



OVAL GEAR

Large capacity positive displacement
Mechanical Flowmeters

INSTRUCTION MANUAL

Models: 3" (080), 3" (080E), 4" (100), & 4" (100E)



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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. The meters are suitable for fuels, fuel oils & lubricating liquids.

This series of 3" (80mm) 4" (100mm) flowmeters are available with 3 digit M1 (Litres) / M2 (USG) or 4 digit M3 (Litres) / M4 (USG) mechanical registers, or with the optional V series 5 digit mechanical register (Litres). The V series register can also be used for mechanical batching applications when used in conjunction with the optional preset batcher and mechanically operated shut-off valve.

These mechanical flowmeters can also be used in conjunction with an optional Air eliminator Strainer (AES) which can be close coupled to the flowmeter.

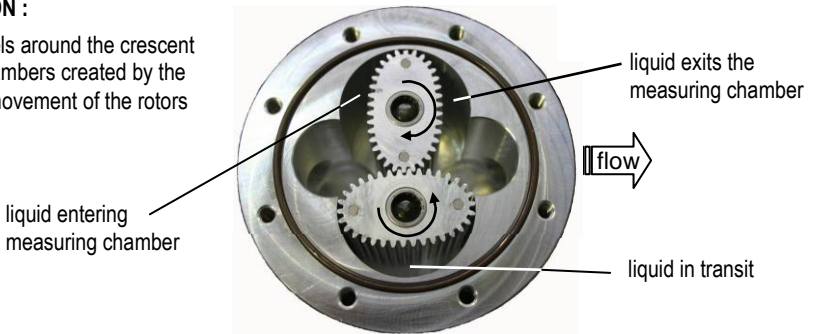
1.2 Operating Principle

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. The motion of the rotors is transmitted to the mechanical register totaliser via an interfacing reduction gear train & dynamic seal assembly.

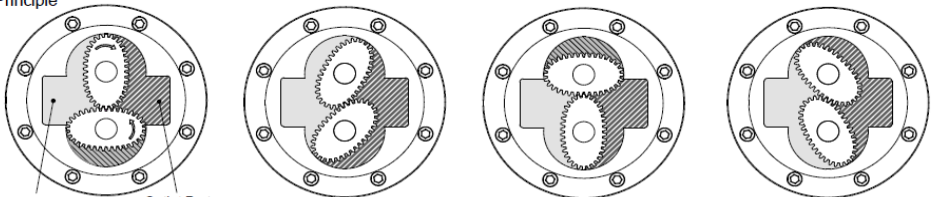
The benefits of this technology allow precise flow measurement and dispensing of most clean liquids irrespective of their conductivity, with other liquid characteristics having nil or minimal effect on meter performance. This metering technology does not require flow profile conditioning as required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




Oval Principle



 Liquid Entering the Measuring Chamber

 Liquid in Transition

 Liquid Leaving the Measuring Chamber

080	3" (80mm)	35~750 L/min	10~200 GPM
080E	3" extended flow (80mm)	50~1000 L/min	13~260 GPM
100	4" (100mm)	75~1500 L/min	20~400 GPM
100E	4" extended flow (100mm)	150~2500 L/min	40~660 GPM

Body material

A	Aluminum
E	Extended flow aluminum version (080E & 100E only)
S	316L Stainless Steel (available 080 only)
D	Ductile iron (Consult factory)

Rotor material

4	Aluminum (aluminum meters only)
5	Stainless steel (standard in all stainless steel models)
6	Aluminum - keishi cut for high viscosity liquids
7	Stainless steel - keishi cut for high viscosity liquids

Bearing type

1	Carbon Ceramic (standard with stainless steel rotors)
4	Hardened steel roller bearings (aluminum rotors only)

O-ring material

1	Viton (standard), -15~+120°C (5~250°F)
2	EPR (Ethylene Propylene Rubber) - for ketones only
3	Teflon encapsulated viton - application specific
4	Buna-N (Nitrile), -65~+120°C (-53~+250°F)

Temperature limits

8	*80°C (176°F) max.
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Process connections

1	BSP female threaded
2	NPT female threaded
4	ANSI-150 RF flanges
5	ANSI-300 RF flanges
6	PN16 DIN flanges
7	JIS 10kg/cm2 flanges
9	Customer nominated

Cable entries

0	no cable entry
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Totaliser capacities**Integral options**

99999 litres	M3	4 digit mechanical totaliser - litres
99999 gal.	M4	4 digit mechanical totaliser - U.S. gallons
Large digit mechanical registers		
999999 litres	V1	5 digit mechanical reset register - litres
999999 litres	V3	5 digit register + 7888 ticket printer - litres
999999 litres	V5	5 digit register + preset batch register - litres
999999 litres	V7	5 digit register + preset + 7888 printer - litres
	SB	Specific build requirement

Close coupled options

1	Back pressure w afer check valve w ithin meter inlet flange
2	Aluminum air eliminator-strainer close coupled to meter
3	Above options 1 & 2 close coupled to meter
4	Back pressure w afer check valve + VR pulse generator
5	Air eliminator-strainer + VR pulse generator
6	Above options 1 & 2 close coupled + VR pulse generator
7	VR quadrature pulse generator (100 pulses/rev)
8	Aluminum strainer close coupled to meter

Control valve options (close coupled)

V	Mechanical control valve + linkages coupled to meter
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Model No. Example**Flow direction for close coupled options**

100	A	4	4	1	-	2	1	0	V1	3	V	-	RL	Flow from right to left (for close coupled options 1-6)
													LR	Flow from left to right (for close coupled options 1-6)

1.4 Specifications

Model prefix :	080A	080E	100A	100E
Nominal size (inches)	80mm (3")	80mm (3")	100mm (4")	100mm (4")
* Flow range (litres / min)	35 ~ 750	50 ~ 1 000	75 ~ 1 500	1 50 ~ 2500
* Flow range (USGM)	1 0 ~ 200	13 ~ 260	20 ~ 400	40 ~ 660
Accuracy @ 3cp	± 1.0% of reading using M3 or M4 registers			
using V register options	± 0.5% of reading using V series registers			
Repeatability	typically ± 0.03%			
Temperature range	-20°C ~ +80°C (-4°F ~ +176°F)			
Maximum pressure (threaded meters)	bar (PSI)			
aluminium	12 (180)	12 (180)	10 (150)	10 (150)
ductile iron	12 (180)	-	10 (150)	-
stainless steel	12 (180)	-	-	-
Protection class	IP53 / 54 (NEMA3)			
Recommended filtering	350 microns (40 mesh) minimum			
Functions				
Display	totaliser (accumulative & resettable)			
Preset batching Option	1 & 2 stage mechanical batch control (V series only)			
Mechanical register options				
4 digit reset totaliser	99999 litres or gallons (8 digit accumulative)			
5 digit reset totaliser	999999 litres or gallons (8 digit accumulative)			

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

* Max. flow is to be reduced as viscosity increases, max. press. drop 100Kpa (15psi)

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 Meter & totaliser 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 mechanical display is facing the user in a horizontal direction, it should never point towards the sky or towards the ground. If installed incorrectly the weight of the rotors will bear down on the lower end of the measuring chamber.

CORRECT ORIENTATION



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. Be sure to observe flow direction (inlet & outlet markings).

Each meter is supplied from the factory with the totaliser orientated to suit horizontal pipe runs, should the installation have a vertical pipe run the totaliser may be rotated 90 degrees by removing front & rear bezel screws (16), the counted wheel assembly can then be removed to access & remove the 4 housing screws (10) then rotate the housing (6) to the desired position.

2.1.2 Flow Conditioning and Locations

Strainer : It is recommended to INSTALL a 40mesh (350 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.

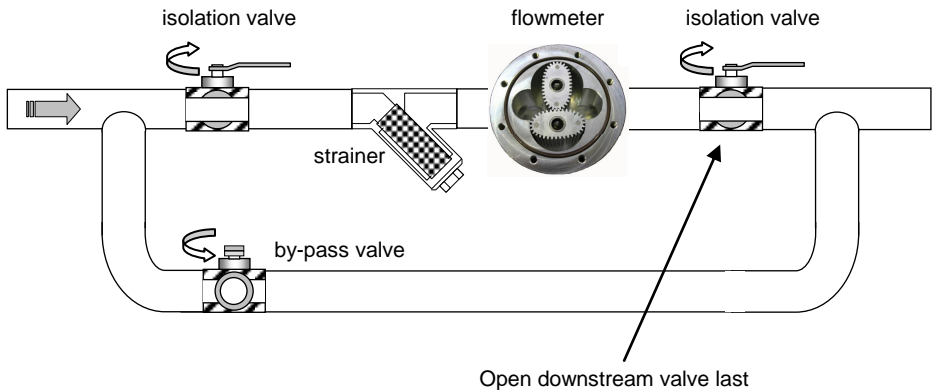
Fluid state : Fluid entering the meter must remain a liquid state at all times so take necessary precautions to protect the meter by avoiding any factors that may result in any solidification or gelling of the metered medium. If meters are to be trace heated or jacketed in any way the maximum temperature rating of the meter must not be exceeded. Size the meter to avoid gasification of volatile liquids (*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.

3.0 Commissioning Once the meter has been mechanically installed 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 on the mechanical display. 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.

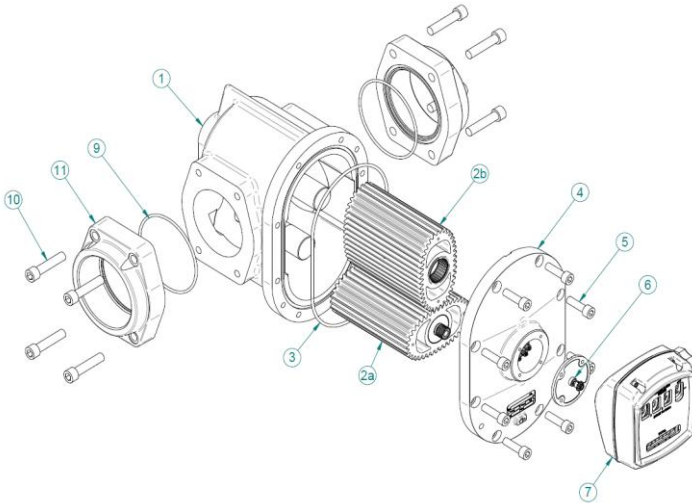
The meter is isolated from any source of supply of liquid upstream or downstream.

The meter is depressurized and liquid drained from the meter.

4.1 Disassembly of meter (*Refer Exploded View*) 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 body O-ring (3) and the rotors (2a & 2b). Ensure the pipeline and flowmeter is depleted of any residual system pressure before removing any of the meter body screws.

If required to gain access to the internals of the mechanical register & gearbox (within meter cap [4]), remove the front bezel screws, the totaliser assembly can then be removed to access & remove the 4 x rear housing screws , remove register plate assembly (6) to expose the mechanical register drive gears :

“BEWARE THAT REMOVAL OF ITEM (6) WILL EXPOSE A WETTED CHAMBER WHICH COULD BE UNDER PRESSURE”.



4.2 Inspection (*refer Exploded View*) Inspect O-rings for damage, chemical attack, deformity or any form. Remove, inspect & clean the rotors, check the primary rotor gear pinion for any damage. Check the measuring chamber for damage or scoring & redress if necessary, the rotor shafts should NOT be loose or able to be rotated.

Inspect the register gearbox drive gears & gear shafts for any wear or damage; check that the gear train rotates freely & that the circlips are in place. Check that the transition gear shaft & bevel gear rotate freely in the register plate (6).

4.3 Re-assembly of meter (*refer Exploded View*) When re-installing the rotors the primary rotor with gear pinion must be fitted to the shorter of the two rotor shafts. 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 and 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 in one position only; this is dictated by the rotor pinion in the 1st rotor (2a).

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. Fit the register assembly while maintaining original orientation if so desired.

4.4 SPARE PARTS (refer to exploded view)

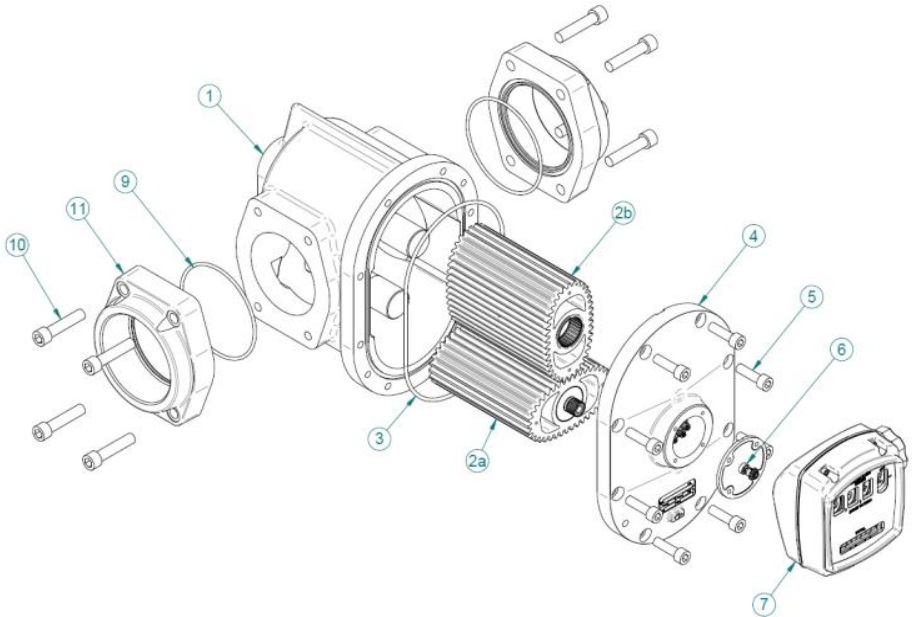
Item Description	Models			
	080 (3")	080E (3")	100 (4")	100E (4")
1 Body assembly with rotor shafts	Part No.			
aluminum body	1401143	1401144	1401145	1401137
stainless steel body	1401165	-	-	-
2a# Primary Rotor assembly				
aluminum rotor + bearings + pinion	1424114	1424130	1424121	1424165
stainless steel rotor + bearings + pinion	1424214	-	-	-
2b# Secondary Rotor assembly				
aluminum rotor + bearings	1424115	1424131	1424122	1424166
stainless steel rotor + bearings	1424215	-	-	-
3# Body O-ring (Viton standard) options below	BS260V	BS267V	BS272V	
EPR(E) Ethylene Propylene Rubber	BS260E	BS267E	BS272E	
Teflon encapsulated Viton(T)	BS260T	BS267T	BS272T	
Buna-N (Nitrile) (B)	BS260B	BS267B	BS272B	
4 Meter cap				
aluminum w ith geartrain	1402074	1402089	1402078	1402130
stainless steel w ith geartrain	1402146	-	-	-
5 Body screw (S/S socket head cap screw)				
aluminum meters	M10 x 30	M10 x 30	M10 x 30	M10 x 35
stainless meters	M10 x 25	-	-	-
6 Register Plate assembly				
Aluminium - Litres				1406047
Aluminium - US Gallons				1406046
Stainless Steel - Litres				1406048
Stainless Steel - US Gallons				1406045
7 Mechanical Register Kit				
M3 Register (Litres)				1502026
M4 Register (US Gallons)				1502030
8 Mechanical Register Mount Screws	M5 x 16 S/S socket head cap screw			
9 Flange portion O-ring Viton (Standard)	BS237V		BS245V	
EPR(E) / Buna-N(B) / Teflon encaps Viton(T)	BS237 (E) (B) (T)		BS245 (E) (B) (T)	
10 Flange portion screw (socket head cap screw)				
socket head screw for threaded portions	M12 x 55		M12 x 50	
socket head screw for flanged portions	M12 x 35			
11 Process connections - Aluminium meters				
Screwed Port - BSP	1322098		1322128	
Screwed Port - NPT	1322099		1322129	
Modular Flange ANSI-150	1322095		1322100	
Modular Flange DIN type PN16	1322096		1322101	
11 Process connections - Stainless Steel meters				
Screwed Port - BSP	1322227	-	-	-
Screwed Port - NPT	1322226	-	-	-
Modular Flange ANSI-150	1322155	-	-	-
Modular Flange DIN type PN 16	1322156	-	-	-

Recommended spares

Note:

It is recommended that some parts be replaced as complete assemblies (e.g. Register Assembly)
For Individual components not listed above, please consult factory.

5.0 Fault Finding Meters have two distinct sections: the mechanical wetted section housing the rotors and reduction gear assembly & the mechanical dry section from the register base (Item 6) out. The aim of fault finding is to trace the source of the fault to one of these two sections.



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.

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.

If the register is not totalizing first check that the rotors are rotating 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. If the rotors are rotating then the problem will most probably be somewhere within the reduction gear assembly (within items 4 & 6) or totaliser assembly (7).

5.1 TROUBLE SHOOTING

Symptom	Possible cause	Solution
Meter readings are high	1. Entrained air or gas	1. Remove source of air or gas entrapment 2. Install an upstream air eliminator
	2. 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
Register no totalising	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.
	3. Gear train jamed	1. Inspect, repair, clean or replace gear train

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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