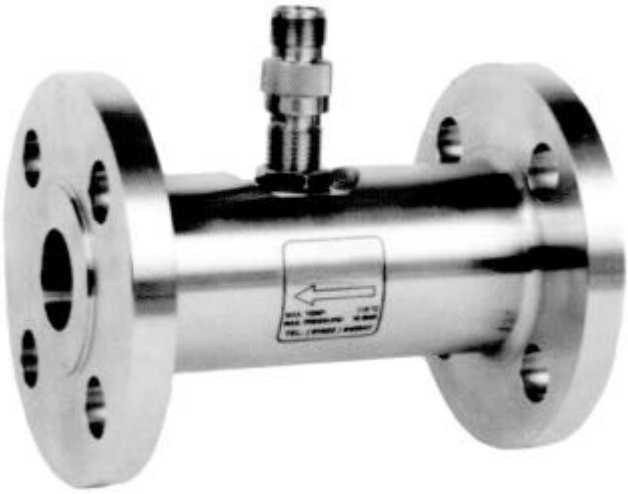
Flowquip
flowmetering systems

FT3/4/7

FT Series Industrial Turbine Flowmeters



Installation and Operation

January 2000

Whilst every effort has been taken to ensure the accuracy of the information contained in this manual, no responsibility is accepted for damage, injury, or expense resulting from errors or omissions. The contents of this manual do not constitute a contract. We reserve the right to change specifications etc. at our discretion without notice. The data in this manual covers the complete FT Series so some data may not be applicable to your turbine meter. If in doubt, and for technical advice, please contact Flowquip Limited.

Contents at a Glance

		Page
1.	Introduction	5
2.	Principle of Operation	6
3.	Performance	6
4.	Installation Requirements	7
5.	Electrical Installation	8
6.	Intrinsic Safety	8
7.	Start-Up Procedure	9
8.	Maintenance	10
9.	Calibration	11
10.	Spares	11
11.	FT3 Flow Data and Dimensions	12
12.	FT4 Flow Data and Dimensions	13
13.	FT7 Flow Data and Dimensions	14
14.	General Specification	15
15.	Fault Finding	16
16.	Typical Performance Curve	17
17.	Personal Flowmeter Details	17
18.	Notes	18

Please read this manual prior to installation

FT3 Turbine Flowmeter
(screwed connections)

FT4 Turbine Flowmeter
(flanged connections)

FT7 Turbine Flowmeter
(hygienic connections)

1. Introduction

The Flowquip Industrial Turbine Flowmeter provides an accurate and economical means of measuring flows of clean liquids in the range of 2 to 10000 litres/minute.

The stainless steel body and hangers, together with an extremely strong rotor construction results in a meter that can be used in a wide range of duties on both lubricating and non lubricating liquids.

The standard meter can be operated at temperatures of up to 110^{o} C., with optional sensing coils and bearing materials allowing temperatures of up to 232^{o} C.

The meter can be supplied with threaded, flanged, or hygienic process connections.

For hazardous area applications meters are available certified to EEx ia IIC T5.

All Flowquip turbine flowmeters are individually calibrated to ensure their accuracy.

2. Principle of Operation

The FT turbine flowmeter consists of a helically cut turbine rotor supported in two plain bush bearings, the rotor being machined from solid ferritic stainless steel of a grade compatible with the metered fluid, all contained within a housing of non-magnetic stainless steel. A pick-off coil having a permanent magnet core is mounted in the housing adjacent to the rotor blade tips such that a magnetic circuit is set up via the rotor blades.

Rotation of the rotor varies the reluctance of this magnetic circuit, and the flux changes induce a small voltage in the coil, the frequency of which is directly proportional to the rotor speed and therefore proportional to the volumetric flowrate.

3. Performance

Referring to the typical performance curve it will be seen that pulses per unit volume are almost constant over a wide range of flowrates. Thus it is possible to establish a meter factor of pulses per unit of volume and this "K" Factor can be used in the programming of ancillary flow instrumentation.

As would be expected with any device possessing a fixed cross sectional area the pressure drop across the meter varies as the square of the flowrate, a typical design figure being 3 psi (0.2 bar) for maximum flowrate.

The effects of increasing viscosity are clearly shown as reducing the linear flowrate at which the pulses per unit volume are constant. For practical purposes should viscosity exceed 10 cSt. it is advisable to consider a special calibration.

Linearity figures vary according to the size of meter and the operating fluid conditions but are generally within ±0.5% of average meter factor with point repeatability of 0.1% of reading.

4. Installation Requirements

The flowmeter may be installed in any attitude in the pipeline, but in the case of vertical installations, it is preferable for fluid to flow in an upward direction. Unless otherwise requested, factory calibration takes place in a horizontal plane, and vertical operation may cause a slight calibration shift of less than 0.1%

Ideally flowmeters should be installed with ten diameters of straight pipe upstream and five diameters downstream. For optimal performance a cruciform or alternative type of flow straightening vane section should be fitted at the upstream end of the straight pipe length. Reducers, where necessary, should be of the concentric type with included angle of 22-30^{o}.

Inlet pipe bore should be matched as closely as possible to that of the meter, but where it is impossible to select the exact diameter, a smaller inlet diameter should be used in order to avoid sharp step at the meter inlet which could cause swirl.

Whilst most plants requiring the precision of turbine flow measurements will usually be protected by adequate filters or strainers, the recommended mesh sizes for protection of FT Turbine Meters are:

Up to 9mm bore	0.1mm
9 - 50 mm bore	0.3mm
Above 50mm bore	0.5mm

Any turbine flowmeter will register the total amount of fluid passing whether this be all liquid or a mixture of liquid and gases, and it is therefore essential to ensure that the pipeline at the meter point is completely filled with liquid.

A good general rule is to ensure that the downstream static pressure is at least equal to twice the pressure drop across the meter plus the vapour pressure of the fluid in order to prevent cavitation at the rotor.

If the meter is to be used with open ended pipe then the metering installation should be located at the lowest possible level in the system with a good positive head on the meter outlet.

Control valves should always be installed downstream, and at least five pipe diameters away of the flowmeter**.**

5. Electrical Installation

The generated voltage output from FT Turbine Meters varies according to size, a minimum figure of approximately 50 millivolts at lowest flow on the smaller meter sizes up to approximately 3 volts for large meters at maximum flow. The frequency of the signal is directly proportional to the flow rate of the measured liquid.

Twin core screened cable should be used to connect the flowmeter to secondary instrumentation. The level of protection required will depend upon the level of electrical noise in the area and the transmission distance. It is good practice to run signal cables separately to power cables.

All standard flowmeters are provided with a 2 pin MS connector. The cable screen should be cut back and not earthed at the flowmeter end.

Where cable runs exceed 100 metres a signal amplifier may be required. Information on such devices can be supplied on request.

6. Intrinsic Safety

For areas where potentially explosive gases may be present sources of ignition must be eliminated. To this end the Flowquip Industrial Turbine Flowmeter range can be supplied with certified sensors and amplifiers. The signal can be used within the hazardous area or taken via suitable barriers to the safe area. The FT sensor is certified to EEx ia IIC T5.

7. Start-Up Procedure

1. Check that no packing material has found its way into the bore of the flowmeter. Carefully blow down the meter bore to ensure freedom of rotation. There may be some amount of stiction present where flowmeters have been stored or have dried out during shipment. This need not cause concern as complete freedom of rotation will be restored once the meter is immersed in its metered liquid.

2. Ensure that flange gaskets or joints are clean edged, of the correct bore, and located centrally. A little light adhesive can be used to locate the gasket on the meter flange to minimise the risk of any misalignment.

3. Ensure that the arrow stamped on the meter housing is in line with direction of flow. Whilst conventional turbine meters will operate satisfactorily in both directions accuracy may suffer if flow is inadvertently reversed.

4. Ensure that the pick-off coil and connector are screwed down using finger pressure only.

5. Make signal cable connections to pins A and B only, and tighten down the Aniphenol connector ensuring that the cable screen is separated from any earth point.

6. If any air is still present in the system, valves should be opened slowly until the flowmeter is completed filled with liquid in order to prevent overspeeding.

8. Maintenance

Once installed the flowmeter requires very little maintenance. It is recommended that after each 3000 hours service the meter is removed from the line and inspected for wear or build up of debris.

In the event of excessive play in the rotor, the meter should be returned to Flowquip for re-bushing of the bearings and recalibration.

After 5000 hours service the meter should be recalibrated.

9. Calibration

Calibration details for your turbine flowmeter are enclosed. If the turbine meter was purchased with Flowquip secondary instrumentation, Flowquip will have already configured this instrumentation to work with the turbine and in most cases the system will be ready to run as soon as all necessary power and signal connections are made.

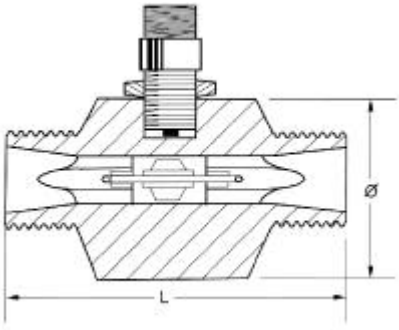
Works calibrations are usually made over eight or ten points throughout the working flow range unless otherwise specified. The average meter factor is given on the assumption that flowrate will vary over the full operating range. For restricted flow ranges closer accuracy can often be obtained by checking from the calibration certificate the flowrate closest to your plant figure and using the pulses per unit volume calibration figure appropriate to that desired flowrate.

10. Spares

Spare parts for most standard sizes of flowmeter are normally held on short delivery from Halifax but major overhauls and repairs must be carried out at our factory.

When requesting spares or service it is important that the full meter serial number is given. This is normally a five digit serial number stamped on the side of the meter body.

11. FT3 Screwed Turbine Flowmeter



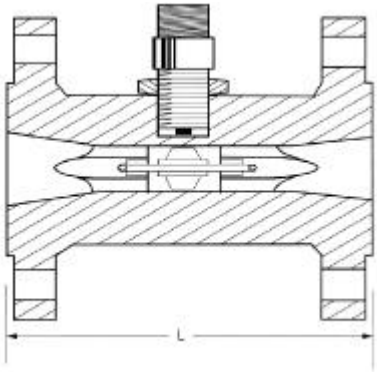
FLOWMETER RANGES

Model Nr.	L/min	K Factor P/litre
FT3/10	1-10	5000
FT3/15	2-20	3800
FT3/20/5	5-50	1080
FT3/20/8	8-80	1080
FT3/25/15	15-150	620
FT3/25	25-250	362
FT3/32	45-450	111
FT3/40	67-670	82
FT3/50	110-1100	59
FT3/80	225-2250	19

DIMENSIONS

Model Nr.	L mm	Bore Size mm	Weight Kg
FT3/10	82.6	10	0.3
FT3/15	82.6	15	0.5
FT3/20/5	82.6	20	0.5
FT3/20/8	82.6	20	0.5
FT3/25/15	90.5	25	0.8
FT3/25	90.5	25	1.0
FT3/32	110.0	32	1.6
FT3/40	116.7	40	1.7
FT3/50	154.0	50	3.1
FT3/80	170.0	80	5.0

12. FT4 Flanged Turbine Flowmeter



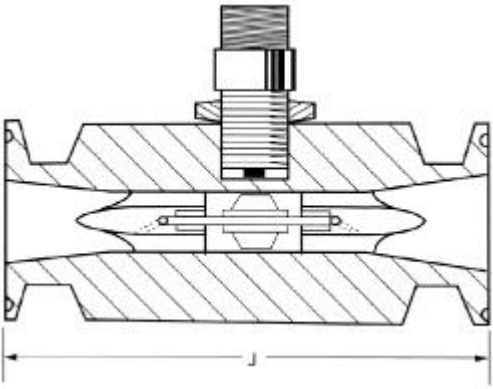
FLOWMETER RANGES

Model Nr.	L/min	K Factor P/litre
FT4/20/5	5-50	1080
FT4/20/8	8-80	1080
FT4/25/15	15-150	620
FT4/25	25-250	362
FT4/32	45-450	250
FT4/40	67-670	70
FT4/50	110-1100	59
FT4/80	225-2250	14
FT4/100	450-4500	6.6
FT4/150	900-9000	2.3

DIMENSIONS

Model Nr.	L mm	Bore Size. mm	Weight Kg
FT4/20/5	139.7	20	2.0
FT4/20/8	139.7	20	2.0
FT4/25/15	139.7	25	2.2
FT4/25	139.7	25	2.7
FT4/32	145.0	32	3.9
FT4/40	152.4	40	6.5
FT4/50	165.1	50	8.4
FT4/80	250.0	80	14.5
FT4/100	300.0	100	16.5
FT4/150	360.0	150	18.0

13. FT7 Hygienic Turbine Flowmeter



DIMENSIONS

Model Nr.	L mm	Clamp Size mm	Weight Kg
FT7/20/5	127	1”	1.0
FT7/20/8	127	1”	1.0
FT7/25/15	127	1½”	1.0
FT7/25	127	1½”	2.3
FT7/40	155	2”	3.2
FT7/50	216	2½”	5.0
FT7/80	300	3”	8.0

FLOWMETER RANGES

Model Nr.	Bore mm	L/min	K Factor P/litre
FT7/20/5	20	5-50	1080
FT7/20/8	20	8-80	1080
FT7/25/15	25	15-150	620
FT7/25	25	25-250	362
FT7/40	40	65-650	82
FT7/50	50	110-1100	59
FT7/80	80	225-2250	14

14. General Specification

Turndown range	10:1
Linearity	±0.5% of reading
Repeatability	±0.1%
Temperature range	-30 to +110o C. (standard & I.S. coil) -30 to +180o C. (with HT coil) -30 to +232o C. (with HT coil and tungsten carbide sleeve bearings)

Pick-off Coil

5/8" x 18 TPI UNF-2A threaded two wire magnetic coil with Amphenol 172-610SL 4P termination.
nominal resistance 240 ohm
nominal inductance 150 mH
Special version available for Hazardous Area operation.

Connections and Working Pressure Limits

FT3	BSP parallel external thread		35 bar
	ERMETO thread	15-25mm	200 bar
		40-80mm	100 bar
FT4	DIN ND16, 25, 40 ANSI 150 & 300 BS10 Table E & F Pressure rating limited by flange specification		
FT7	Tri-Clamp, RJT, IDF, DIN 11851		16 bar
	and ISS Hygienic end connections		16 bar

15. Fault Finding

1. No Signal

Check the liquid is actually flowing.
Check wires are connected properly with no breaks.

Resistance of the sensor is approximately 1100 ohms. If it is short circuit across the coil or to the case, or open circuit across the coil, replace it.

Check there is nothing stopping the rotor from turning.

2. Repeatable Error

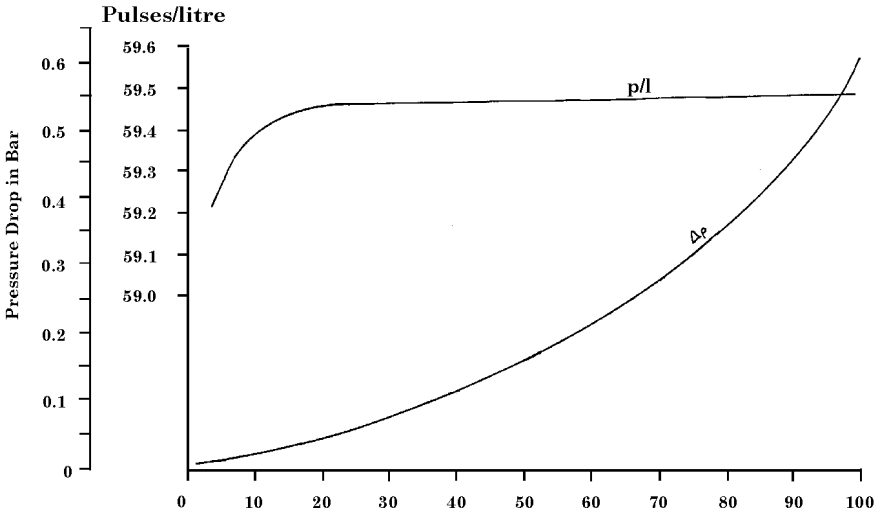
This could be caused by turbulence or may be due to the viscosity of the liquid. An on-site calibration should be carried out.

3. Random Error

Check that there is nothing fouling the rotor.

There may be electrical interference. Check that the cable is correctly screened and separate from any power supply cables. In severe cases an amplifier may be required.

16. Typical Performance Curve for Turbine



17. Flowmeter Details

For your convenience we suggest you log all the relevant details relating to your turbine flowmeter. Most of the information can be found on the flowmeter calibration certificate.

Model Nr. : .....

Serial Nr. : .....

K Factor (pulses/litre): .....

Date of delivery: .....

18. Notes

Flowquip Limited

Riverside, Canal Road, Sowerby Bridge,
Halifax, West Yorkshire HX6 3LD

Tel: 01422 829920 Fax: 01422 829921

Email: sales@flowquip.co.uk

Flowquip

flowmetering systems