

FLOW CONTROLS FCO SERIES

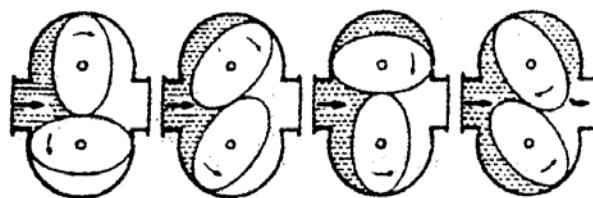
General Description

Oval gear flowmeters are instruments used for the continuous and intermittent measurement and control of the pipe liquid flow, which are typical of positive displacement meter, feature large flow range, low pressure loss, large viscosity range, easy installation, high accuracy and can measure high temperature, high viscosity liquids with easy calibration.

FCO oval gear flowmeters are fitted with mechanical pointer and register which can indicate the liquid flow and totalized flow passing through the pipeline. For the different liquids (acid, alkali, salt, organic solution etc.), the meters can be made of different materials (cast iron, cast steel, stainless steel etc.). The meters are widely used for the flow measurement in the field of petroleum, chemical, chemical fiber, traffic, food industries and commerce, medical and sanitary departments.

Structure and Principle

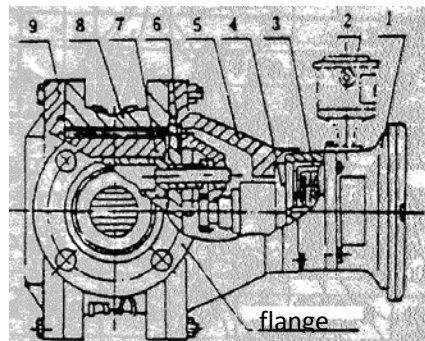
Oval gear flowmeter is generally comprised of a flow transducer and a register mechanism. The main part of the transducer is a measuring chamber which consists of a pair of oval wheels and a sealing coupling. The register mechanism contains speed reduction gears, adjusting device, register, and pulse transmitter etc.



In the measuring chamber, a pair of oval wheels and cover plate make a crescent shape cavity which is used as a measuring unit. The oval wheels are rotated by the pressure difference in the inlet and outlet of the meter and drive the inlet liquid through the cavity to the outlet, each revolution of the oval wheels displaces fluid four times the

volume of the cavity, the total revolutions of the oval wheels and the revolution rate will be transferred to the mechanical Register, and the total liquid volume and instantaneous flow will be known by the pointer display and the roller integration. The attached signal generator converts the rotary axial angular shift to the pulse signal and then transmits it to the electrical indicator for remote integrated flow and instantaneous flow indication and control.

1. Register
2. Pulse transmitter
3. Accuracy adjustor (above DN50)
4. Sealing coupling
5. Front cover
6. Cover plate
7. Oval gears
8. Shell
9. Back cover



Technical Specification

➤ General Specifications

Accuracy:	0.5%, 0.2%
Protection Level:	IP66
Working Temp:	FCOA: -20°C~+60°C; FCOB,E: -41°C~60°C, FCOQ: -20°C~+60°C, With high temp. Radiator: 60°C-200°C
Explosion Proof:	Exia IICT6, ExdIICT6
Medium Viscosity:	Max 2000mPa.s
Flowmeter Size:	DN10-DN200

➤ Main Types and Materials

FCOA: Cast-iron Oval Gear Flow meter, applied widely in various oil or other medium which is not corrosive to cast iron material;

FCOE: Cast-steel Oval Gear Flow meter, applied in the low-corrosive fluids with high pressure.

FCOB, C: Stainless steel Oval Gear Flow meter, applied to strong corrosive fluids such as acid, alkali, salty or organic chemicals.

Main parts material and Nominal operation pressure

Table 1

	Shell & Cover	Cover Plate	Oval Gear	Shaft	Nominal Pressure (1.6Mpa)
FCOA	Cast iron	Cast iron	Cast iron/ Stainless steel/ Aluminium alloy	Bronze(with oil) or rolling bearing	1.6Mpa
FCOE	Cast steel	Cast iron			≤DN50: 6.3 Mpa DN80-100: 4.0, 6.3 Mpa DN150-200: 2.5 Mpa
FCOB/C	Stainless steel	Stainless steel	Stainless steel	Graphite or rolling bearing	≤DN50: 2.5 Mpa ≥DN80: 1.6 Mpa

Note:

FCOC Material: 316 Stainless steel, FCOB Material: 304 stainless steel

Flange below 2.5 Mpa is RF, 6.3 Mpa flange is MFM, 4.0 Mpa flange can be RF or MFM.

➤ Flow range and Viscosity

Flow Unit :m3/h

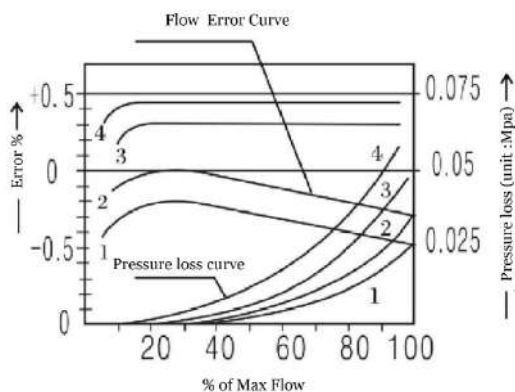
Table 2

Model	Size (mm)	Medium Viscosity (mPa. s)							
		0.3-0.6	0.6-2		2-200		200-1000		1000-2000
FCO-10II	10	0.08-0.2	0.1-0.25	0.05-0.25	0.08-0.25	0.05-0.25	0.03-0.05	0.02-0.05	
FCO-10	10	0.2-0.5	0.15-0.5	0.1-0.5	0.1-0.5	0.05-0.5	0.06-0.3	0.03-0.3	0.03-0.2
FCO-15	15	0.75-1.5	0.5-1.5	0.3-1.5	0.3-1.5	0.15-1.5	0.2-1.0	0.1-1.0	0.07-0.7
FCO-20	20	1.5-3	1-3	0.5-3	0.5-3	0.3-3	0.4-2.1	0.2-2.1	0.15-1.5
FCO-25	25	3-6	2-6	1-6	1-6	0.6-6	0.8-4.2	0.4-4.2	0.3-3
FCO-40	40	7.5-15	5-15	2.5-15	2.5-15	1.5-15	2.1-10.5	1.0-10.5	0.7-7.5
FCO-50	50	8-24	8-24	4.8-24	4.8-24	2.4-24	2.4-16.8	1.6-16.8	1.2-12
FCO-B40(50)	40,50	6-20	6-20	4-20	4-20	2-20	2.8-14	1.4-14	1.0-10
FCO-65	65	20-40	15-40	8-40	8-40	4-40	5.6-28	2.8-28	2-20
FCO-80	80	30-60	20-60	12-60	12-60	6-60	8.4-42	4.2-42	3-30
FCO-100	100	50-100	34-100	20-100	20-100	10-100	14-70	6-70	5-50
FCO-150	150	45-180	45-180	20-220	8-220	15-220	5-220	8 - 220	5 - 220
FCO-200	200	170-340	114-340	56-340	56-340	34-340	47.6-238	23.8-238	17- 350
Accuracy		0.5	0.2	0.5	0.2	0.5	0.2	0.5	0.5

Note: when the viscosity is over 200 mPa. S, it belongs to high viscosity medium.

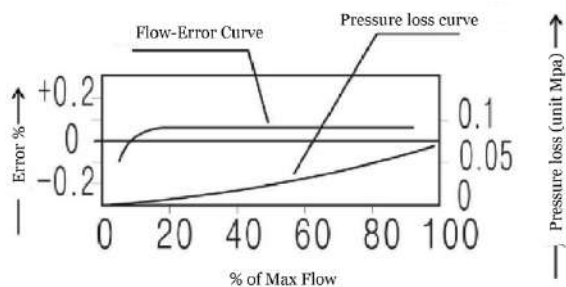
➤ Flow meter Error and Pressure loss

0.5% Accuracy Error and Pressure Loss Curve



1. Aerial petrol 0.7mPa*s
2. Light diesel oil 5mPa*s
3. Water 1mPa*s
4. Transformer oil 20mPa*s

0.2% Accuracy Error and Pressure Loss Curve



Notes:

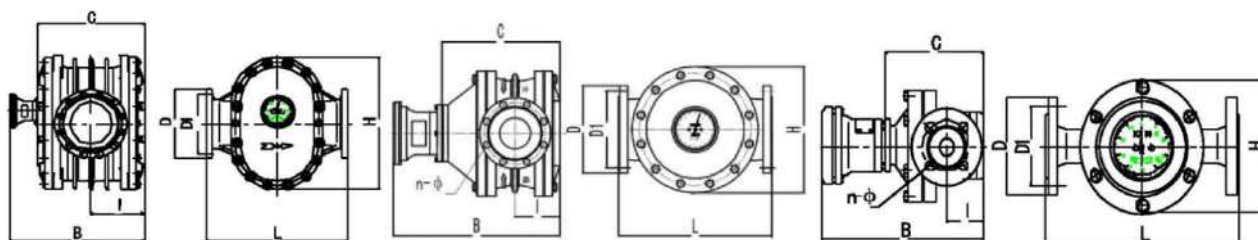
1. The accuracy curve shows the meter error when the metered liquids have different viscosities, and the meter error can be adjusted up and down the Axis 0 by the accuracy adjustor to optimize the error.
2. For any liquid when the flow range rate is reduced, the meter accuracy can be improved by means of accuracy adjustor.

Dimensions

The dimensions are only for mechanical Register A



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➤ FCO-A Cast Iron Oval Gear Flow meter Dimensions (B=Register A dimensions)

Table 3

Unit :mm Nominal Diameter	L	H	B	C	I	D	D1	n	Φ	Weight (kg)
10	150	100	213	135	45	90	60	4	14	6
15	170	118	226	147	48	95	65	4	14	8
20	200	150	238	155	53	105	75	4	14	11
25	260	180	246	164	60	115	85	4	14	18
40	245	180	271	199	77	145	110	4	18	20
50	340	250	379	249	88	160	125	4	18	46
80	420	325	441	311	118	195	160	8	18	87
100	515	418	467	337	131	220	180	8	18	160
150	560	500	860	620	400	350	270	25	25	250
200	650	650	950	750	500	390	295	25	25	400

➤ FCO-E Cast Steel Oval Gear Flow meter Dimensions (B=Register A dimensions)

Unit :mm

Table 4

Unit :mm Nominal Diameter	L	H	B	C	I	D	D1	n	Φ	Pressure (Mpa)	Weight (kg)
15	200	138	220	142	53	105	75	4	14	Example: Flange pressure 6.3Mpa	12
20	250	164	244	166	63	125	90	4	18		18
25	300	202	252	173	68	135	100	4	18		22
40	300	202	283	205	83	165	125	4	23		27
50	384	262	398	268	88	175	135	4	23		66
80	450	337	460	330	118	210	170	8	23		118
100	555	442	484	354	131	250	200	8	25		210
150	560	500	860	620	400	350	270	25	25	Example: Flange .5Mpa	250
200	650	650	950	750	500	390	310	25	25		430

Overview

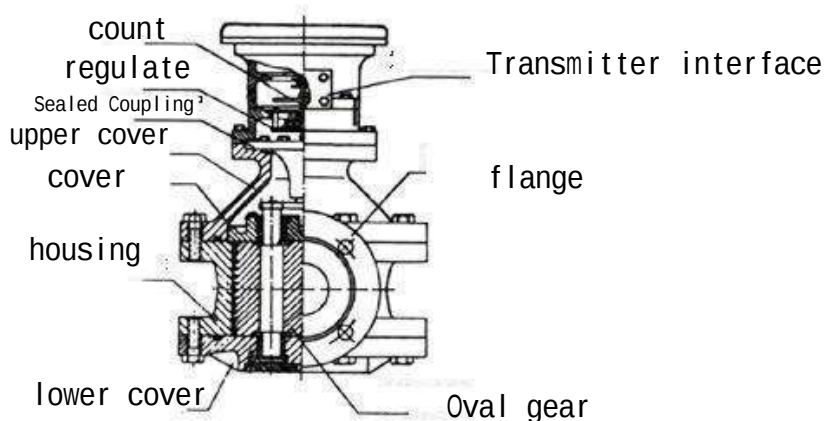
Oval gear flowmeter is a volumetric meter for continuous or intermittent measurement and control of liquid flow in a pipeline. It has many advantages, such as large range, high accuracy, small pressure loss, strong viscosity adaptability, measurement of high temperature and high viscosity liquid, convenient calibration, installation suggestion and so on. It is suitable for flow measurement in petroleum, chemical, chemical fiber, transportation, commerce, food, medicine and health departments.

FCO series oval gear flowmeter is equipped with a pointer and printing wheel accumulation device, and can directly display the liquid accumulation flow through the pipeline on the spot. The accumulative, quantitative and instantaneous flow remote transmission control can be realized by attaching the transmitter and the electric display instrument to the counting mechanism. High temperature and high viscosity liquid can be measured by adding radiator or ellipsoid undertooth.

The flowmeter for different liquids (acids, bases, salts, organic solutions, etc.) can be made of different materials.

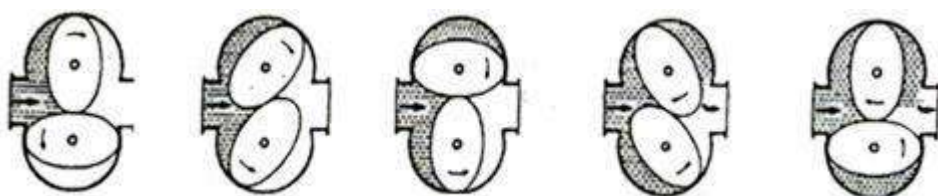
Structure and Working Principles

Oval gear flowmeter consists of flow transmitter and counting mechanism. A high temperature flowmeter if formed if a radiator is installed between the transmitter and the counting mechanism. The transmitter consists of a metering chamber and a sealing coupling with a pair of elliptical gear rotors. The counting mechanism comprises a deceleration mechanism, a regulating mechanism, a counter and a transmitter



Structure diagram

The metering chamber has a crescent cavity composed by a pair of oval gear and cover plate as the metering unit of flow. The oval gear is rotated by the pressure difference between the inlet and outlet of the flowmeter so that the liquid is continuously measured by the crescent cavity and sent to the outlet. The liquid that flows every turn is four times of the crescent cavity. By sealing coupling, the total number of turns of oval gear and the speed of rotation are sent to the counting mechanism or transmitter. Thus, we can know the total amount of liquid and instantaneous flow through the pipeline.



Installation and Use of Oval Gear Flowmeter

- 9.1 A matching filter shall be installed before the flowmeter, and the outlet of the matching filter is connected to the inlet of the flowmeter. The arrow points on both bodies are consistent with the flow direction of the liquid.
- 9.2 When the liquid under test contains gas, the gas elimination filter should be installed before the Flowmeter.
- 9.3 No matter whether the pipeline is installed vertically or horizontally, the oval gear in the flowmeter shall be installed in a horizontal position (i.e. the gauge disc shall be perpendicular to the ground).
- 9.4 When the flowmeter is properly installed, if it is not easy to read, turn the counter to 180 degrees or 90 degrees.
- 9.5 The new flowmeter pushes the elliptical gear several times from the exit with a bamboo stick before installation. If it doesn't move, soak in diesel oil (Avoid sediment after factory check).
- 9.6 Flow control valve should be installed at the inlet of the Flowmeter, and open and close valve is installed at the outlet. When using open and close valve, start slowly, do not suddenly open to prevent "water hammer" phenomenon.
- 9.7 Before installing the flowmeter on the new pipeline, the pipeline needs to be flushed, and the straight pipe section (instead of the position of the Flowmeter) is used to prevent welding slag, sundries and so on from entering the flowmeter.
- 9.8 It is strictly forbidden to check the flowmeter of cast iron and steel with water.
- 9.9 The flow size of the flowmeter in use shall not exceed the technical requirements. The flowmeter operates at a maximum flow rate of 50-80%.
- 9.0 If the tested liquid is chemically corrosive, a flowmeter of stainless steel should be selected.

Error Calculation and Adjustment

- 10.1 The basic errors of flowmeter and the measured value of each flow point are calculated respectively: (volumetric method)

$$E=(V_m-V)/V\times 100\%$$

E—Flowmeter error (Generally cumulative error) takes two-digit effective numbers.

V_m —Measured value of Flowmeter

V—Measured value of flow standard device after correction (Actual value)

From the calculation formula of basic errors, when

$V_m > V$, the basic error of the flowmeter is "+", indicating the flowmeter goes fast;

$V_m < V$, the basic error of the flowmeter is "-", indicating the flowmeter goes slow.

In order to make the Flowmeter error within the basic error limit, error adjustment is often needed, that is to change the mechanical transmission speed ratio by replacing a pair of adjusting gears (adjusting teeth) installed in the counter, so that the indicator value of the Flowmeter can be adjusted.

The error adjustment cannot change the flow characteristics of the flow meter, only make its characteristic curve artificially in the new coordinate system.

In general, the basic error range of its maximum and minimum flow points is not the basic error limit of the specified precision in the specified (or actual use) flow range, and the basic error range of its Flowmeter can be qualified by error adjustment.

For used flow meters, the original adjustment gear set is used to check the error and then the error adjustment is made according to the specific error situation.

10.2 Error adjustment method of oval gear flowmeter (Description of Use of Error Adjustment Sheet)

1. The standard double-layer gear is 38/35 when designed. If the flowmeter goes fast during the test,

such as $+1.02 \sim 0.3$, the corresponding “zero” place of 38/35 gear should be moved to the position of $+0.63$ of 41/38 gear. In this way, the error curve is located in the new coordinate system and the error of the flowmeter is adjusted into the range of $+0.33 \sim -0.33$.

The error of flowmeter may change and exceed the difference due to different working conditions and changes. It may be adjusted as long as the error range does not exceed 1%. For example when the instrument error reduces to $-0.7 \sim +0.2$ and the double-layer gear should be replaced, we should firstly check the number of gears. If it is 38/35, it is adjusted with method (1); if it is 41/38, the corresponding error of gear $+0.63$ should be 0. At this time, 41/38 gear should be replaced to 40/37 double-layer gear and the error may be adjusted to the range of $-0.5 \sim +0.4$

Common Faults, Causes and Troubleshooting Methods

Fault phenomenon	Causes	Measures	Notes
Oval gear does not rotate	1. There are sundries in the pipeline 2. The liquid tested contains more debris; the filter is damaged; the sundries enter the meter and the gear is blocked.	Remove the instrument and pipeline and repair the filter	
Leakage of axial sealing coupling	Sealing filler wears or lacks seal oil	Tighten gland or replace packing, fill sealing oil	
Unstable pointer rotation	Pointer and washer are loose or rotating parts are dumb	Retighten to eliminate inflexibility	
Small flow error is too negative	Elliptical gear collides with the wall of the measuring box due to wear of the bearing or deformation of the measuring cavity	Replace the bearings, repair the metering cavity and gear at the deformed place, make the rotation flexible and ensure the required clearance	Calibrate after repair
Error changes a lot	Large or gaseous flow pulsation	Reduce pulsation and add gas separator	
Error is too large but not more than $\pm 1\%$.	Changes in service life or clearance after maintenance	Re-calibrate and adjust it	For level 0.1 flowmeter, the maximum and minimum change does not exceed $\pm 0.17\%$
	.		