CAMERON

TECHNICAL SPECIFICATIONS

BARTON Floco/Flotrac Meters, Floco Samplers and Pulse Transmitters

Floco Series F Meters Models F-500/F-2500

Cameron's BARTON® Floco® Series F meter is a positive displacement meter with a unique rotor design that provides sustained accuracy even under adverse conditions. It accurately measures viscous, waxy, corrosive and abrasive liquids to within ±1% maximum uncertainty.

The Series F meter measures liquid by separating it into equal portions and counting them. Liquid enters the meter through the inlet port, where the bridge deflects the liquid downward to strike the rotor blades and turn the rotor. The liquid then passes through the outlet port, which is aligned with the inlet port. The unique rotor design allows solid particles and sediment to pass through the meter without causing damage or malfunction. Bridge seals prevent the liquid from passing to the outlet port without being measured.

As the process fluid viscosity increases the measurement performance of the Floco also increases. The enhancement is most notable in the capability to measure low flow rates. Because of this many process fluids can be measured at lower rates than published.

Series F meters are available in various models with pressure ratings up to 2000 psi (138 bar), an operating temperature range of -20° F to 400° F (-29° C to 205° C), and a flow rate capacity of 6 to 90 USGPM based on 20° API gravity oil.

Standard connections include 1" female and 2" or 3" male NPT threads. Raised face and ring joint flanges can also be supplied. Standard units for registering totals are US gallons, 42-gallon barrels, liters or cubic meters.

Series F meters are available with Buna-N®, Viton® or Teflon® components for compliance with process demands, and a long life between maintenance cycles.

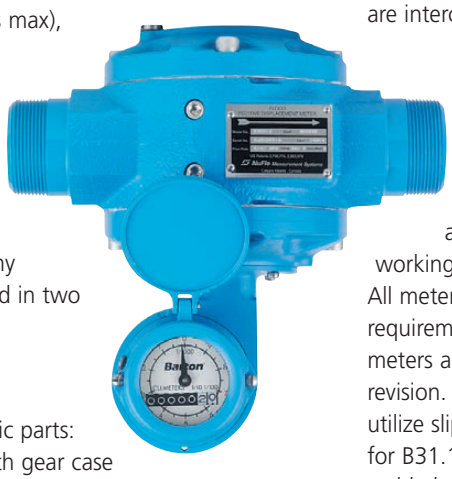
Key Features

- Unpowered mechanical operation
- Suited to viscous fluids laden with solids
- 25,000 cP upper viscosity limit
- Optional integral sampler
- Optional electronic output

Application

A wide variety of liquids can be metered with the Series F meter, including heavy oil (25,000 centistokes max), asphalt emulsion, brine, bunker C oil, crude oil, kerosene, liquid fertilizers, paraffin, refined oils and water.

The Series F meter does not require the installation of straight-run pipe upstream or downstream of the meter. The meter can be installed in any position and the register can be rotated in two planes for optimal visibility.



Construction

The Series F meter consists of four basic parts: body, rotor, sideplates and register (with gear case assembly and magnetic coupling seal). Almost all spare parts are interchangeable among Series F models.

Body and Sideplates

The meter body is A216 WCB cast steel with a maximum hardness of HRC22.

The sideplates are A105 forged steel. The number and type of sideplate bolts determines the safe working pressure of the meter, as shown in the table below. All meters are compliant with ASME B31.1 & B31.3 requirements. When equipped with NACE bolts, Series F meters are compliant with NACE MR0175/ISO 15156: 2009 revision. All meters supplied with flanged end connections utilize slip-on flanges as standard. Optional weldneck flanges for B31.1 compliance are available. All flanged connections are welded per ASME Section IX procedures.

Safe Working Pressure

Model	Number of Bolts per Sideplate	Bolt Diameter (in.)	Bolt Grade	Safe Working Pressure (psi)	Safe Working Pressure (Mpa)
F-500	4	3/8	Standard (A574 or SAE Grade 8)	750	5.2
F-500	4	3/8	NACE (A320 L7M & A193 B7M)	425	2.9
F-2500	8	3/8	Standard (A574 or SAE Grade 8)	1500	10.3
F-2500	8	3/8	NACE (A320 L7M & A193 B7M)	850	5.9
F-2500	8	7/16	Standard (A574)	2000	13.8
F-2500	8	7/16	NACE (A564)	1500	10.3

Liner and Wearplates

Body parts subject to mechanical wear or fluid abrasion are designed for economical field replacement. The body liner and side wearplates are constructed of polished 316 stainless steel to assure a low-friction seal with the rotor blades. Wearplates are reversible for extended life.

Bridge

The bridge is available in either Delrin® or 316 stainless steel. Delrin is a plastic material that can withstand chemical attack and temperatures to 180° F (82° C). Alternatively, 316 stainless steel is extremely resistant to abrasive and high-temperature fluids.

Bridge seals are constructed of Viton.

Bearings

Bearing selection should be based on the following guidelines:

- Aluminum Bronze – General bearing, durable in most applications including crude oil
- Meehanite – Recommended for use with abrasive process fluid, which is often apparent by indications of severe wear on the rotor shaft
- Carbon Graphite – Recommended for use where yellow metals are not acceptable or where the process fluid has very low lubricity
- Glass-Filled Teflon – Recommended for use where other materials fail due to chemical attack

Rotor

The rotor, which is the measuring element of the flow meter, is constructed of 316 stainless steel and has chrome-plated shaft ends for bearing surfaces. The standard rotor hub is made of non-clad 316 stainless steel for superior corrosion resistance. An optional rotor hub is clad with a Viton or Buna-N elastomer for improved flow at very low flow rates. The spring-loaded blades are made of a stainless steel substrate with a Buna-N, Viton, or Teflon covering.

Registers

The register and gear case assembly, featuring a 316 stainless steel proven magnetic coupling design, is sealed from contact with the metered liquid for accurate registration and long life.

All registers display flow totals in seven digits with the resolution indicated in the table below. A standard sweep hand provides 10 times greater resolution than that shown. Reset registers have two displays: one reset and one small-digit non-reset. The displays feature 1/4" digits for good visibility.

Available Registers

Units	Resolution
US Gallons (1" and 2")	1 gal
US Gallons (3" only)	10 gal
Barrels (42 US gal)	0.1 bbl
Liters	10 liters
Cubic Meters	0.01 cubic meters

Maintenance

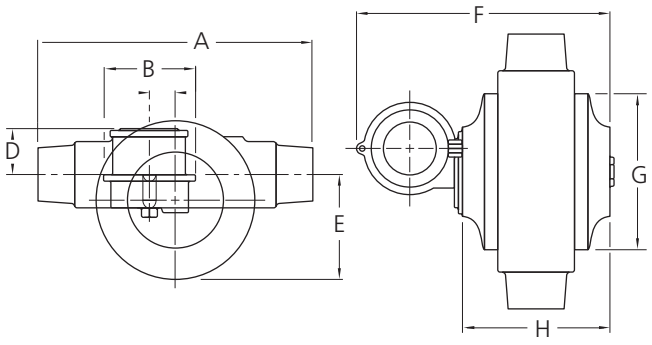
Floco meters can be serviced without being removed from the line, and without special tools or training. Removal of the meter sideplate provides easy access to all internal parts. Using the assembly drawing and parts list shipped with each meter, a user can readily identify all parts and assembly procedures.

Dimensions

Series F Meter with Threaded or Victaulic Ends (in.)*

Meter Size	A	B	C	D	E	F	G	H
1 and 2	10-1/2	3-1/2	1	1-7/8	4	10-1/2	6	5-3/4
3	12	3-1/2	1	1-7/8	4	13-1/2	6	8-3/4

* Victaulic ends are available only on 2" meters.



Series F Meter with Flanged Ends (in.)
Face-to-Face, Raised Face or Ring Joint Meters

Meter Size[1]	150 or 300 ANSI	600 ANSI	900 ANSI
2	11	12	13-1/2
3	12	13	13-1/2

[1]Flanged ends are not commonly available on 1" meters.

Specifications

Common Trim Configurations

Internals	Standard	High Temp.	NACE
Maximum Temperature	180° F (80° C)	300° F (150° C) 410° F (210° C) optional	180° F (80° C)
Bearing	Aluminum Bronze	Aluminum Bronze	Carbon Graphite
Rotor	Welded SS/Viton	Welded SS/Teflon	Welded SS/Viton
Bridge	Delrin	Stainless Steel	Delrin
O-rings	Buna-N	Viton	Viton
Bolting	Standard	Standard	L7M

Flow Rates

Meter Size	Flow Capacity	Ideal Flow Rates	Pressure Drop at Max. Flow
(in.)	(USGPM)[1]	(USGPM)[2]	(PSID)[1]
1 Female	6 min to 60 max	10 min to 35 max	12
2 Male	6 min to 60 max	10 min to 35 max	12
3 Male	9 min to 90 max	15 min to 60 max	5

[1] Based on pale hydraulic oil 0.89 S.G. at 60° F (16° C), 110 SSU at 100° F (38° C) with ±1.0% accuracy. Minimum capacity improves with higher viscosities.
[2] These flow rates are determined to provide the best accuracy and durability.

Floco Automatic Samplers

The Floco Automatic Sampler is an accessory to the Floco meter that provides proportional-to-flow sampling of fluids as they are metered. The sampler is used to determine the fluid quality which aids in determining:

- The ratio of oil and water being produced
- The ratio of dissolved gasses in heavy oil
- The physical and chemical properties of the flowing fluid

As defined by API and ISO, the proportional-to-flow technique is superior to manual-grab sampling or automatic sampling based on time or event in producing representative results. Proportional-to-flow sampling is achieved by automatically extracting a series of small, consistently sized samples from the flowing stream. The sample size is easily adjusted and the sample interval can be adjusted by changing a gear within the sampler.

The Floco sampler is extraordinarily economical to install. It mounts on the side of a Floco meter and is mechanically driven by a gear train connected to the flow-driven rotor within the meter. The sample is typically stored in a container mounted on the sampler. The container is vented locally, therefore entrained or dissolved gas and light hydrocarbons with vapor pressures higher than atmospheric pressure will break out of solution and be lost to atmosphere. To avoid exposing personnel to toxic vapors, never use this container for sour fluids.

The Floco Sampler is available in two models:

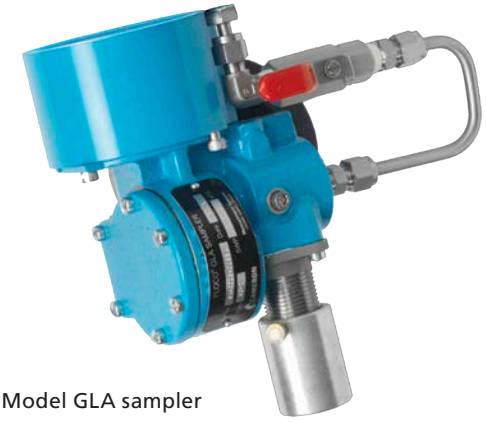
- The FRA Sampler can be attached to an F-500 Floco meter and is limited to a 500 psi safe working pressure.
- The GLA Sampler is based on the original FRA design, but offers a number of advanced features not available in the FRA including:
  - An improved weight-activated full shut-off mechanism
  - A wide-mouth glass or plastic receiver. Glass receivers may be preferred for their transparency, ease of cleaning and immunity to static electricity charge. Plastic receptacles may be preferred for their shatter resistance.
  - Easy adaption to large-capacity remote-mounted receivers, including those used with sour fluids. Cameron's CLIF MOCK™ receivers are available in capacities up to five gallons and include float-operated full bottle shut-offs. They are available in plastic or stainless steel. The stainless steel containers include a mechanical level gauge.

CLIF MOCK large-capacity receiver

  - Adaptable to vertical installation when flow is oriented upwards
  - An integral manually operated ball valve shut-off to stop operation or to allow removal of the sampler for maintenance without interrupting the meter's operation.
  - A magnetic drive coupling for reduced maintenance
  - 1000 psi standard operating pressure, enabling the sampler's use with F-500 meters up to 750 psi and with specially adapted F-2500 meters.

Samplers ordered with Floco meters are preassembled with the meter before shipment. Samplers may also be ordered individually for assembly with an existing meter in the field.

Model FRA sampler



Model GLA sampler

Floco Automatic Samplers (continued)

Specifications	GLA Sampler	FRA Sampler
Body	ASTM A48 Cast Grey Iron No. 30 (not NACE-listed)	ASTM A48 Cast Grey Iron No. 30 (not NACE-listed)
Internals	Hardened 440 stainless steel and Meehanite – standard High performance treatment for abrasive process services – optional	Hardened 440 stainless steel and Meehanite – standard High performance treatment for abrasive process services – optional
Elastomer	Viton	Buna-N/ Viton
Drive Coupling	Magnetic	Mechanical
Integral Sample Receiver	Wide mouth glass – standard Wide mouth plastic – optional Remote receiver – optional	Narrow mouth polyethylene plastic
Receiver Volume with Scale and Transport Lid	1800 ml	1600 ml
Minimum Process Pressure	10 PSIG	10 PSIG
Maximum Process Pressure	1000 PSIG	500 PSIG
Maximum Process Temperature	200° F (93° C)	400° F (205° C)[1]
Maximum Viscosity (flowing)	5000 cP	5000 cP
Dimensions (additional to horizontal pipe centerline when mounted on a Floco meter Includes clearance to remove bottle)	13.75" high X 5.5" wide 35 cm high X 14 cm wide	16.5" high X 7.5" wide 42 cm high X 19 cm wide
Vertical Pipe - Option	Downward flow	Upward flow
Sample Volume	Adjustable 0.6 to 5.7 cc (ml)	Adjustable 0.6 to 5.7 cc (ml)
Sample Rate[2]		
Gear ratio 80:1 standard Gear ratio 40:1 Gear ratio 20:1	34.6 samples per cubic meter 69.2 samples per cubic meter 138.4 samples per cubic meter	34.6 samples per cubic meter 69.2 samples per cubic meter 138.4 samples per cubic meter

[1] Temperature rating does not preclude the effects of process water flashing to steam and the suitability of the receiver for resistance to thermal shock or melting.
[2] Reduce sample rate by half when used with a 3" Floco meter

Floco Model 1334 Pulse Transmitter

The Floco Pulse Transmitter (FPT) adds a frequency output to a Floco Series F meter. It is ideally suited for retrofitting *in-situ* meters to provide the necessary electronic output associated with an automation or SCADA project. The transmitter consists of a gear-like target that is driven by the Floco meter and mounted within the magnetic field of a standard turbine flow meter pick-up coil. As the teeth of the gear pass under the pick-up coil, an electronic pulse is generated in the same way the movement of the rotor blades of a turbine meter generates a pulse. The FPT can generate up to 126 pulses per US gallon for any 1" or 2" Floco meter.

The FPT can be installed easily and quickly without removing the meter from service. The transmitter mounts directly to the meter body and can be ordered for use with or without a mechanical register.

Optional NUFLO™ electronics are available to meet desired output signal requirements. As an option, Cameron offers the Model 1334 with an economical powered coil for applications requiring a high-amplitude 2V to 24V square wave signal. Electrical certifications for this model are different than those for the standard model.

Model 1334 pulse transmitter with optional junction box

Floco Model 1334 Pulse Transmitter (continued)

While the standard FPT is suitable for 250° F (121° C), optional temperature ratings up to 450° F (232° C) are available.

Explosion-proof models feature a 1/2" FNPT electrical connection, while the intrinsically safe model has an optional 1" MNPT hub.

Blind 2" F-500 meter with MC-III flow analyzer

Approval Classification Options

- ATEX, Explosion-proof, Exd IIc, T4, -40˚ F to 212˚ F (-40˚ C to 100˚ C)
- CSA, Explosion-Proof, Class I, Groups B, C, D; Class II, Groups E, F, G; Class III; Enclosure 4 (US and Canadian electrical code)
- CSA, Intrinsically Safe, Class I, Groups A, B, C, D; Class II, Groups E, F, G; Class III; Enclosure 4 (with approved barrier)
- CSA, Intrinsically Safe, Class I, Groups A, B, C, D; Class II, Groups E, F, G; Class III; Enclosure 4 (without barriers when connected to a NUFLO Scanner® Flow Computer, or a NUFLO MC-II™ Flow Analyzer)
- CSA, General Purpose

Output Specifications

Output Form	Required Accessory
Low-amplitude pulse	Model 1334 standard
Amplified pulse	Model 1334 option (powered coil)
LCD total and rate, 4-20mA, amplified pulse, Modbus	Model 1334 standard plus MC-III™ Flow Analyzer
LCD total and rate, amplified pulse, datalogging, Modbus, 4-20mA or FOUNDATION® Fieldbus	Model 1334 standard plus Scanner® 2000 microEFM

Floco Model 308 Pulse Transmitter

Like the Model 1334 transmitter, the Model 308 transmits a discrete electrical pulse to represent that a specific amount of liquid has transferred through the Floco meter. The rate of pulse transmission can be interpreted to determine the flow rate while counting the pulses representing the flow total. With the Model 308, each pulse is exactly divisible by a factor of ten to allow either very simple or sophisticated remote devices to scale the pulses into preferred units of measure.

Optional pulse rates from 1 to 1000 pulses per barrel or 1 to 100 pulses per gallon may be used to operate electric counters, batching counters or combined with preset electrical counters to control pumps, motors, valves, or solenoid-actuated equipment.

A glass-encapsulated dry reed switch is actuated by the magnetic field of a gear-driven magnet. Although the Model 308 transmitter is not explosion-proof or agency-certified for hazardous areas,

Register Type	Pulses Per Unit of Volume	
	10:1 Gear Ratio (Part No. 9A-0308-0004A)	100:1 Gear Ratio (Part No. 9A-0308-0006A)
Gallons	10	100
Barrels	100	1000
Liters	1	10
Cubic Meters	1000	10,000

Floco Model 308 Pulse Transmitter (continued)

the reed switch is hermetically sealed for use in hazardous locations as allowed by local electrical code.

Model 308 pulse transmitter

The wafer-type cast aluminum case of the Model 308 mounts on a Floco meter just beneath the register. The pulse transmitter is easily retrofit to existing meters in the field without recalibrating the meter. The Model 308 Pulse Transmitter incorporates an integral weatherproof junction box with a three position terminal strip that is easily replaced in the field.

General Specifications

Dimensions	Length: 4.5″ Width: 3.75″ Height: 2.0″
Weight	1.5 lb
Temperature Rating	-25° F (-32° C) to 160° F (71° C)
Conduit Connection	1/2″ NPT
Contact Rating	12 volt-ampere AC 10 watts DC resistive 1/2 amp or 250 volts max.
Contact Resistance	10 to 60 milliohms plus 40 milliohms lead resistance

Flotrac Meters

Like positive displacement meters, Cameron's Flotrac meter is designed for mechanically measuring volumes of low-viscosity liquids flowing at high pressure. The Flotrac meter employs the unique constrained vortex principle to provide an accurate measurement over a 10:1 range.

Process liquid enters the metering chamber through the 1″ (25mm) inlet connection. As the liquid makes a 360-degree loop, it is separated equally into two streams. The special configuration of the metering chamber forces these streams into a series of vortices, causing the rotor assembly to rotate in direct proportion to the flow rate. The two liquid streams are then combined at the meter outlet port.

Specifications

Operating Pressure	2500 psig (172 bar) SWP with standard bolting 1500 psig (103 bar) SWP with L7M NACE bolting
Operating Temperature	32° F (0° C) to 200° F (95° C)
Viscosity	10 centistokes, max.
Pipe Connections	1″ (25 mm) female, inline Flanged connections optional
Register	8 digits
Weight	22 lb (10 kg)
Dimensions	Length: 8.75″ (220 mm) Width: 5.75″ (145 mm) Height: 6.0″ (150 mm)

Features

All construction materials used in the Flotrac meter are resistant to corrosion and abrasion, and only one moving part in the meter —the rotor — comes in contact with the process fluid. The rotor assembly, comprised of bearings and an integral magnet, can be quickly removed or replaced without removing the meter from the line. The register assembly is magnetically coupled to the rotor assembly, eliminating friction and leakage from packing glands.

Flotrac models 306 and 380 share several interchangeable parts, enabling the user to easily convert a standard flow Model 306 meter to a low flow Model 380 meter and vice versa.

Similar to a PD meter, the Flotrac meter does not require the installation of straight-run pipe upstream or downstream of the meter.

	Model 306	Model 380
Accuracy and Capacity	±1.0% of reading, 9 to 90 USGPM	±2.0% of reading, 1.5 to 15 USGPM (water) ±2.0% of reading, 4 to 15 USGPM (10 centistokes)
Pressure Drop	50 PSID (345 Kpad) in water at maximum flow	50 PSID (345 Kpad) in water at maximum flow
Register Resolution	1/100 US Barrels	1/1000 US Barrels
Register Resolution	1 Liters	1/10 Liters
Register Resolution	1/1000 Cubic Meters	1/10,000 Cubic Meters

Flotrac Meters (continued)

Construction

The Flotrac meter body is constructed of SA-216 WCB epoxy-coated cast steel with an SA-105 forged steel cover. The impeller and housing inserts are made of glass-filled Ryton®, which is practically impervious to dissolved salts and alkalis, water, most acids, and low-viscosity hydrocarbon liquids. Other wetted parts include 300 series stainless steel and a Buna-N body seal O-ring. The assembly is suitable for sour non-NACE service when the non-wetted body bolts are supplied as optional grade L7M and the body O-ring is supplied in Viton. The rotor bearings and journals are made of special materials that provide exceptional service life with water or non-lubricating liquids. The register assembly features a sealed weatherproof aluminum case. The meter is compliant with ASME B31.1 and B31.3 requirements.

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