



LITREMETER

Specialist flow measurement engineering

VFF Flowmeters for Chemical Injection

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Technical Data



The VFF has successfully metered for over 30 years, with fluids such as oils, hydraulic fluids, corrosion / wax / demulsifier / pour point dispenser / scale / hydrate inhibitors, biocides, oxygen scavengers, etc. Meter bodies are produced in a variety of high grade materials which offer good chemical and environmental resistance.

Applications for flow-rates as low 0.00013 litres/min (0.19 litres/day) have been metered within the off-shore oil industry. The VFF flow meter provides exceptional rangeability with potential turndowns of up to 3000:1, dependent on operating viscosity.

The meters range in size from the smallest standard stock size, LF03 - 18 L/hr max, to the largest V270 - 270 L/min max. Higher flow-rate meters are available to special order.

An extensive range of meter construction offers pressure ratings from 0 to 1380 bar (20,000 psi) suitable for most common applications and special higher pressure rating designs are manufactured up to 4000 bar.

Applications

- Chemical Injection, Litre Meter has successfully supplied over 4,000 flow meters within the chemical injection flow meter market measuring fluids from 0.3 cSt to 100,000 cSt; flows between 0.008 l/hr to 16,200 l/hr and at pressures of up to 2,500 bar.
- Hydraulic line monitoring for well control valves and leak detection
- Wash water measurement and general metering of low and high viscosity fluids
- Subsea Chemical injection and hydraulic fluid measurement

2015 Innovations

The 2015 VFF range uses the same ultra-reliable Rotary Piston/ Oscillating Piston type that Litre Meter developed and refined for the past 30 years. With only one moving part the flow meter is a robust and low maintenance component within your chemical injection system.

The VFF series developed by Litre Meter has been distilled into one series to meet the specific requirements of Chemical Injection Flow Metering.



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Key Features

- Rotary Piston/ Oscillating Piston type flow meter with a single moving part provides robust and low maintenance technology.
- Suitable for low & high viscosity liquids at pressure rating up to 4,000 bar (60,000 psi).
- Available materials of construction: 316L, Duplex F51(UNS S31803), Super Duplex F53(UNS S32750)/F55(UNS S32760). 6Mo F44(UNS S31254) & Titanium.
- Connections: NPT, Autoclave, ANSI & API flanges, Grayloc Hubs, Galperti Hubs, Techlok hubs. More on request.
- Communications: 4-20mA HART, Pulse, MODBUS, Foundation Fieldbus, dependent on electronics and certification requirements.
- Compact
- Very Low Flow Measurement
- Tolerant of particulate up to 100+ microns
- Low pressure drop (<0.1 bar typical)
- Single Moving Part
- Large Viscosity range, from methanol upwards
- Measures pulsing flow accurately
- Preserves Molecular Integrity of fluid
- Pressure independent measurement
- Ultra High Pressure Capability
- Low Maintenance
- Highly Durable
- Proven since 1986

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Internals: Constructed of either Nitronic-60 (anti-galling) or Titanium for the LF03, LF05 & LF15 size to achieve the lowest flow and widest turndown possible. Chambers and rotors are PVD coated. Coatings are applied by physical vapour deposition. A hard metal chromium nitride base layer provides surface hardness and appropriate support for the carbon (WC/C) which is laid over. The WC/C coating provides excellent protection against adhesive wear and its low coefficient of friction reduces the risk of surface fatigue (pitting) and fretting corrosion, vastly improving turndown and low flow capability.

Seal: There are pressure seals between the meter body and cap as well as the internal chamber contains an FPM seal. The seals are available in, FFKM, FEP covered silicon and in higher pressure versions PTFE and Inconel. The seals are selected based on pressure and fluid to optimise the full use of the meter.

Connections: NPT threaded connections are standard for lower pressure versions, Autoclave Medium Pressure fittings (cone & thread) are standard for higher ratings. ANSI & API flanges in raised face and ring type joint also available. Hubs such as Grayloc, Galperti, Techlok are available as standard.



- Internal Chamber and Rotor

Accuracy: 1% of reading, requires linearisation. Provided by all Litre Meter instrumentation.


Viscosity: 0.5 – 100,000 cSt or greater.

Turndown: Consult calibration table

Temperature rating: -40 °C - 100 °C with remote mounted electronics. For direct mount versions see next page. Higher temperature special versions available on request.

Filtration: A 100 micron filter is advisable for 100% long life serviceability. For LF03 & LF05 size a 40 micron filter is recommended.

New Innovation - Sensor

<p>Reed Sensor - standard</p> <p>This new and improved reed switch sensor package comes in a robust stainless steel 316 enclosure which is easy to install within the VFF range. The sensor comes complete with two reed switches that can be set for reverse flow detection or redundancy</p>		<p>Reed Sensor Key Features:</p> <ul style="list-style-type: none"> 316 SS Housing Simple apparatus - 0.01W Reverse flow detection Redundancy built in Tested for over 1 billion pulses Environmentally tested in accordance with BS EN 13628-6: 2006 Temperature rated to -20 to +75°C, (dependent on instrument and area classification) Available with the 2 or 4 wire FlowPod and other instruments. 0.001– 50 Hz detection rate
<p>Field Sensor - optional</p> <p>This new Field sensor package come in the same robust stainless steel 316 housing as the reed sensor so they are interchangeable with one another. However the field sensor enables the output resolution of the VFF meter to be increased 10x and can still detect reverse flow.</p>		<p>Field Sensor Key Features:</p> <p>As above but:</p> <ul style="list-style-type: none"> Low power 2.5-24Vdc - 0.0015W 0.001 - 10 Hz detection rate

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FlowPod

The FlowPod is Litre Meter's latest flow indication display unit. Utilising state-of-the-art technology, the FlowPod comes in a compact and light weight flame proof Stainless Steel enclosure that is only 85mm in diameter and weighs in at only 1.5kg. The FlowPod is one of the smallest flow displays for the Chemical Injection industry on the market today. The back-lit display with high contrast, large flow rate indication and totalizer digits, enables the display to be easily read at distance in poorly lit conditions. The FlowPod comes equipped with Litre Meter – Memory Card facility. LM-MC has been developed by Litre Meter for 2-wire low powered systems. The LM-MC enables calibration data to be easily swapped without having to remove the FlowPod from the installation or having to perform difficult calibration curve changes on site. The LM-MC has data logging capabilities to enable recalibration to be tailored to flow rate of the meter as specified by the client. The FlowPod can be controlled without having to power down, by using HART commands or by the integrated magnetic switches that allows for simple programming and menu selection. The display can either be direct mounted or remote mounted using suitable armoured signal cable or conduit. The standard specification includes HART 7 protocol output on a two or four wire 24 Vdc powered system.



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Key Features:

Exia- ATEX, IECEx
Exd- CSA(US): Class1 Div1 (B,C,D)
CSA(CAN): Class1 Div1 (B,C,D)
ATEX: Ex db IIC
IECEx: Ex db IIC
IP 66/IP68 dual certified
Ambient temperature: -20 to +75°C

2 or 4 wire 4-20mA HART v7 programming and monitoring

Compact lightweight 316L steel housing

Rotatable through 360° for optimised viewing angle

2 sensing options - standard and hi-res - both with bidirectional sensing

Removable LM-MC storage card for data logging & offsite programming

Local programming

Resettable and non-resettable Totalizer

Batch control

Power: 12 – 30 Vdc

Display Features:

Pulsing Input Indicator: This pulses at low flow, as a visual check of flow rate.

Total Digits: A total of 8 digits with the option to display: non resettable total, a resettable total and the resettable reverse flow total.

Rate Digits: The large 5 digits display the real time flowrate, the large digits and high contrast allows this to be easily read from a distance in poor light conditions.

Units: The option to display the flowrate and total in many different units, depending on your requirements.

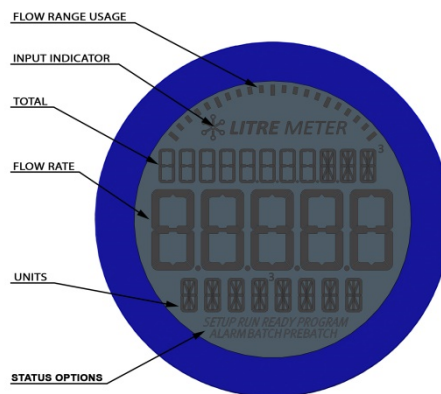
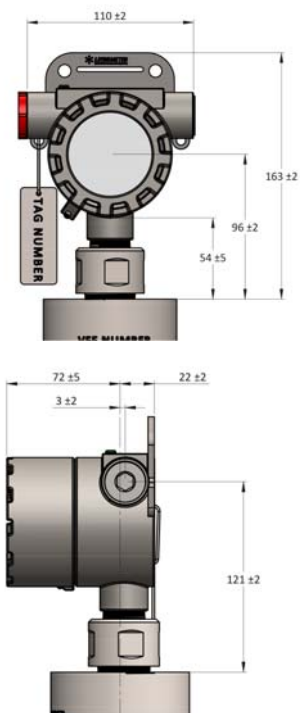
Flow range usage: Analogue display of flow rate in 20 steps - programmable.

Status options: Identifies which mode is active as well as providing status messages.

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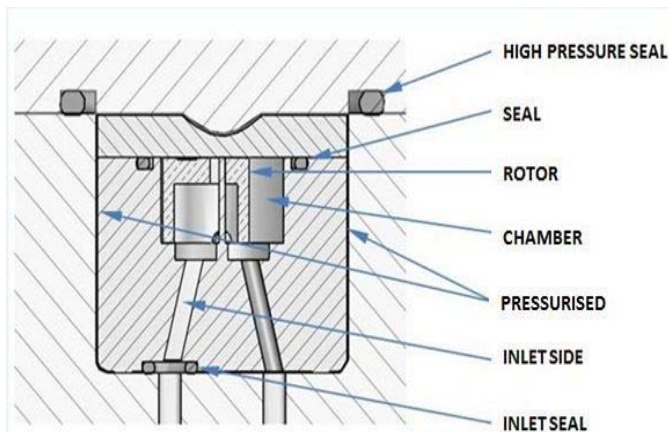
Dimensions:



Pressure Balance Chamber

What Is a Pressure Balance Chamber?

Extensive testing by Litre Meter in 2005 proved that leaks occur over the top of the rotor at higher pressures. This is due to minute distortions of the cap. For example, at 700bar the cap moves by just 0.02mm in the centre. Increasing the bulk of the cap still produces this movement. The effect on meter performance was the creation of a leak path for fluid that avoided the positive displacement of the rotor. This was equivalent to



about a 3% inaccuracy at 700bar. As a result, of this Litre Meter designed a special pressure balance chamber for its VFF flowmeters so it could operate at extreme pressure and at low-flow rates. The pressure balance chamber acts as a barrier, protecting the internal measurement components of the instrument from the high pressure conditions, preventing them from expanding and contracting under the immense pressure. All VFFs over 414bar are fitted with this technology. It is identified by the letters PBC in the calibration certificate.

Key Benefits:

- No distortion of the chamber at higher pressures.
- Enables selection of optimal materials for the chamber to match the rotor i.e. PVD coated stainless steel or titanium.
- Enables selection of optimal materials for the pressure vessel.
- Enables construction of a duplex bodied flowmeter.

Chemical Injection



Chemical injection is the process designed to assist in the production of oil. Various chemicals are injected into the crude oil to provide a degree of protection. For example a scale inhibitor will prevent the build-up of scale on the pipes and fittings used to transport the oil on its journey

Flowmeters are used to monitor and control the amount of chemicals added to the crude oil. Biocide prevents the build-up of organisms in the pipe. Corrosion inhibitor is the most popular additive to be measured. There are various types depending on the type of main liquid. Pour point depressant is added to reduce the pour point thereby making the oil easier to flow through the main pipelines. Most of the chemicals added tend to be at low flow rates, typically between 0.01 to 30 litres per hour (LF03 or LF05 flow rate range). LDHI or Low Dosage Hydrate Inhibitor has the highest injection rate sometimes up to 17,000 litres per hour (V270). It is designed to inhibit water based mixtures which would otherwise have a tendency to freeze. Methanol is often used with the same effect. More exotic chemicals are used for similar purposes all with the intention of reducing cost on the way to the refinery.

It is a little known fact that these chemicals contribute 30% of the cost of running an offshore platform. Control systems are often manually set from the flowmeter displayed value (either locally or from the SCADA system) and there is a trend towards automation of this process using control valves such as a SkoFlo. A typically turndown ratio of 500:1 is measurable with the VFF positive displacement flowmeters.

Often the systems are relatively slow dynamically and need only slight adjustments from day-to-day which is why manual control is still so popular.

It is important that the flow measurement system for the chemicals is able to cope with the pulsing nature of the pumps used and also with the high pressures that are encountered. These can be up to 1035bar/15000psi/15ksi in modern systems injecting subsea. Topsides injection is at lower pressures typically from 200 to 6000 psi. There is also a trend towards measuring the chemicals subsea i.e. underwater rather than when the crude oil reaches the surface. Not only does the flowmeter have to work at high internal pressures of over 10,000 psi, 690bar but also with external pressures up to 345bar/5000psi. Contact us with your application. We have 100s of meters in use subsea. VFF meters meet all these requirements.

LF03 – New Low Flow

Along with the new 2015 VFF Range after the huge success of the LF05 comes the greatly anticipated LF03 - the smallest Flow Meter Litre Meter has developed.

The development of the LF03 mean that the VFF series can now measure ever reducing flows keeping ahead of the competition.

Manufactured from Titanium with a maximum tolerance of 3 microns, the rotor and chamber combination achieve the lowest flow and widest turndown possible. Chambers and rotors are PVD coated by physical vapour deposition. A hard metal chromium nitride base layer provides surface hardness and appropriate support for the carbon (WC/C) which is laid over. The WC/C coating provides excellent protection against adhesive wear and its low coefficient of friction reduces the risk of surface fatigue (pitting) and fretting corrosion, vastly improving turndown and low flow capability.

The LF03 can be assembled into any connection type or size available on the market today or tomorrow.



Key Features:

Ultra Low Flow measurement- even lower than the LF05

Still only one moving part

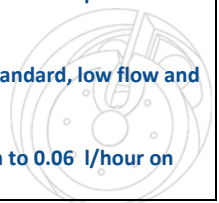
The LF03 comes in the same module size as the rest of the LF sub-range so it can replace either the LF05 or LF15 with ease without having to break pipe connections so reducing costs skid down time and labour.

The unique PBC design that isolates pressure containment from measurement ensures accurate measurement from 1 bar to 1,000bar to 4,000 bar.

Increased output resolution compared to the LF05 and LF15

3 calibration options: standard, low flow and ultra-low flow

LF03 can measure down to 0.06 l/hour on 10cSt



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Data and Calibration

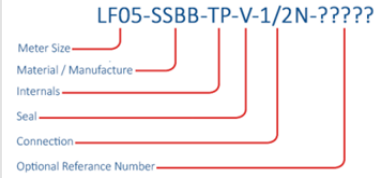


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The VFF ordering code is split into the options as indicated in the sample code to the right.

Below are the ranges, materials and types available and their associated maximum pressure ratings.

VFF meters are calibrated over 10 points on actual customer working fluid viscosity. Minimum flow rates are dependent on viscosity. Consult the following tables for more information.



Size	Range
LF03	0 - 18 L/hr
LF05	0 - 30 L/hr
LF15	0 - 90 L/hr
MF30	0 - 180 L/hr
VFF4	0 - 400 L/hr
VFF8	0 - 800 L/hr
HF20	0 - 20 L/min
HF40	0 - 40 L/min
HF60	0 - 60 L/min
V125	0 - 125 L/min
V270	0 - 270 L/min
SEE BROCHURE FOR MINIMUM FLOW RANGE	

Code	Material
SS	316 Stainless Steel
44	F44 6Mo SS Body & Cap (UNS S31254)
51	F51 Duplex Body (UNS S31803) & F44 Cap (UNS S31254)
53	F53 Super Duplex Body (UNS S32750) & F44 Cap (UNS S31254)
55	F55 Super Duplex Body (UNS S32760) & F44 Cap (UNS S31254)
HA	Hastelloy Body & Cap (UNS N10276)
TI	Titanium

Code	Manufacturing Method
BB	Body - Not Forged / Cap - Not Forged
FB	Body - Forged / Cap - Not Forged
FF	Body - Forged / Cap - Forged
CS	Custom Specification

All VFF flowmeters are custom calibrated across the customer specified min – max flow conditions and working viscosity. The minimum flow rates achievable are dependent on fluid viscosity. To see the achievable calibration ranges for each meter size please consult the table below.

		Minimum Flow Rate Measurable at Viscosity, L/hr							
		1 cP	1.5 cP	2.5 cP	7.5 cP	10 cP	25 cP	50 cP	250 cP
LF03 - 18 L/hr max	Standard	0.6	0.33	0.12	0.075	0.060	0.038	0.026	0.012
	Low Flow	0.4	0.22	0.08	0.05	0.040	0.025	0.017	0.008
	Ultra Low	0.2	0.09	0.05	0.03	0.025	0.016	0.015	0.005
LF05 - 30 L/hr max	Standard	1.5	0.83	0.30	0.125	0.100	0.063	0.042	0.03
	Low Flow	1	0.55	0.20	0.083	0.050	0.042	0.028	0.02
	Ultra Low	0.4	0.22	0.125	0.052	0.025	0.020	0.015	0.008
LF15 - 90 L/hr Max	Standard	3.75	2.1	1.5	1.13	0.75	0.53	0.3	0.03
	Low Flow	2.5	1.38	1	0.75	0.5	0.35	0.2	0.02
	Ultra Low	1	0.55	0.4	0.3	0.2	0.14	0.08	0.008
MF30 - 180 L/hr Max	Standard	12	6.6	3.6	2.4	1.2	1.1	0.9	0.3
	Low Flow	8	4.4	2.4	1.6	0.8	0.7	0.6	0.2
VFF4 - 400 L/hr max	Standard	14	7.4	4	3.2	2.4	2	1.5	1.2
	Low Flow	9	5	2.7	2.1	1.6	1.3	1	0.8
VFF8 - 800 L/hr Max	Standard	45	25	8	6.4	4.8	3.9	3	2.4
	Low Flow	30	16.5	5.3	4.3	3.2	2.6	2	1.6

		Minimum Flow Rate Measurable at Viscosity, L/min							
		1 cP	1.5 cP	2.5 cP	7.5 cP	10 cP	25 cP	50 cP	250 cP
HF20 - 20 L/min Max	Standard	2	1	0.33	0.27	0.2	0.16	0.13	0.1
	Low Flow	1.3	0.7	0.22	0.18	0.13	0.11	0.08	0.07
HF40 - 40 L/min Max	Standard	4	2	0.66	0.53	0.4	0.33	0.25	0.2
	Low Flow	2.5	1.4	0.44	0.35	0.27	0.22	0.17	0.13
HF60 - 60 L/min Max	Standard	6	3	0.99	0.8	0.6	0.49	0.38	0.3
	Low Flow	3.8	2.1	0.66	0.53	0.4	0.33	0.25	0.2
V125 - 125 L/min Max	Standard	12	6.5	2.09	1.67	1.26	1.02	0.79	0.63
	Low Flow	7.9	4.3	1.39	1.12	0.84	0.68	0.53	0.42
V270 - 270 L/min Max	Standard	24	13	4.17	3.35	2.52	2.05	1.58	1.26
	Low Flow	15.8	8.7	2.78	2.23	1.68	1.37	1.05	0.84



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Selected Recent Oil and Gas Contracts

Project	Portion	Primary	Region	Scope	Year	Qty
150116 HS3	Hydraulic fracturing	NA		VFF4 1380bar, F53 duplex	2016	1
TempaRossa		Total	Italy	12 flanged meters	2016	12
Nawara and South Tunisia Gas	CPF Chemical Injection	ETAP OMV	Tunisia	LF03 x 18, 0.2-2 l/hr	2016	18
451295/AFE J634				F55 Norsok M650	2016	4
Jack & St Malo	CI	Chevron	GOM	VFF4 in F55	2016	1
Ichthys	Start Up heater	Inpex	Australia	VFF8 MEG in F55	2016	1
Shearwater	Corrosion Inhibitor	Shell	North Sea	LF05, replaces VFF1773	2016	1
	CSIU Corrosion and Scale			LF03 x 2, Scotron G10140	2015	2
	MIU Methanol injection unit			HF40 in duplex, for methanol	2015	2
Balmoral	HPU	Premier Oil		Water/glycol	2015	2
Triton FPSO		Dana Petroleum	North Sea	LF15 x 2	2015	2
Leman		Shell/BP	North Sea	VFF8	2015	2
Kaombo	CI	Total	Africa	LF15 subsea modules	2015	154
Shah Deniz 2	High Pressure MEG	BP	Azerbaijan	HF40 1035 x 30	2015	30
Kinabalu	NAG optimisation	Petronas Carigali	Malaysia	VFF8 Du 1035	2015	1
Gina Krog Topside EPCH	PD Flowmeter	Statoil	North Sea	V125 x 2, Techlok H2	2015	2
Ichthys	MEG injection	Inpex	Australia	V125 x 13, HF60 690bar, HF40 414bar	2015	15
Corrib, Bellanaboy Bridge Gas	CI	Shell	Ireland	LF15, ANSI 2500	2015	1
Gina Krog Topside EPCH	PD Flowmeter	Statoil	North Sea	V125 x 2, Techlok H2	2015	2
Stones	Methanol and CI	Shell	GOM	HF40, LF05, spares VFF3723+	2015	8
Ichthys	MEG injection	Inpex	Australia	V125 x 13, HF60 690bar, HF40 414bar	2015	15
Gulfstar	Gunflint Chemical Injection	Williams	GOM	LF05	2015	2
Coulomb		Shell	GOM	LF15 x 4, VFF4 x 4, LF05 x 4	2015	12
Platform A6A	Injection skids	Wintershall	North Sea	LF05 Demulsifier Defoamer Scale Corr	2015	4
Huangyan Phase II	CI		East China Sea	LF05x13, F018	2015	13
Dunbar	Corrosion Inhibitor	Total	North Sea	LF05 x 3	2015	3
		COOEC	China	LF05 x20, 3/4" & 1/2"#1500	2015	20
Tahiti	CI upgrade	Chevron	GOM	LF05x28, HF20x3, VFF8x14, LF15x6	2015	51
Kashagan	CI Package	ENI agip kco	Kazakhstan	VFF4 LF05	2015	15
In Amenas	Operation Spares	BP Amoco	Algeria	LF15 x 4	2014	4
Mariner	CI	Statoil	North Sea	MF30x48, VFF4 x 5, LF15x2	2014	55
Kenli 10-1	CI Package	COOEC	China	LF15x39 etc	2014	49
New Booster Station, SE	New Booster Station	Kuwait Oil	Middle East	LF05 x 4	2014	4
Scott/Telford	Demulsifier Skid	Nexen	North Sea	LF15 x 6	2014	6
Kinabalu NAG Project	Chemical Injection	Petronas Carigali	Malaysia	LF05 1035 x 7	2014	7
TGT Field Development	CI Package	Hoang Long Joint	Vietnam	LF05 x 3, MF30 x 3, VFF4	2014	7
Murphy Medusa Expansion		Murphy	GOM	LF05 690 x4	2014	4
Baobab	MeOH and Chemical	CNR	Ivory Coast	LF05x24, HF40x7	2014	31
Western Isles	CI and Methanol skids	Dana Petroleum	North Sea	LF05x47, HF40x12, LF15x24 etc	2014	89
Jack & St Malo	H2S Scavenger Injection Skid	Chevron	GOM	LF15 x 8	2014	8
Chim Sao?	Chemical Skid	Petrovietnam	Vietnam	LF15 x 4, MF30	2014	5
Shah Deniz 2	CI	BP	Azerbaijan	VFF8, MF30, LF15 x 10, LF05 x 30	2014	60
Gina Krog	CI Package	Statoil	North Sea	LF05 x 30, 10 were 690bar	2014	30
Stones	Methanol and CI	Shell	GOM	LF05 x 34, HF40 x 6	2014	40
FPSO Cidade de Anchieta	Antiscale Injection	Petrobras	Brazil	LF05 x 11	2014	11
Alder	Subsea CI	ConocoPhillips	North Sea	LF05 x 4	2014	4
Heidelberg	Chemical Skid	Anadarko	GOM	LF05 x 9, LF15 x 10, MF30 x 2	2014	21
Ichthys	Chemical Skid	Inpex	Australia	LF05 to V125	2014	30
Cygnus Bravo	PD flowmeter	GDF Suez	North Sea	LF05, VFF8, HF20	2014	3
Lianzi	CI	Chevron	Angola, Cabinda	LF05 x 16	2014	16
Gina Krog	CI Package	Statoil	North Sea	LF05 x 30, 10 were 690bar	2014	30
Stones	Methanol and CI	Shell	GOM	LF05 x 34, HF40 x 6	2014	40
FPSO Cidade de Anchieta	Antiscale Injection	Petrobras	Brazil	LF05 x 11	2014	11
Alder	Subsea CI	ConocoPhillips	North Sea	LF05 x 4	2014	4
Heidelberg	Chemical Skid	Anadarko	GOM	LF05 x 9, LF15 x 10, MF30 x 2	2014	21
Jack & St Malo		Chevron	GOM	HF40 x 10, LF15 x 18	2014	28
Jack & St Malo	H2S Scavenger Injection Skid	Chevron	GOM	LF15 x 8	2014	8
Chim Sao?	Chemical Skid	Petrovietnam	Vietnam	LF15 x 4, MF30	2014	5
Ichthys	Chemical Skid	Inpex	Australia	LF05 to V125	2014	30
Cygnus Bravo	PD flowmeter	GDF Suez	North Sea	LF05, VFF8, HF20	2014	3
Lianzi	CI	Chevron	Angola,Cabinda	LF05 x 16	2014	16

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Rev A3, 08/2016