OVAL GEAR

Medium capacity positive displacement flowmeters

INSTRUCTION MANUAL

Models: **1" (025), 1½" (040), 2" (050) & 2" (050E)**

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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.

Stainless Steel flowmeters are suited to most water based products and chemicals and aluminum meters are suitable for fuels, fuel oils & lubricating 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, flowrate 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.

These flowmeters can be installed within hazardous areas by using the reed switch pulse output in Intrinsically Safe loops or fitting Intrinsically Safe certified Instruments. Please consult the factory for the availability of flameproof models.

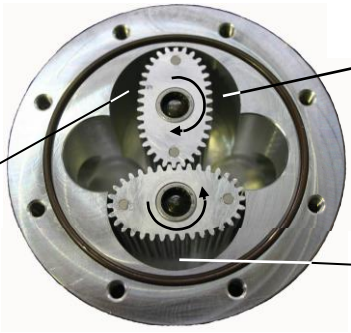
1.2 Operating Principle

The Oval gear are positive displacement flowmeters 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



1.3 *Model Number information*

015	1 /2"	(15mm)	1 ~ 40 L/min	0.26 ~ 1 0.6 GPM
025	1"	(25mm)	1 0 ~ 1 50 L/min	2.6 ~ 40 GPM
040	1 1 /2"	(40mm)	1 5 ~ 250 L/min	4 ~ 66 GPM
050	2"	(50mm)	30 ~ 450 L/min	8 ~ 1 20 GPM
050	2" extended flow	(50mm)	35 ~ 580 L/min	9 ~ 1 50 GPM

Body material

A	Aluminum
E	Extended flow range aluminum meter *(050E only)*
M	Intermediate Pressure aluminium - 138 bar *(2000 psi) max. (025 only)*
S	316L Stainless Steel
N	Intermediate pressure 316L Stainless Steel *(025 = 1 00bar, 040 = 50bar, 050 = 50bar max.)*
H	High Pressure 316SS

Rotor material

4	Aluminum *(aluminum meters only)*
5	Stainless steel - *standard in stainless steel meters (optional for aluminium meters)*
6	Aluminum - "keishi" cut for high viscosity liquids
7	Stainless steel - "keishi" cut for high viscosity liquids

Bearing type

1	Ceramic *(st andard with stainless steel rotors)*
4	Hardened steel roller bearings *(standard with aluminum rotors)*

O-ring material

1	Viton *(st andard),* -1 5 ~ +1 20ºC *(5 ~ 250ºF)*
2	EPR *(Ethylene Propylene Rubber)* - for ketones only
3	Teflon encapsulated viton - application specific
4	Buna-N *(Nitrile),* -65 ~ + 1 20ºC *(-53 ~ +250ºF)*

Temperature limits

-	**2**	1 20ºC (250ºF) max. *(80 °C / 1 76 °F meter mount inst. without ACF)*
-	**5**	* 1 20ºC (250ºF) max. *(includes ACF - integral air cooling fin)*

Process connections

1	BSP female threaded
2	NPT female threaded
4	ANSI-150 RF flanges
5	ANSI-300 RF flanges
6	PN1 6 DIN flanges
9	Customer nominated

Cable entries

B2 & B3 options fitted to High Pressure Meters Only	**0**	3~6mm cable gland or no cable entry
	1	M20 x 1.5mm
	2	1/2" NPT adapter

Integral options

	00	Nil
IECEx & ATEX approved	**E1**	Explosionproof ~ Exd
not available with high press models	**QP**	Quadrature pulse *(2 NPN phased outputs)*
IECEx & ATEX approved	**Q1**	Explosionproof Exd *(with quadrature pulse)*
for injected combustion engines	**PF**	Pulsating flow option *(Hall effect output only)*
IECEx & ATEX approved	**P1**	Explosionproof ~ Exd with PF pulsating flow option
with scaleable pulse output	**B2**	* BT1 1 totaliser with pulse output
IECEx & ATEX approved	**B3**	* Intrinsically safe BT11 with pulse output
scaled pulse, alarms, 4~20mA	**R0**	* RT1 2 rate totaliser with all outputs *(Alloy Housing)*
scaled pulse, alarms, 4~20mA	**R2**	* RT1 2 rate totaliser with all outputs *(GRN Housing)*
IECEx & ATEX approved	**R3**	* Intrinsically safe RT12 with all outputs
scaled pulse + backlighting	**R4**	* RT20 large LCD flow rate totaliser
2 stage DC batcher & totaliser	**E0**	* EB1 0 batch controller
	FI	Loop powered 4~20mA analog output
	SB	Specific build requirement

1.4 Specifications

Model prefix :	**015**	**025**	**040**	**050**	**050E**
Nominal size (inches)	1 5mm *(1 /2")*	25mm *(1 ")*	40mm *(1 1 /2")*	50mm *(2")*	50mm *(2")*
** Flow range (litres / min)*	1 ~ 40	1 0 ~ 150	1 5 ~ 250	30 ~ 450	35 ~ 580
** Flow range (USGM)*	0.26 ~ 10.6	2.6 ~ 40	4 ~ 66	8 ~ 1 20	9 ~ 1 50
Accuracy @ 3cp	± 0.5% of reading *(± 0.2% with optional RT12)*				
Repeatability	typically ± 0.03%				
Temperature range	-20ºC ~ +1 20ºC *(-4ºF ~ +250ºF)*				
Maximum pressure (threaded meters)	bar *(PSI)*				
aluminium	68 *(1 000)*	68 *(1 000)*	30 *(440)*	20 *(300)*	20 *(300)*
316L stainless	68 *(1 000)*	68 *(1 000)*	30 *(440)*	38 *(560)*	38 *(560)*
high pressure stainless	400 *(5880)*	400 *(5880)*	400 *(5880)*	300 *(4200)*	-
Protection class	IP66/67 (NEMA4X), (optional Exd I / I I B T6 or I.S.)				
Recommended filtering	1 50 microns *(1 00 mesh)* minimum				
***Electrical** - for pulse meters (see also optional outputs)*					
Output pulse resolution :	pulses / litre *(pulses / US gallon)* - nominal				
Reed switch	84 *(31 8)*	27 *(1 02)*	14 *(53)*	6.5 *(25)*	4.8 *(18)*
Hall effect	1 68 *(636)*	1 07 *(405)*	56 *(212)*	26 *(99)*	19.2 *(73)*
Quadrature Hall option	1 68 *(636)*	54 *(204)*	28 *(106)*	13 *(49)*	9.5 *(36)*
Reed switch output	30Vdc x 200mA max. *(max. temp. shock 10ºC (50ºF) / min)*				
Hall effect output (NPN)	3 wire open collector, 5~24Vdc max., 20mA max.				
Optional functions					
Display	flowrate, total *(accumulative & resettable)*				
Preset batching	1 & 2 stage high speed batch control				
Optional outputs					
Flow	4 ~ 20mA, high & low flow rate alarms				
Pulse	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 5 psi)*

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 max. 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).*

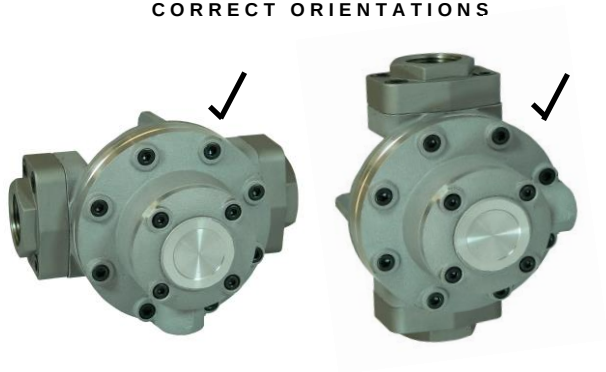
Process temperature and pressure does not exceed meter ratings.

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

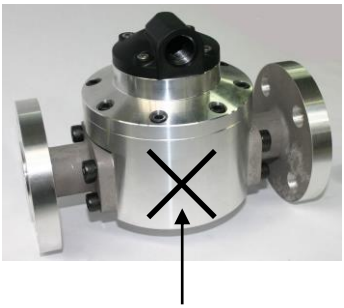
2.1.1 Orientation

The 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 a liquid at all times so protect the meter to 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. 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 *(0.5mm²)* 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).*

2.2.2 Hazardous area wiring Intrinsically safe wiring including using the reed switch pulse output as simple apparatus, wiring to an Intrinsically Safe Instrument or wiring to the Exd explosionproof option(Exd IIB T4/T6) wiring techniques must be undertaken in accordance with the rules, regulations and requirements applying to the territory in which the meter is being installed. The meters should only be connected by qualified staff, the qualified staff must have knowledge of protection classes, regulations & provisions for the apparatus in hazardous areas.

If the flowmeter is fitted with an intrinsically safe instrument refer to the appropriate manual & I.S. supplement for wiring of the instrument inputs and outputs.

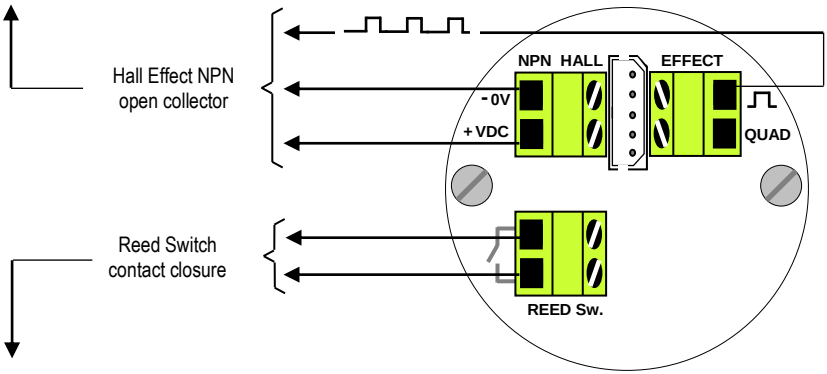
Earthing lugs are located within the terminal housing cover and on the meter body. Use a separate earth within the cable making sure that the earth conductor does not come in contact with the cable shield / screen.
Use only high temperature cable at the flowmeter when the process temperature exceeds 85ºC.

2.3 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.

2.3.1 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).

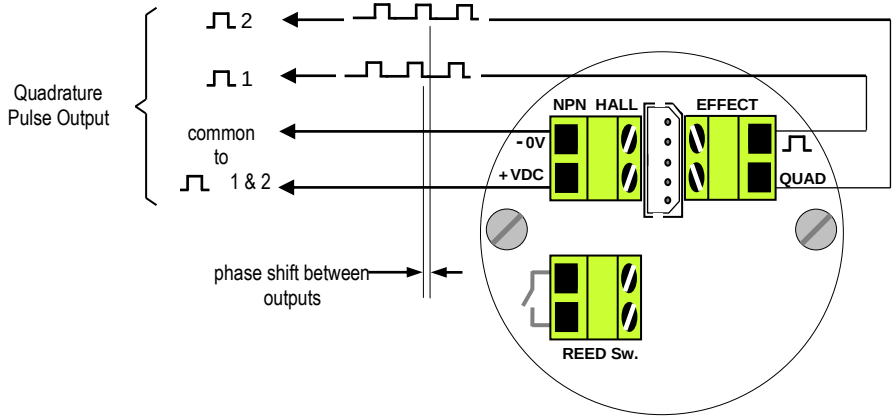


2.3.2 Reed Switch Pulse Output The reed switch output is a two wire normally open SPST voltage free contact ideal for installations without power or for use in hazardous area locations when Intrinsically Safe (I.S.) philosophy is adopted. **Note:** when using the reed switch output the liquid temperature must not change at a rate greater than 10ºC per minute (50ºF 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.

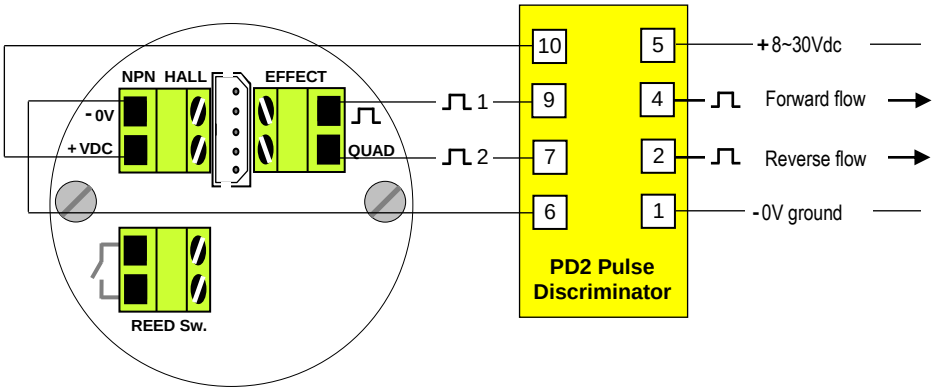
2.3.3 Quadrature (QUAD) Pulse Output The diagrams below apply when the meter is fitted with the Quadrature pulse output option *(two Hall Effect sensors arranged to give separate outputs out of phase with one another).*

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.

2.3.4 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.



2.3.5 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.

with LCD register

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 or low flow so if unsure remove the instrument bezel to check the wiring.

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, flowrate 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.

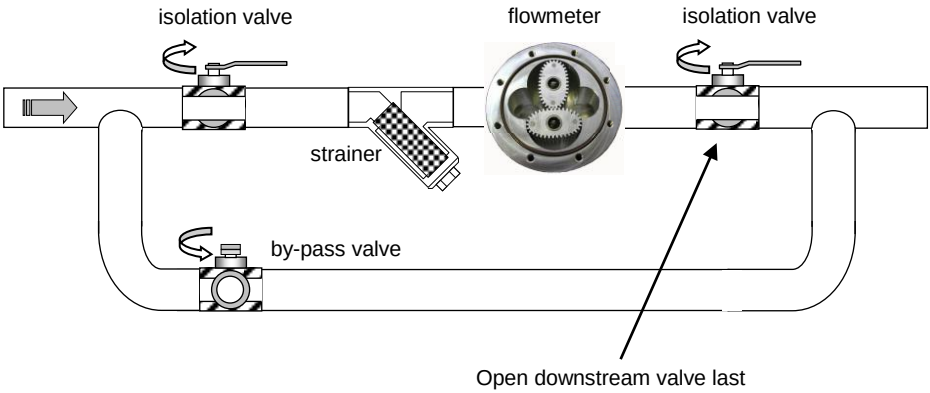
2.4.1 Meter Calibration Factor *(K or scale Factor)* Each flowmeter is individually calibrated and supplied with a calibration certificate showing the number of pulses per unit volume *(eg pulses per litre or pulses per USgallon).* Nominal figures are shown in the specification section of this manual.

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 flowrate and temperature.

BEFORE undertaking meter maintenance ensure the following :

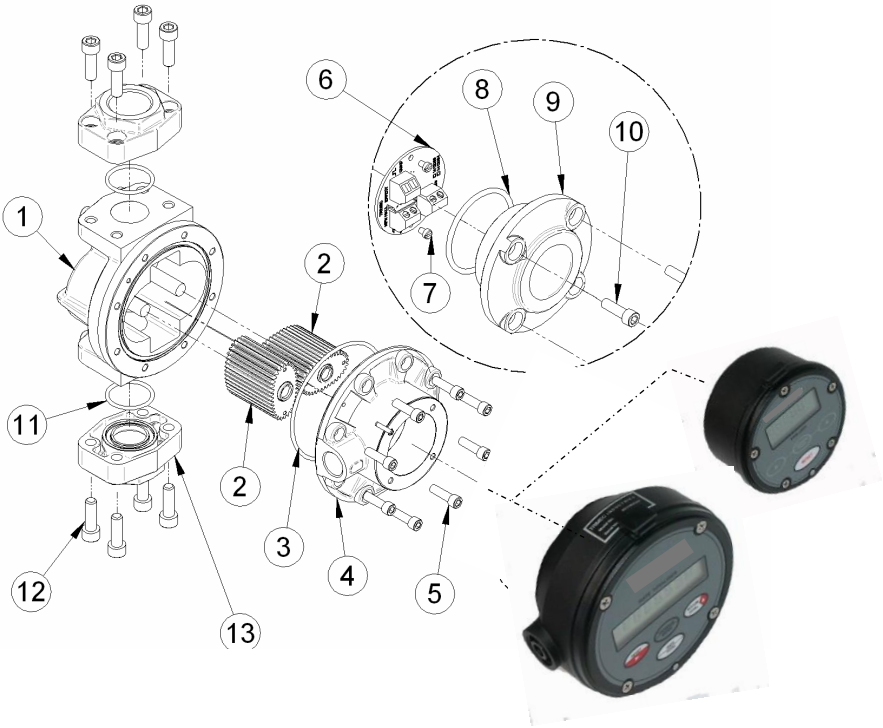
Associated alarm(s) or control output(s) are isolated so not to affect the process.

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 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 (screws 7). If required to gain access to the oval geared rotors undo the 8 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.

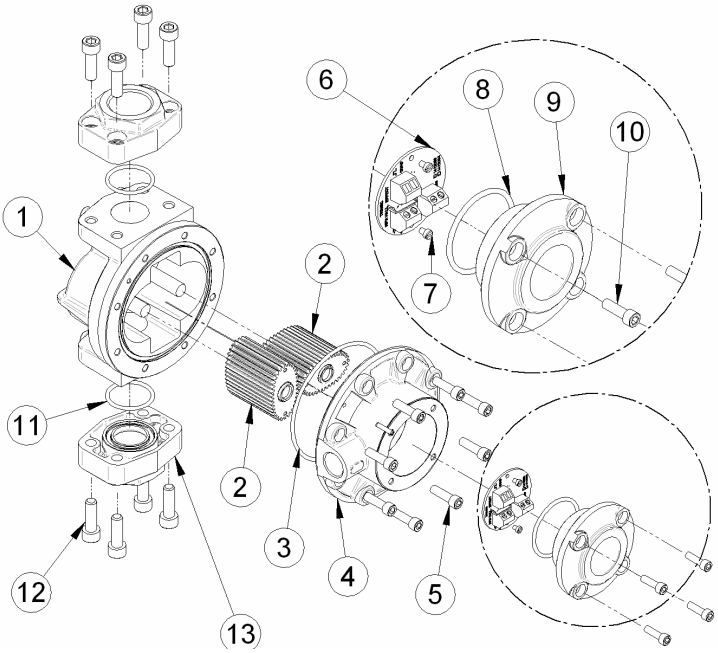
4.3 SPARE PARTS *(refer to exploded view)*

Item	Description	1" (025)	1 ½" (040)	2" (050)	2" (050E)
1	**Body assembly with rotor shafts**	Part No.			
	aluminum	1 401 096	1 401 094	1 401 092	1 401 1 32
	intermediate pressure aluminium	1 401 1 48	-	-	-
	stainless steel	1 401 097	1 401 1 30	1 401 093	-
	high pressure stainless steel	1 401 1 27	1 401 1 33	1 401 1 34	-
2#	**Rotor assembly set**				
	aluminum rotor + bearings	1 524008	1 52401 8	1 524020	1 524039
	stainless steel rotor + bearings	1 524009	1 52401 9	1 52401 1	-
	aluminum rotor set for pulsating flow *(PF op tion)*	1 524028	1 524030	1 524032	1 424044
	stainless steel rotor set for pulsating flow *(PF op tion)*	1 524029	1 524031	1 524033	-
3#	**Body O-ring** (Viton Standard) *(other material types below)*	*size BS1 53V*	*size BS245V*	*size BS253V*	
	EPR (E) / Buna-N (B) / Teflon encapsulated Viton (T)	1 53 (E) (B) (T)	245 (E) (B) (T)	BS253 (E) (B) (T)	
4	**Meter cap**				
	aluminum *(M20 conduit entry)*	1 302286	1 3021 60	1 302088	1 3021 07
	intermediate pressure aluminum (M20 conduit entry)	1 3021 91	-	-	-
	stainless steel *(M20 conduit entry)*	1 3021 65	1 3021 66	1 306025	-
	high pressure stainless steel - *(M20 conduit entry)*	1 3021 99	1 3021 95	1 302224	-
	1 / 2" NPT to M20 conduit adaptor	1 322 1 31			
5	**Body screw** *(screw size) - stainless steel socket head*	*(M6 x 20)*	*(M1 0 x 25)*	*(M1 0 x 20)*	
5	**Body screw - High tensile** *- for High Pressure Meters*	*(M6 x 35)*	*(M1 2 x 45)*	*(M1 0 x 45)*	-
6#	**Pulse output board**				
	standard pulse board	1 41 2033	1 41 2034	1 41 2034	
	quadrature pulse board	1 41 2039	1 41 2040	1 41 2040	
	high pressure pulse output board *(Hall & Reed)*	1 41 21 21	1 41 21 01	1 41 21 02	-
	output board for pulsating flow *(PF option)*	1 41 2085	1 41 2085	1 41 085	
7#	**Output board screw**	M3 x 4 stainless steel cheese head slotted screw			
8	**Terminal cover O-ring (Standard Pressure Meters)**	*Viton O - ring size*			
	Standard stainless steel cover	*size BS033V*			
	Exd Stainless steel cover	*size BS132V*			
8	**Terminal cover O-ring (HP - High Pressure Meters)**	*Viton O - ring size*			
	Standard GRN cover	*size BS032V*			
	Stainless steel cover	*size BS1 32V*			
9	**Terminal cover (Standard Pressure Meters)**				
	Standard stainless steel cover	1 306032			
	Exd Stainless steel cover	1 306030			
9	**Terminal cover (HP - High Pressure Meters)**				
	GRN glass reinforced nylon - *(M20 conduit entry)*	1 30601 2			-
	GRN glass reinforced nylon - *(1 /2" NPT conduit entry)*	1 30601 8			-
	Exd Stainless steel cover - *(M20 conduit entry)*	1 306001			-
	Exd Stainless steel cover - (1 /2" NPT conduit entry)	1 306008			-
10	**Terminal cover screw (Standard Pressure Meters)**	*M5 x 1 2 stainless steel socket head cap screws*			
10	**Terminal cover screw (HP - High Pressure Meters)**	*M5 x 1 6 stainless steel socket head screws*			-
11	**Flange portion O-ring** (Viton Standard)	*size BS1 23V*	*size BS1 3 V*	*size BS1 40V*	
	EPR(E) / Buna-N(B) / Teflon encaps.Viton(T)	1 23 (E) (B) (T)	1 36 (E) (B) (T)	BS1 40 (E) (B) (T)	
12	**Flange portion screw** *(screw size)*				
	socket head screw for threaded portions	*(M8 x 20)*	*(M1 0 x 40)*	*(M1 0 x 40)*	
	socket head screw for flanged portions	*(M8 x 20)*	*(M1 0 x 30)*	*(M1 0 x 30)*	
13	**Flange portion - Aluminium Meters**	*refer diagram page 1 3*			
	Screwed Port - BSP *(Aluminium meters)*	1 3221 60	1 3221 34	1 3221 08	
	Screwed Port - NPT *(Aluminium meters)*	1 32221 7	1 3221 38	1 3221 09	
	Screwed Port - BSP *(Stainless steel meters)*	1 322063	1 3221 34	1 3221 08	-
	Screwed Port - NPT *(Stainless steel meters)*	1 322064	1 3221 38	1 3221 09	-
	Modular Flange ANSI - 150 *(Aluminium & S/S meters)*	1 3221 20	1 3221 40	1 3221 1 0	
	Modular Flange - DIN PN16 *(Aluminium & S/S meters)*	1 3221 20	1 3221 40	1 3221 1 1	

 # = recommended spares

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 **r**e-installing the rotors all four magnets MUST be visible when both rotors are in place. 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 tighten in the same sequence to a firm torque. This sequence and procedure ensures the meter bodies are assembled correctly and evenly. 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

Symptom	*Possible cause*	*Solution*
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

5.3 Exd option

Flowmeters ordered with the optional Exd Explosionproof terminal enclosure are fitted with a label plate stating the relative apparatus grouping and temperature classification as follows:

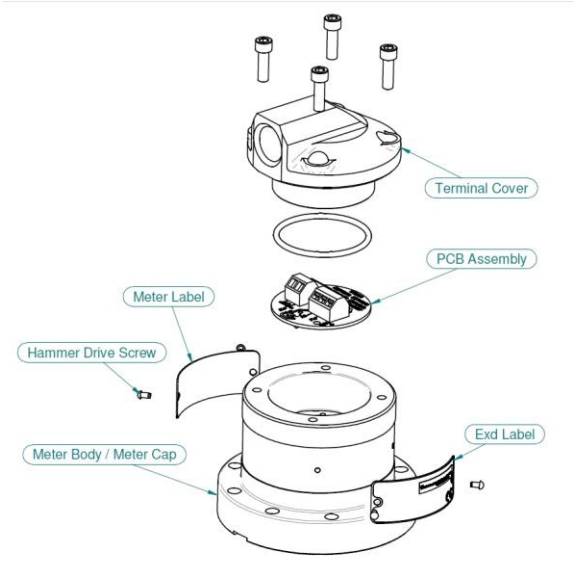
Group I : electrical apparatus for mines susceptible to fire-damp. Fire-damp is the natural gas given off by coal and carbonaceous strata in coal mines. Stainless steel meters only are suitable for use in Group 1, in accordance with IEC 60079-0:2004, clause 8.1.1, aluminum meters are not permitted in Group 1.

Group II : electrical apparatus for areas with an explosive gas atmosphere other than mines susceptible to fire-damp. Either aluminum or stainless steel flowmeters may be used in group II installations.

Exd I: Stainless steel flowmeters only: When flowmeters carrying this label are to be used as a Group 1 (mines) apparatus, the surface temperature of the enclosure should not exceed 150ºC. The maximum temperature of the process fluid must be below 120 ºC.

Exd IIB T4/T6 : When flowmeters carrying this label are to be used as a IIB apparatus, temperature restrictions as described below are applicable.

Exd IIB T4/T6 Aluminum or stainless steel flowmeters: When applied as a temperature class T6 enclosure the temperature of the process fluid passing through the flowmeter must be below 70ºC, and for temperature class T4 the temperature of the process fluid passing through the flowmeter must be below 120ºC.



General notation :

Apparatus marked IIB is suitable for applications requiring Group IIA apparatus.

Service note :

The maximum allowable diametric clearance of the cylindrical joint between the terminal cover and the Exd enclosure must not exceed 0.15mm. If, through corrosion or wear, diametric clearance is increased to above 0.15mm, corroded or worn parts must be replaced.

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).

Wichita ' Sydney ' Mexico City

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