

# SATAM

The Satam flowmeter range is used for the custody transfer measurement of liquid hydrocarbons, liquid gas and liquid chemicals.

Consisting of four distinct families, the range is able to meet the needs of most industrial metering applications.

Areas of activity:

- Oil depots
- Metering for road tankers
- Aviation
- Transport via pipeline

## Flowmeters

- **Positive Displacement meter**
- **Coriolis mass flowmeter**
- **Turbine flowmeter**
- **Ultrasonic flowmeter**



## Positive Displacement meter

# ZC17

The SATAM Positive Displacement meter (PD meter) is a system with freely-moving blades used to measure "white" petroleum products such as fuels, bio-fuels and refined liquid hydrocarbons. Its simple design using only two pairs of blades and one moving rotor makes it exceptionally robust and allows the user to make significant savings on maintenance costs.

### Sectors of application

- **Oil depots**  
For product reception and loading stations for trucks, wagons and ships
- **Hydrocarbon transportation**  
Distribution of fuel oil or fuel by road tanker
- **Aircraft refuelling**  
Aircraft dispensers and aircraft fuelling tankers
- **Army**  
Depot supplies and loading of trucks
- **Transport companies**  
Refuelling of locomotives, trucks and public transport coaches
- **Marine applications**  
Refuelling of ships
- **Mining sites**  
Refuelling of trucks or site machinery

### Key points

- > **Reduced pressure loss**  
0,3 to 0.5 bar at maximum flow rate
- > **Low maintenance costs**  
Simple and robust design with mechanical components interchangeable between the different models
- > **Stability of measurements**  
Accuracy of measurement guaranteed over a period of many years without any drift in the calibration curve
- > **Modular design**  
Wide range of accessories for performing customized measurement applications
- > **Robust construction**  
Flowmeter manifold separated from measurement chamber to eliminate any possible influence of external mechanical stresses on measurement. Few moving parts

## Technical specifications

Model		ZC17 12	ZC17 24	ZC17 48	ZC17 80	ZC17 150	ZC17 250
Maximum flowrate	(m³/h)	12	24	48	80	150	250
	(l/mn)	200	400	800	1333	2500	4166
	(USGPM)	53	105	210	360	660	1100
Minimum flowrate	(m³/h)	1,2	2,4	4,8	8	15	25
	(l/mn)	20	40	80	133	250	416
	(USGPM)	5,3	10,5	21	36	66	110
Application		Multi-product metering					
Connection - Flanges	Diameter	2"	2"	2"	3"	4"	6"
Materials	Manifold	Aluminium			Steel or aluminium		Steel
	Casing	Aluminium	Ductile iron or Ni resist iron				
	Front and back flanges	Kanigen-plated steel					
	Rotor	Aluminium					
	Blades	Graphite					
	Gaskets	Viton (option nitrile)					
Operating conditions	Pressure	0 to 10 bar / 0 to 150 PSI					
	Viscosity	Max. 800 mPa.s/ 800 cPo / 3850 SSU					
	Liquid temperature	-40°C (-40°F) à +60°C (+140°F)					
	Ambient temperature	-40°C (-40°F) à +60°C (+140°F)					
	Pressure drop	Max. 0.5 bar					
Internal construction	Cyclic volume (litres)	0,33	0,40	0,80	2,27	4,54	6,82
	(US gallons)	0,08	0,10	0,21	0,6	1,12	1,8
Metrological performance	Accuracy	< ± 0.15% / Option < ± 0.1% / For 10:1 measuring range					
	Mass repeatability	< ± 0,02 %					
Installation	Straight inlet and outlet sections	Not necessary					
Custody transfer approval		EC Evaluation Certificate N° LNE - 11052					

## Weight and dimensions

Model		ZC17 12	ZC17 24	ZC17 48	ZC17 80	ZC17 150	ZC17 250
Distance between flanges	(mm)	180	180	180	356	432	400
	(inches)	7	7	7	14	17	15,7
Width	(mm)	180	287	287	356	432	400
	(inches)	7	11,3	11,3	14	17	15,7
Depth	(mm)	215	235	269	370	497	675
	(inches)	8,5	9,3	10,6	14,6	19,6	26,6
Height	(mm)	221	406	406	406	405	568
	(inches)	8,7	16	16	16	16	22,4
Weight	net kg (lbs)	14 (31)	20 (44)	25 (55)	56 (123)	85 (187)	141 (311)
	Gross kg (lbs)	32 (71)	38 (84)	43 (95)	95 (209)	124 (273)	180 (387)



## Coriolis mass flow meter

MFM

The Satam mass flowmeter is used to measure the mass and density of viscous products such as heavy fuel oil, engine oil, bitumen or crude oil. Its excellent pressure resistance qualities combined with its straight tube design without any moving mechanical parts means it is capable of providing reliable and accurate measurements for liquid gases such as LPG.

### Sectors of application

- **Oil depots**  
For product reception and at loading stations for trucks, wagons and ships
- **Oil production**  
Metering for transfers of products via pipeline
- **Marine applications**  
Loading and unloading of tankers
- **Refineries**  
Internal metering and control of manufacturing processes
- **Fuel storage**  
Metering of heavy fuel oil at mixer intake

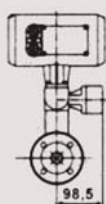
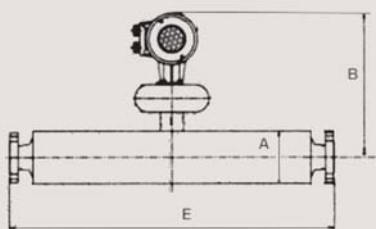
### Key points

- > **Direct measurement of mass**  
Direct measurement without any correction for temperature or viscosity
- > **Reliability of measurements**  
Strain gauges for correction of dilatation effects related to temperature changes
- > **Flexibility of installation**  
Patented construction allowing the system to be supported by its own housing or on the inlet and outlet pipes
- > **Low maintenance costs**  
Simple and robust design without any moving mechanical parts
- > **Direct measurement of density**  
Identification of liquid being measured and detection of any change of product

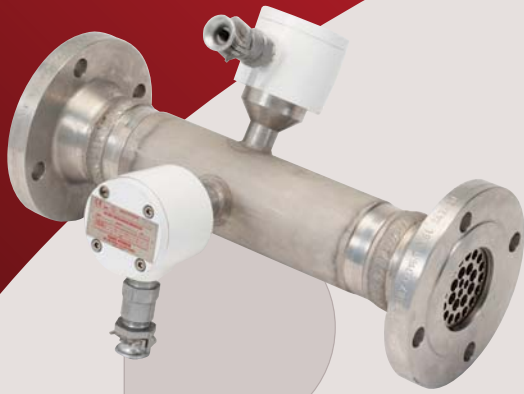
## Technical specifications

Models		MFM S	MFM T
Mass flowrate	Maximum flowrate (kg/h)	430 000	
	(kg/mn)	7 167	
	Minimum flowrate (kg/h)	480	
	(kg/mn)	8	
Applications	Multi-product metering for low viscosity products	Multi-product metering and measurement of density	
Connection - Flanges	Pressure class	150lbs RF (standard), 300lbs, 600lbs, 900lbs RF & RTJ (optional)	
	Diameter	3/4" to 4"	
Materials	Measurement tube	318L stainless steel	Grade 9 titanium
	Secondary containment and flanges	304 stainless steel	
Operating conditions	Pressure	0 to 63 bar	
	Viscosity	Max. 100 mPa.s	Unrestricted
	Liquid temperature	-40 à +100°C	-40 à +150°C
	Ambient temperature	-40 to +60°C	
	Pressure drop	1 bar (at maximum flowrate, 1 mPa.s)	
Internal construction	Measurement tube	Single straight tube (S50 and S80) Dual straight tube (S15, S25, S40)	Single straight tube
	Measurement converter	MFC300	
Metrological performance	Mass accuracy	< ± 0.2% + zero stability	< ± 0.1% + zero stability
	Mass repeatability	< ± 0.025% + zero stability	
	Density accuracy	< ± 0.002 g/cm3 <± 0.0005 g/cm3 after on site calibration	
	Temperature accuracy	≤ ± 0,5°C	
	Zero stability	< ± 0.025% of sensor max. flowrate	< 0.008% of sensor max. flowrate sensor
Installation	Straight inlet and outlet sections	Not necessary	
	Protection class	IP 67, equivalent to NEMA 6	
	EX approval	EEx d e [ib] IIC T6	

## Measuring range - Weight and dimensions



Measuring range			Weight and dimensions			
MFM 7000	Min. flowrate	Max. flowrate	A	B	E	Weight
	(kg/h)	(kg/h)	(mm)	(mm)	(mm)	(kg)
T15	1 125	11 250	102	311	548	23
T25	3 450	34 500	115	317	700	35
T40	9 150	91 500	169	344	925	80
T50/S50	18 000	180 000	219	370	1101	145
T80/S80	43 000	430 000	273	398	1460	260
<b>MFM 1000</b>						
S15	480	4 800	102	311	520	13,5
S25	2 000	20 000	114	317	565	16,5
S40	6 000	60 000	169	344	742	29,5
S50	12 500	125 000	219	370	896	57,5



## Turbine flowmeter

# SA-LM-ZN

The Satam turbine flowmeter is primarily used for high-capacity metering. Its 500mm measurement tube can accurately measure at flowrates of over 3000 m<sup>3</sup>/h. Its excellent pressure and temperature resistance qualities means it is capable of providing reliable and accurate measurements for liquid gases such as LPG, as well as for cryogenic liquids.

The SA model comes fitted with a straight-bladed rotor. It is intended for use with single-product low-viscosity applications.

The LM and ZN models come fitted with a two-bladed helical rotor. This construction ensures low sensitivity to variations in viscosity.

### Sectors of application

- **Marine applications**  
Loading and unloading of tankers
- **Oil production**  
Metering for transfers of crude oil and condensate via pipeline
- **Oil depots**  
For product reception and at loading stations for wagons and ships
- **Refineries**  
Internal metering and control of manufacturing processes

### Key points

- > **Low maintenance costs**  
Simple and robust design with interchangeable mechanical components
- > **Stability of measurements**  
Not sensitive to variations in pressure. Integrated flow straightener
- > **Wide range of uses**  
Available for liquid and for gas from 10 l/h to 6 000 m<sup>3</sup>/h

## Technical specifications

Model		SA	LM	ZN
Flow rate		1,36 to 3 406 m <sup>3</sup> /h	3 to 300 m <sup>3</sup> /h	0,012 to 6 000 m <sup>3</sup> /h
		6 to 15 000 USGPM	13 to 1320 USGPM	0,05 to 26 400 USGPM
Application		Single-product	Single and multi-product	Single and multi-product
Connection - Flanges	Pressure class	ANSI 150 to ANSI 1500 DN 25 to DN 300	ANSI 150 ANSI 300 DN 50 to DN100	ANSI 150 to ANSI 2500 DN10 to DN 500
	Diameter	1" to 12"	2" to 4"	1/2" to 20"
Materials		316L stainless steel (other materials available on request)		
	Measurement tube & flanges	316L stainless steel (other materials available on request)		
	Bearings	Ceramic, tungsten carbide	Graphite, tungsten carbid	Graphite, tungsten carbid
	Turbine rotor	304 L stainless steel	Aluminium / Titanium (optional)	Aluminium / Titanium (optional)
Operating conditions	Pressure	0 to 200 bar	0 to 40 bar	0 to 420 bar
	Viscosity	0,1 to 10 cSt	0,1 to 15 cSt	0,1 to 1000 cSt
	Liquid temperature without preamplifier	-270 to +230°C	-40 to +180°C	-40 to +180°C
	Liquid temperature with preamplifier	-20 to 80°C		
	Pressure drop (1 mPa.s, Qmax)	< 1 bar	< 1 bar	< 0,8 bar
Internal construction	Turbine rotor	Straight multi-blade	Helical twin-blade	Helical twin-blade
	Pulser	1 or 2	2	2
	Preamplifier	Optional		
	Measurement chamber	Fixed	Removable	Removable
Metrological performance	Volume accuracy	< ± 0.15%		
	Repeatability	< ± 0.02%		
Installation	Straight sections	Inlet 10 DN / Outlet 5 DN	Inlet 0 DN / Outlet 0 DN	Inlet 10 DN / Outlet 5 DN
	Protection class	IP65	IP65	IP66
	EX approval	EEx ia IIC T6	EEx ia IIC T6 and EEx d ia II C T6	EEx ia IIC T6 and EEx d ia II C T6

## Measuring range

Nominal diameter	SA model				LM model				ZN model			
	Min. flowrate		Max. flowrate		Min. flowrate		Max. flowrate		Min. flowrate		Max. flowrate	
	m <sup>3</sup> /h	USGPM	m <sup>3</sup> /h	USGPM	m <sup>3</sup> /h	USGPM	m <sup>3</sup> /h	USGPM	m <sup>3</sup> /h	USGPM	m <sup>3</sup> /h	USGPM
1/2"	-	-	-	-	-	-	-	-	0,012	0,053	0,12	0,53
1"	1,36	6	13,6	60	-	-	-	-	0,2	0,88	2	8,8
1 1/2"	2,95	13	29,5	130	-	-	-	-	0,8	3,52	8	35,2
2"	5,1	22,4	51	224	3	13,2	30	132	3	13,2	30	132
2 1/2"	40	176	400	1760	-	-	-	-	-	-	-	-
3"	65	286	650	2860	5	22	50	220	7	30,8	70	308
4"	28,4	125	284	1250	30	132	300	1320	20	880	200	8800
6"	65,9	290	659	2900	-	-	-	-	40	176	400	1760
8"	118	520	1180	5200	-	-	-	-	80	352	800	3520
10"	182	801	1820	8010	-	-	-	-	120	528	1200	5280
12"	273	1202	2730	12020	-	-	-	-	240	1056	2400	10560
14"	-	-	-	-	-	-	-	-	350	1541	3500	15410
16"	-	-	-	-	-	-	-	-	400	1760	4000	17600
18"	-	-	-	-	-	-	-	-	480	2113	4800	21130
20"	-	-	-	-	-	-	-	-	600	2642	6000	26420



## Ultrasonic flowmeter

# UFM III

The Satam ultrasonic flowmeter is used for measuring refined petroleum liquids. It is capable of measuring high-pressure fluids such as LPG or any other liquid gas. Its measurement tube without any intrusive elements or moving mechanical parts results in very little pressure drop and nearly no maintenance costs at all. Because of the measurement method used, ultrasonic flowmeters are available in diameters of up to 40 inches and provide exceptional accuracy of measurement.

### Sectors of application

- **Transport of petroleum products via pipeline**  
Metering stations, leak detection
- **Oil depots**  
For product reception  
and at loading stations for wagons and ships
- **Marine applications**  
Loading and unloading of tankers
- **Chemical industry**  
Metering stations for non-corrosive liquids

### Key points

- > **Minimum pressure drop**  
Measurement tube of same diameter as the flanges  
No intrusive element
- > **Low maintenance costs**  
Totally static measurement system  
No need for filtering
- > **Exceptional reliable measurements**  
Three-channel redundant configuration  
for measurement validation
- > **Easy installation**  
Bi-directional measurement  
Reduced weight in a compact design

## Technical specifications

Model		UFM III
Flow rate		7 to 29 200 m <sup>3</sup> /h / 30 to 128 550 USGPM
Application		Single-product metering
Connection - Flanges	Pressure class	150lbs RF (standard), 300lbs, 600lbs, 900lbs RF & RTJ (optional)
	Diameter	2" to 40"
Material	Flanges, measurement tube, housing	316L stainless steel (other materials available on request)
<b>Operating conditions</b>		
	Operating pressure	0 to 63 bar
	Liquid temperature	+25 to +140°C
	Ambient temperature	-40 to +70°C
	Viscosity	0,1 to 10 mPa.s
	Pressure loss (1 cSt, Qmax)	< 0.1 bar
Internal construction	Ultrasound transmitters	Windows incorporated into wall of measurement tube
	Measurement lines	3 parallel channels
Metrological performance	Measured parameter	Actual volume
	Volume accuracy	< ± 0.15%
	Repeatability	< ± 0.02%
Installation	Straight sections	Inlet 10 DN / Outlet 5 DN
	Protection class	IP 66, equivalent to NEMA 4/4X/6 to IEC 529
	EX approval	EEx d [ib] II C T6 and EEx d e [ib] II C T6

## Measuring range - Weight and dimensions








Nominal diameter	Measuring range		Weight and dimensions				
	Min. flowrate	Max. flowrate	a	Di	W	T	Weight
	(m <sup>3</sup> /h)	(m <sup>3</sup> /h)	(mm)	(mm)	(mm)	(mm)	(kg)
2"	7	73	290	49,2	150	345	14
3"	16	164	330	73	200	380	26
4"	29	292	380	97,2	220	412	33
6"	66	657	440	154,1	270	466	45
8"	117	1167	600	202,7	370	523	72
10"	182	1824	640	254,4	420	582	105
12"	263	2627	710	304,7	470	645	145
14"	358	3575	770	336,5	500	687	179
16"	467	4670	830	387,3	550	744	221
18"	591	5910	900	438,1	600	788	256
20"	730	7297	950	484	650	845	335
24"	1051	10507					
28"	1430	14301					
32"	1868	18679					
36"	2364	23641					
40"	2919	29196					



## Satam meters for oil transport chain

● : Ideally suited ○ : Suitable subject to certain conditions

### Oil transport chain

		PD meter	Mass flowmeter	Turbine flowmeter	Ultrasonic flowmeter
	Metering station for crude oil on pipeline		○	○	○
	Loading and unloading station for crude oil tankers		○	○	○
	Loading and unloading station for crude oil tanker wagons	○	●	○	○
	Refining and intermediary storage	○	●	○	○
	Road tanker loading station	●	○	○	○
	Delivery of domestic fuel oil by road tanker	●	○		
	Aircraft refuelling	●	○		

# Flowmeter selection table

● : Ideally suited ○ : Suitable subject to certain conditions

## By liquid

Type of liquid	PD meter	Mass flowmeter	Turbine flowmeter	Ultrasonic flowmeter
Premium grade fuel, gasoline	●	●	●	●
Ethanol	●	●	○	●
Diesel	●	●	●	●
Fatty Acid Methyl Ester (FAME)	●	●	○	●
Kerosene	●	●	●	●
Bio-diesel	●	●	○	●
E5...E85	●	●	○	●
Heavy fuel oil	○	●		
Bitumen		●		
Pitch		●		
LPG		●	○	●
LNG			○	○
Light crude oils		●	○	○
Condensates		●	●	●
Industrial oils	○	●		

## By application

Type of application	PD meter	Mass flowmeter	Turbine flowmeter	Ultrasonic flowmeter
Truck loading station	●	○	○	○
Wagon loading/unloading station	●	●	●	●
Tanker loading/unloading station	○	○	●	●
Aircraft refuelling	●	○		
On-board metering for road tankers	●	○	○	○
Preparation and metering of bio-fuels	●	○	○	○
Metering for light crude oil on pipeline		○	○	●
Metering for condensate on pipeline		○	○	●
Multi-product metering on pipeline		○	○	○
Product identification on multi-product pipeline		●		○
Control of mixer flowrate for preparation of maritime fuel oils	○	●		

# SATAM

## Worldwide Sales

- **Headquarters - Sales Department**

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As Tokheim regularly improves its products to ever better respond to evolving market and regulatory requirements, it reserves the right to change any of the specifications of these products, and this without prior notice.