations of chlorine (less than 1% concentration).

These PPS meters come with Ceramic (*High Purity Alumina AL2 O3*) Rotor shafts as standard making them suitable for applications where stainless steel would not be suitable.

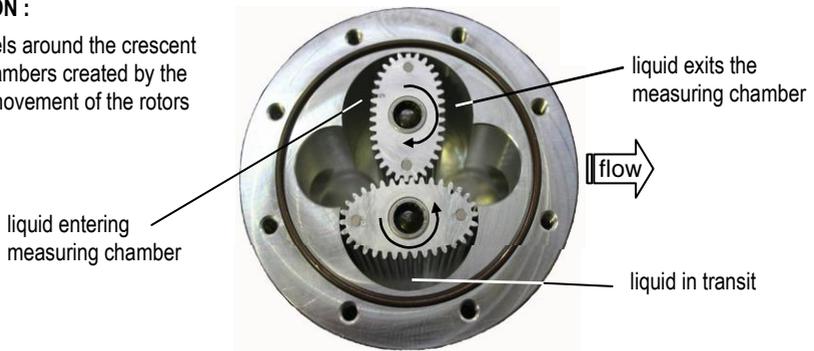
### 1.3 Operating Principle

The Oval gear meter is a positive displacement flowmeter where the passage of liquid causes two oval geared rotors to rotate within a precision measuring chamber and with each rotation a fixed volume of liquid is displaced passing through the meter. Magnets embedded within the rotors initiate a high resolution pulse train output. The pulse output can be wired directly to process control and monitoring equipment or can be used as an input to instruments supplied with or fitted directly to the meter.

The benefits of this technology allow precise flow measurement and dispensing of most clean liquids irrespective of their conductivity, with other liquid characteristics having nil or minimal effect on meter performance. This metering technology does not require flow profile conditioning as required with alternative flow technologies making the installation relatively compact and low cost

#### OPERATION :

Liquid travels around the crescent shaped chambers created by the rotational movement of the rotors



### 1.4 Specifications

<i>Model prefix :</i>	<b>025P ( PPS - RYTON )</b>
<i>Nominal size ( inches )</i>	25mm ( 1 " )
<i>* Flow range ( litres / min )</i>	1 0 ~ 1 50
<i>* Flow range ( USGM )</i>	2.6 ~ 40
<i>Accuracy @ 3cp</i>	± 0.5% of reading ( ± 0.2% with optional RT1 2 )
<i>Repeatability</i>	typically ± 0.03%
<i>Temperature range</i>	-20°C ~ +80°C ( -4°F ~ +1 76°F )
<i>Maximum pressure ( threaded meters )</i>	5 bar ( 72 PSI )
<i>Protection class</i>	IP66 / 67 (NEMA4X)
<i>Recommended filtering</i>	1 50 microns ( 1 00 mesh ) minimum
<b>Electrical - pulse meters ( also see optional outputs )</b>	
<i>Output pulse resolution :</i>	pulses / litre ( pulses / US gallon ) - nominal
<i>Reed switch</i>	27 ( 1 02 )
<i>Hall effect</i>	1 07 ( 405 )
<i>Quadrature Hall option</i>	53.5 ( 203 )
<i>Reed switch output</i>	30Vdc x 200mA max. ( max. temp. shock 1 0°C ( 50°F ) / min )
<i>Hall effect output (NPN)</i>	3 wire open collector, 5~24Vdc max., 20mA max.
<b>Optional functions</b>	
<i>Display</i>	flowrate, total (accumulative & resettable)
<i>Preset batching</i>	1 & 2 stage high speed batch control
<b>Optional outputs</b>	
<i>Flow</i>	4 ~ 20mA, high & low flow rate alarms
<i>Pulse</i>	scaled pulse (programmable), pulse amplifier

\* Maximum flow on fuels may be maintained for intermittent periods of refuelling.

\* Maximum flow is to be reduced as viscosity increases, max. pressure drop 1 00Kpa ( 1 5psi)

## 2.0 Installation

### 2.1 Mechanical Installation *Prior to installing the meter check :*

# The fluid is compatible with the meter materials of construction using appropriate information such as fluid compatibility charts and site experience.

# Application and process conditions are compatible with the meter specifications. Minimum and maximum flows are within the meter specified range including any in-situ cleaning processes. When metering viscous liquids the maximum allowable flow may need to be reduced to ensure the pressure drop across the meter does not exceed 100 kPa (1 Barg, 15 PSIG).

# Process temperature and pressure does not exceed meter ratings.

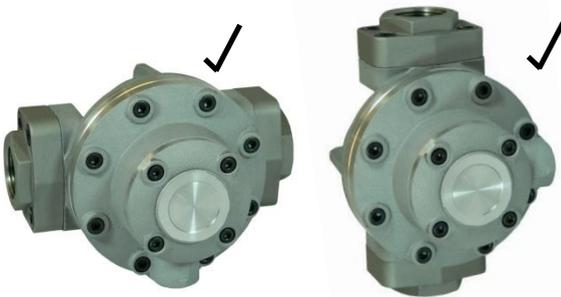
# The meter is not exposed to process temperatures and pressures that will cause the liquid medium to gasify (flash) within the meter.

# **Care should be taken when installing fittings into the plastic pipe threads of the 025P flowmeter, as over-tightening of pipe fittings may cause physical damage to the meter body. Do not tighten pipe fittings beyond the amount required to form a seal.**

#### 2.1.1 Orientation

The oval gear flowmeter **MUST** be mounted so that the rotor shafts are in a horizontal plane. This is achieved by mounting the meter so that the terminal cover or integral instrument display, whichever is fitted, is facing in a horizontal direction. Note: The terminal cover or instrument display can be rotated in 90 degree increments to provide access to the electrical entry and to allow the display orientation to suit the installation.

#### CORRECT ORIENTATIONS



#### INCORRECT



**When installed incorrectly the weight of the rotors will bear down on the base of the measuring chamber.**

Liquid can flow into the meter from either a horizontal or vertical direction. For vertical flow installations the most common orientation is for the liquid to rise through the meter (*i.e. travel from bottom to top*) to assist in air or entrained gas elimination. The meter operation is independent of the liquid flow direction thus there is no markings for inlet or outlet.

## 2.1.2 Flow Conditioning and Locations

Strainer : It is recommended to INSTALL a 100mesh (150 micron) strainer immediately upstream of (prior to) the meter. Strainers are available from the factory.

Flow conditioning : The flowmeter does not require any flow conditioning, therefore straight pipe runs before or after the meter are not required. If required, the pipe size about the meter can be altered to suit the installation.

Locations : The flowmeter is preferred to be fitted upstream of any flow control and/or shut off valve, this prevents free discharge from the meter and minimizes the risk of drainage and air entrapment which can result in erroneous readings or damage the meter on start up.

Process or safety critical meters should be installed in a by-pass section of pipe with isolation valves to enable the meter to be isolated and serviced as required. A by-pass installation also allows purging of the system during commissioning (see *Commissioning*). The meter must be appropriately rated and is typically located downstream (on the discharge side) of the pump.

If mounted outdoors ensure a suitable watertight gland or plug is used to seal any open electrical entries. In humid environments take precautions to avoid condensation build up within the electrical and/or instrument enclosure. It is good wiring practice for conduits to be connected from the bottom of an entry port, in this way condensation will gravitate away from any terminal housing.

Fluid state : Fluid entering the meter must remain in a liquid state at all times, so take necessary precautions to protect the meter by avoiding any factors that may result in 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. Size the meter to avoid gasification of volatiles (*flashing*) within the liquid due to the pressure drop experienced within the system or within the meter.

Hydraulic shock : If pressure surges or hydraulic shock of any kind is 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 can damage the meter. Such pulsations can be caused by the injection profile in diesel engines. Most pulsations are removed with the installation of a suitable pulsation dampener.

## 2.2 Electrical Installation

**2.2.1 Instrument Cable** Twisted pair low capacitance shielded instrument cable 7 x 0.3mm (0.5mm<sup>2</sup>) should be used for electrical connection between the flowmeter and remote instrumentation, use Belden® number 9363 or similar. The cable drain or screen should be terminated on a DC COMMON or a specifically assigned shield termination at the readout instrument end only in order to protect the transmitted signal from mutual inductive interference. IMPORTANT, tape off & isolate the shield at the flowmeter end of the cable.

The cable should not be run in a common conduit or parallel with power and 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 the cable in separate conduit or with other low energy instrument cables. The maximum transmission distance is typically 1000m (3300 Ft).

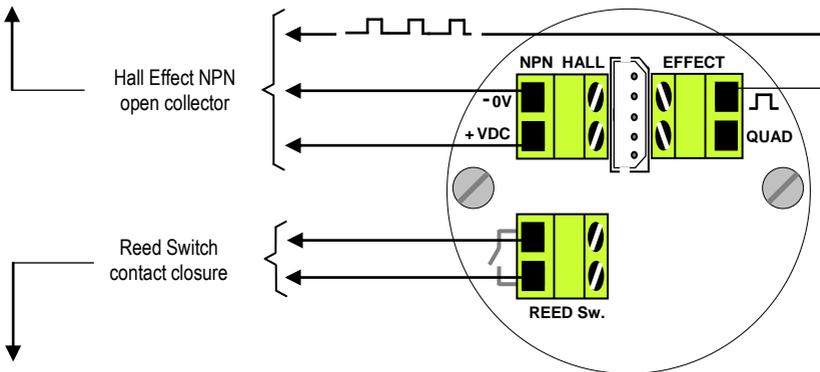
## 2.3 Pulse Outputs

**2.3.1 Pulse Output selection for pulse meters** Two types of output are available on each meter, open collector from Hall Effect sensors or reed switch contact. Each output type is linearly proportional to volumetric flow and each pulse is representative of an equal volume of liquid.

**2.3.2 Hall Effect Sensor Pulse Output** The Hall Effect Sensor is a high resolution solid state 3 wire device providing an un-sourced, open collector, NPN transistor output. The term "un-sourced" means that no voltage is applied to the output from within the flowmeter, it must be pulled to a 'high' or 'on' state by between 5~24Vdc supplied from an external source, typically the receiving instrument.

The pulse output between signal  and -0V is a voltage square wave with the high level being the dc voltage available at the open collector  and the low level being -0V.

The receiving instrument must incorporate a pull up resistor ( *typically greater than 10K ohms in most instruments* ) which ties the open collector to the available dc voltage level when the Hall sensor is not energized. When energized the open collector output  is pulled to ground through the emitter (-0V).

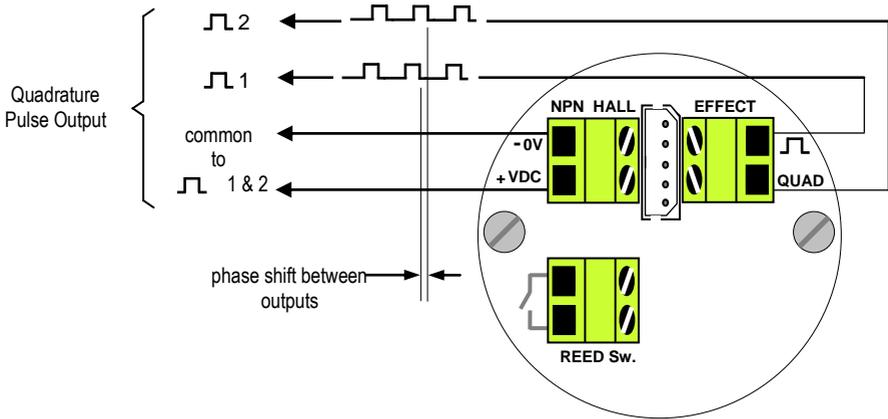


**2.3.3 Reed Switch Pulse Output** The reed switch output is a two wire normally open SPST voltage free contact ideal for installations without power or for use in hazardous area locations when Intrinsically Safe (I.S.) philosophy is adopted. **Note:** when using the reed switch output the liquid temperature must not change at a rate greater than 10°C per minute (50°F per minute). In general the reed switch life will exceed 2 billion actuations when switching less than 5Vdc @10mA as is the case when combined with the RT, EB or BT instruments.

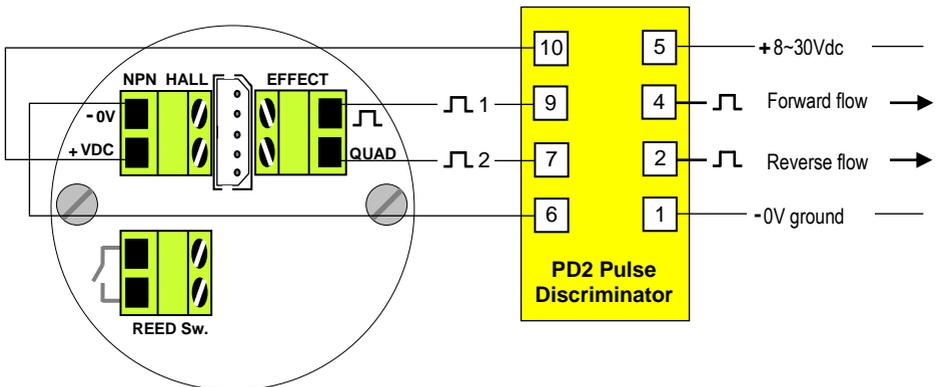
**2.3.4 Quadrature (QUAD) Pulse Output** The diagrams below apply when the meter is fitted with the Quadrature pulse output option (*two Hall Effect sensors arranged to give separate outputs out of phase with one another*).

The Quadrature output is typically suited to custody transfer applications where signal integrity verification is required, it is also used for metering bi-directional flow.

**2.3.5 Signal integrity verification** Many fiscal transactions require the primary measuring device (*flowmeter*) to have Quadrature outputs in order to detect any difference in the number of pulses from each input (from  1 &  2 ) during delivery.



**2.3.6 Bi-directional flow** Combining the Quadrature feature and model PD2 pulse discriminator module produces forward & reverse outputs both of which may be integrated to provide a "net" reading. The RT12 flow rate totaliser will take both output & will perform the "net" flow function.



**2.4 Meters fitted with integral instruments** If your flowmeter is fitted with an integral instrument such as a totaliser, rate totaliser or batch controller then the pulse output from the meter has been factory wired to the flow input of the readout instrument.



As a default the reed output is pre-wired and DIP switches set for a integral totaliser or rate/totaliser allowing self powered operation of the instrument displays.

Also by default the open collector output from the Hall Sensor is pre-wired and DIP switches set for a integral batch controller allowing high speed, solid state operation of the model EB batch controller.

These defaults may vary at the customer request or for specific applications such as dual flow input or high & low flow rate alarms so if unsure, remove the instrument bezel to check the wiring connections.

The output(s) and function(s) available from a meter fitted with an integral instrument depends on the model of the instrument fitted and may include meter pulse repeater, prescaled pulse output, 4-20mA flow output, flow rate alarms or single/dual stage batch control logic (*preset controller*).

Refer to the option in the meter model number and relevant instrument manual. Unless programming details were provided at time of order the instrument program will contain factory default parameters. Integral instruments will however be programmed with the relevant calibration factor (*K factor or scale factor*) for the meter.

Factory default settings can be found in the instrument instruction manual and it should be noted all output(s) are turned OFF and if required need to be turned ON then programmed to suit the application requirements.

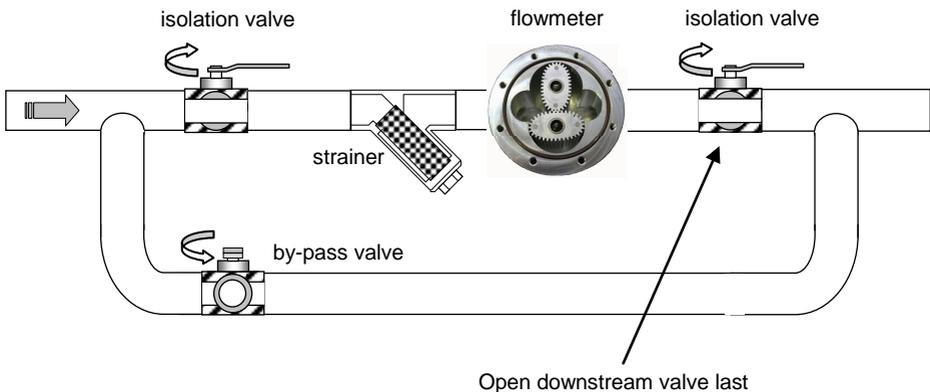
**2.4.1 Meter Calibration Factor (*K or scale Factor*)** Each flowmeter is individually calibrated and supplied with a calibration certificate showing the number of pulses per unit volume (*e.g. pulses per litre or pulses per US gallon*). Nominal figures are shown in the specification section of this manual.

Meters fitted with Integral Instruments will have the relevant calibration factor entered into the program of the instrument. Please refer to relevant instrument manual for programming details.

**3.0 Commissioning** Once the meter has been mechanically and electrically installed in accordance with this and any other relevant instrument manual(s) the meter is ready for commissioning.

The meter must NOT be run until the pipework is flushed of foreign matter, more often than not foreign matter is present after pipework fabrication or modification, weld slag, grinding dust, sealing tape & compound &/or surface rust are most common offenders.

Flushing can be undertaken by utilizing a by-pass or removing the meter from the pipework. If neither is practical then the meter rotors must be removed prior to flushing (*refer to Maintenance section of this manual for disassembly*).



After flushing or following long periods of shutdown the meter must be purged of air/vapour. This can be achieved by allowing the liquid to flow through the meter at a slow rate until all air/vapour is displaced. Never run the meter above its maximum flow or exceed 100kpa (1 bar, 15psi) pressure drop across the meter. Now the meter is ready for its operation to be confirmed by ensuring correct indication or operation at the receiving instrument(s). Refer if necessary to fault finding section of this manual.

**4.0 Maintenance** Adhering to the installation instructions in this manual should ensure your meter provides the required operational performance. These are mechanical meters and a periodic maintenance and inspection regime will maximize the operational availability of the meter.

The frequency of maintenance depends on the application factors including liquid lubricity and abrasiveness and operational factors such as flow rate and temperature.

**BEFORE undertaking meter maintenance ensure the following :**

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

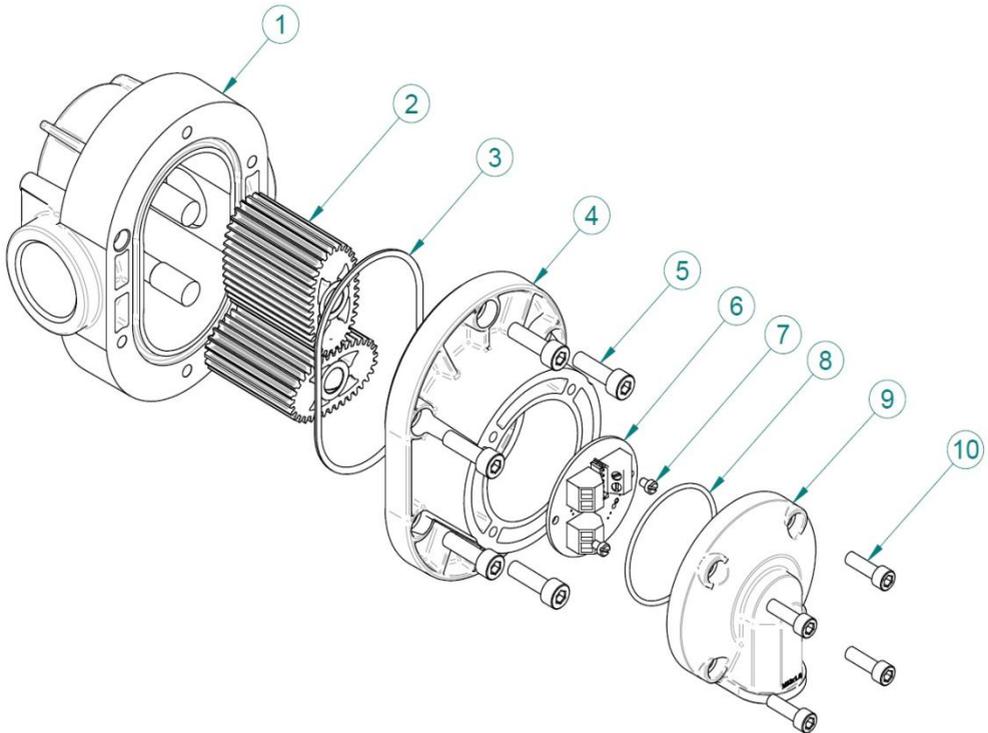
*Voltage supply is isolated from the meter.*

*Liquid supply to the meter is closed off.*

*The meter is depressurized and liquid drained from the meter.*

**4.1 Disassembly of Pulse meter** (*Refer Exploded View*) If required to gain access to the meter terminals and pulse output board, undo the 4 x cap screws (10), remove the terminal cover (9) carefully to avoid putting strain on the terminal connections. The pulse output board (6) can now be accessed and removed if necessary by removing mounting 2x screws (7).

If required to gain access to the oval geared rotors undo the 8 x body screws (5), carefully pry the meter body apart avoiding misplacing or damaging the O-ring (3) and rotors (2).



**4.2 Disassembly of meters fitted with an Instrument** If the meter is fitted with an integral instrument the instrument display assembly must be removed if required to gain access to the instrument terminal connections, instrument battery or pulse output board. This is achieved by undoing the bezel screws and separating the display assembly from its base. Do not stress or damage the wires that connect the display assembly to the meter output. Take care not to misplace or damage O-ring(s). The pulse output board can now be accessed. To remove the pulse output board, first undo the screws that fix the instrument base to the flowmeter.

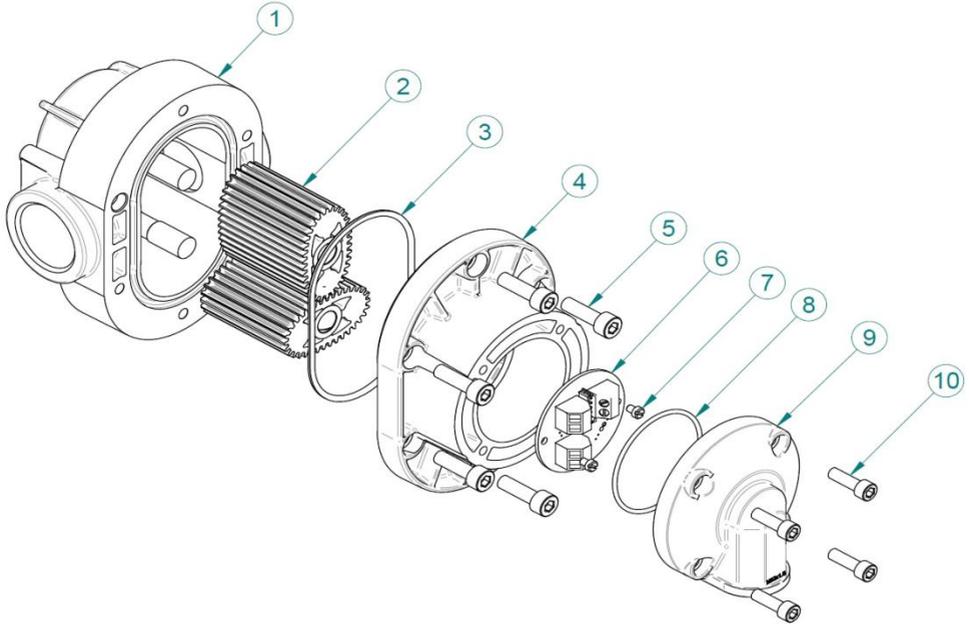
## 4.3 Spare Parts List

## 4.3 SPARE PARTS (refer to exploded view)

<b>Item</b>	<b>Description</b>	<b>025P</b>
<b>1</b>	<b>Body / shaft assembly</b>	Part No.
	PPS Body assembly - BSP - with Ceramic shafts	14 01162
	PPS Body assembly - NPT - with Ceramic shafts	14 01164
<b>2#</b>	<b>Rotor assembly set</b>	
	PPS ( standard ) rotor set	1524105
	PPS rotor set for High Viscosity fluids	1524106
<b>3#</b>	<b>Body O-ring (O-ring size)</b>	
	Viton ( standard )	BS151V
	EPR ( Ethylene propylene rubber )	BS151E
	Teflon encapsulated Viton	BS151T
	Buna-N ( Nitrile )	BS151B
<b>4</b>	<b>Meter cap</b>	
	PPS	1302249
<b>5</b>	<b>Body screw (screw size)</b>	
	stainless steel socket head cap screw	M6 x 20 ( 6 pcs )
<b>6#</b>	<b>Pulse output board</b>	
	standard pulse board	14 12207
	quadrature pulse board	14 12202
<b>7</b>	<b>Output board screw</b>	
	stainless steel cheese head slotted screw	M3 x 4 ( 2 pcs )
<b>8</b>	<b>Terminal cover O-ring (O-ring size)</b>	
	Standard GRN Terminal cover (Viton )	BS032V
<b>9</b>	<b>Terminal cover</b>	
	GRN glass re-inforced ( M20 )	1306012
	GRN glass re-inforced ( 1/2" NPT )	1306018
<b>10</b>	<b>Terminal cover screw</b>	
	stainless steel socket head cap screw	M5 x 16

**4.4 Inspection** (*refer Exploded View*) Inspect O-rings for damage, chemical attack, deformity or any form of deterioration.

Remove, inspect and clean the rotors, also check that the magnets have not been chemically attacked. Check the measuring chamber for damage or scoring & redress if necessary, the rotor shafts should NOT be loose or able to be rotated.



**4.5 Re-assembly of meter** (*refer Exploded View*) When re-installing the rotors all four magnets MUST be oriented towards the pulse output board (6) when both rotors are in place. The magnets are not visible being installed in blind holes from the underside of the rotors, then sealed in place by screws or plugs. The magnet locating screws or plugs are visible and should not be mistaken for magnets. The position of the magnets can be checked with a small steel object such as a steel ruler, paperclip or similar item held at the end of the rotors.

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.

Fit the O-ring into the groove and assemble the two parts of the meter, the body & cap align with a location pin.

Fit the body cap screws (5) and tighten in a star sequence, then carryout a final check tighten in the same sequence to a firm torque. This sequence and procedure ensures the meter bodies are assembled correctly and evenly.

**Warning:** Do not over tighten any screw fasteners in these PPS plastic meters; otherwise the internal screw threads will be stripped from the plastic components.

Fit the pulse output board, terminal cover or instrument as appropriate.

**5.0 Fault Finding** Pulse meters have two distinct sections: the mechanical wetted section housing the rotors and the electrical section housing the pulse output board.

Meters fitted with integral instruments have these two sections plus the instrument.

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. Also refer to Trouble Shooting Guide on following page.

**Step 1 - Check application, installation and set up.**

Refer to Mechanical Installation section for installation and application factors that may effect the meter operation including pulsation and air entrainment or incorrect meter selection including incorrect flow rate, temperature and pressure or materials compatibility. Refer to Electrical Installation for correct wiring.

**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. If necessary test the meter with the flow turned off and turned on to familiarize yourself with the audible rotation signature.

**Step 5 - Ensure pulses are being generated during flowing conditions.**

A multimeter is often not fast enough to distinguish the pulse train from the Reed Switch or Hall Effect sensor. An oscilloscope will allow you to view the output pulse train. When viewing the Hall Effect sensor pulse ensure a pull up resistor is installed between the pulse output and the supply voltage (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.

### 5.1 TROUBLE SHOOTING

<b>Symptom</b>	<b>Possible cause</b>	<b>Solution</b>
Meter readings are high	1. Output signal interference	1. Ground shield of signal cable 2. Re-route cable from high electrical energy sources
	2. Entrained air or gas	1. Remove source of air or gas entrapment 2. Install an upstream air eliminator
	3. Pulsating flow from reciprocating style pump	1. Increase back pressure on pump 2. Install a fast response one way check valve 3. Install a surge arrestor between pump & meter 4. Re-calibrate meter in situ to compensate for pulsations 5. Change pump style to smooth delivery type pump
Meter readings are low	1. Damaged or worn rotors	1. Inspect, repair, clean or replace rotors
	2. Damaged or worn measuring chamber	1. Inspect measuring chamber for damage - repair 2. Check concentricity of rotor shafts within chamber
	3. Output signal interference	1. Ground shield of signal cable 2. Re-route cable from high electrical energy sources 3. Check all electrical terminations & wires for continuity.
No output from meter	1. Rotors fouled	1. Check that rounded teeth are towards base of chamber 2. Check for obstruction due to foreign particles 3. Clean, repair or replace rotors
	2. Meter incorrectly reassembled	1. See instructions for reassembly of meter with particular emphasis on positioning of rotors & magnets
	3. No output from output board	1. Check terminal connections & solder joints 2. Ensure dc voltage is available at Vdc & 0v and receiving instrument is fitted with a pull up resistor 3. Replace output board
Not reading on readout instrument	1. Faulty receiving instrument	1. Check DIP switch settings & program data 2. Check terminal connections & electrical continuity 3. Repair / replace receiving instrument

**Notes:**

**Notes:**

**Each meter has been calibrated on mineral oil  
and will contain a small amount of oil residue.**

**The oil used is Castrol Diesel Calibration  
Fluid 4113 (product code 055830).**



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