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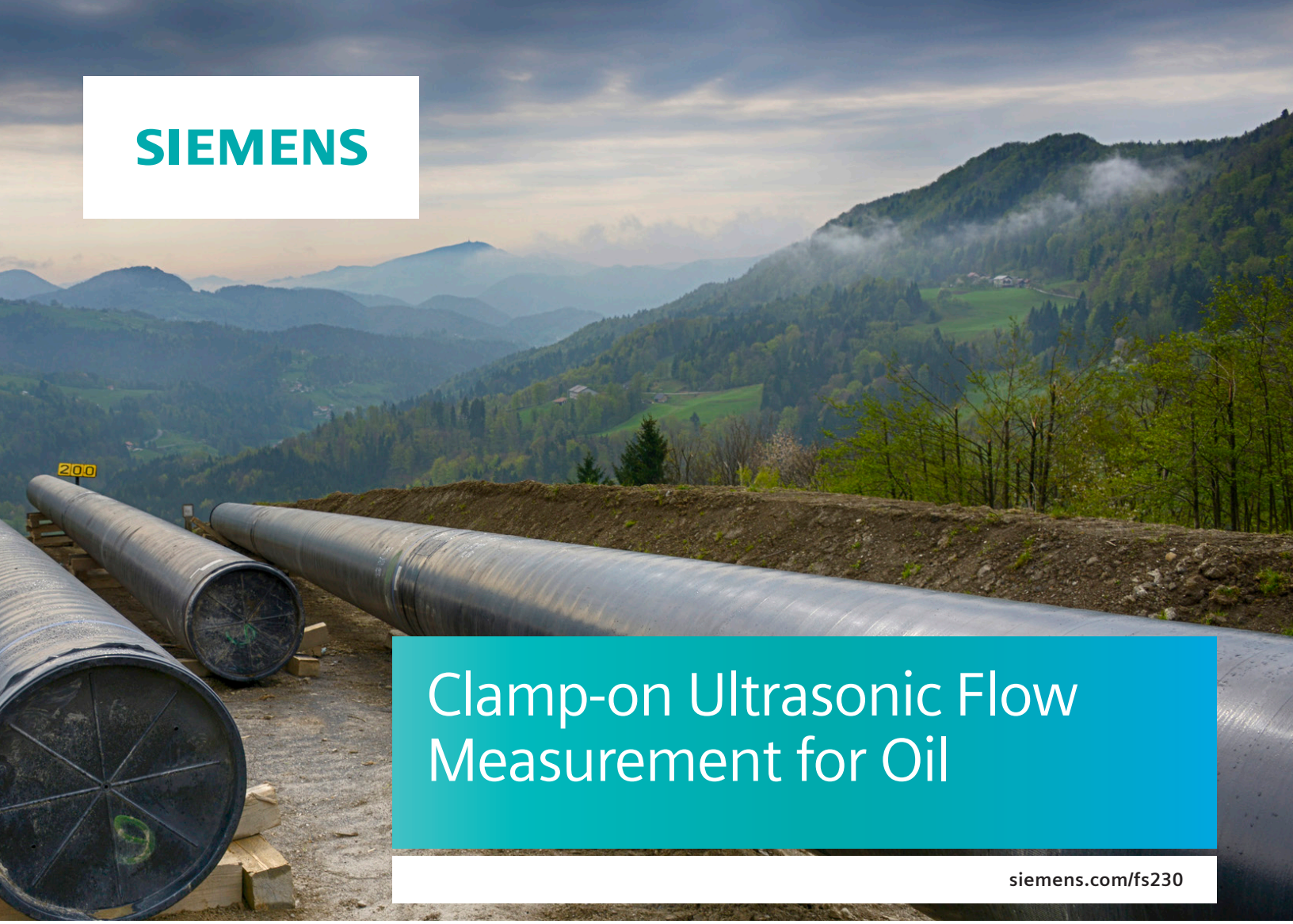


Clamp-on Ultrasonic Flow Measurement for Oil

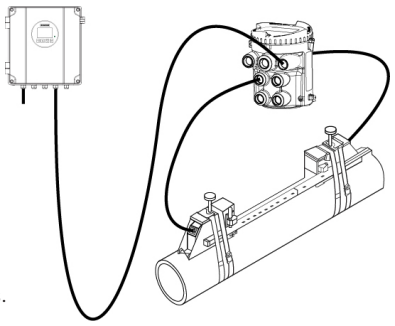
siemens.com/fs230

Clamp-on flow measurements

With over 50 years of experience, Siemens continues to set new standards in ultrasonic flow measurement technology.
With our WideBeam process, we create the basis for outstanding basic accuracy - even in difficult conditions, for liquid or gas flow.
On the one hand, the clamp-on technology offers enormous advantages, but it also faces the challenge of transmitting measurement signals through existing pipes. The intelligent integration of the pipe wall as part of the measuring system leads to significantly better signal waves that spread over a wide radiation range. The advantage is a better signal-to-noise ratio and a higher measuring accuracy even with changes in the medium, e.g. temperature or margin changes. We call this WideBeam technolgy and use it to improve the measuring performance of Lambwave sensors even further.
The best possible signal transmission is achieved through the harmonious interaction between the pipe wall and the ultrasonic sensors. Lambwave sensors transmit signal waves that are individually adapted to the resonance range of the pipe for each measurement. This is the key to data acquisition for high-precision measurements on petroleum products. And with the SITRANS FS230, Siemens is now opening a new window on this technology.

Measuring gas with the SITRANS FS230 flowsystem

A SITRANS FS230 essentially consists of an FST030 transmitter, a digital sensor link and paired FSS200 ultrasonic sensors, each connected with a cable.
The sensors are individually clamped onto the pipe for each measurement.
The digital sensor link (DSL) is an electronic module that generates analog signals specifically according to the measurement technology (here ultrasound), which are evaluated by sensors and recorded as measured values.
The analog measured values are thus digitized as early as possible and transmitted to the transmitter.
There, the digital signals are processed, possibly corrected, displayed, counted, and saved.



Schematic drwaing of an FS230 flow system consisting of the SITRANS FST030 transmitter, the external FS-DSL and the SITRANS FSS200 sensors.

SITRANS FS230 for hydrocarbon flow measurements:

- Suitable for new installations as well as retrofitting
- Robust sensor assembly and device structure for years of operation
- Measurement technology without media contact: safe and easy to maintain
- Fast value acquisition, real 100 Hz signal update
- Very high basic accuracy, easily expandable up to 4-path measurement
- Reynolds compensation for multiproduct pipelines
- State-of-the-art diagnosis, data backup and data output
- Designed according to NAMUR requirements and Industry 4.0, with a wide range of diagnostic options

Measuring principle - Why the SITRANS FS230 is ideal for hydrocarbon applications

Ultrasonic flow meters based on the transit time difference method are volumetric measuring devices. In order to correctly determine the volume flow, it is necessary to observe the flow profile in the pipe, i.e. faster flow speeds in the middle of the pipe compared to near the pipe wall. The flow profile is described by the Reynolds number, a dimensionless number, which is calculated from the mean flow rate, the kinematic viscosity of the liquid in the pipe and the inside diameter of the pipe.

Challenges in measuring hydrocabon products

The challenge of hydrocarbon measurements in particular is to record the different flow rates, taking into account different margins or products in the tube, temperature changes, the associated change in viscosity and flow behavior. A temperature measurement, either directly via a sensor or as an external analog input signal, is necessary. Pressure changes are usually not relevant, but can also be recorded. Based on the actual measured values of the current speed of sound, the measuring device accesses an internal liquid table taking into account the current temperature. Aided by the table, the transmitter identifies the measured liquid, determines the current viscosity, calculates the Reynolds number and corrects the volume flow accordingly. The measuring device always shows the currently recognized liquid on the display, but is also able to output the current mass or a standard volume calculation.

Read Oil Table | Write Oil Table | Sort table | Store Table In Flash

End User Password entered
Command executed
Flash successfully updated

	Liquident	Liquident Identifier	MPMS 11.1 Reference Density	Viscosity Values		Liquid Classification Coefficients		
Unit	[°]	N/A	[kg/m³]	[m²/s]	[m²/s]	[kg²/m⁴*K²]	[kg/m⁴*K]	[1/K]
Index	PID_OilTable_Liquident @ T3 & Pref	PID_OilTable_LiquidIdentifier [0;255]	PID_OilTable_MPMSReferenceDensity @ T3 & Pref	PID_OilTable_ReferenceViscosity1 + 2		PID_OilTable_LiquidCoefficientK0 + 1 + 2		
1	1100	1 - MTBE	640	1E-06	6E-07	346,4228	0,4388	0,0000
2	1180	2 - LFB	717	1E-06	6E-07	346,4228	0,4388	0,0000
3	1200	3 - LR	733	1E-06	6E-07	346,4228	0,4388	0,0000
4	1330	4 - Kerosene	775	3,5E-06	2,2E-06	594,5418	0,0000	0,0000
5	1350	5 - AVJET	818	3,5E-06	2,2E-06	594,5418	0,0000	0,0000
6	1380	6 - HS Diesel	819	5,5E-06	3,5E-06	186,9696	0,4862	0,0000
7	1410	7 - LS Diesel	885	5,5E-06	3,5E-06	186,9696	0,4862	0,0000
8	1420	8 - GASOIL	959	2E-05	8,00E-06	186,9696	0,4862	0,0000
9	1490	9 - FO	930	0,000119	3E-05	186,9696	0,4862	0,0000
10	1579	10 - HFO	960	0,001049	0,0003	186,9696	0,4862	0,0000
11								

Catering for different liquid types

The internal Liquident table can record up to 32 different liquids. A set of values for common products such as petrol, diesel or kerosene is already stored in the device. Crude oil blends with different margins, however, are almost always unique and must therefore be adjusted together with the pipeline operator.
Another option in the Liquident table is the detaction of acid or alkali mixtures. Depending on the acid content, different sound velocities are measured and assigned. For all these measurements, the temperature must continuously be observed as a point of reference for the device to calculate the correct volumetric flow going through the pipe. Rapid changes in flow can be detected and logged to create trend views over a defined time period.

Reliable leak detection

When used for leak detection, the FS230 shows its outstanding strengths. Depending on the pipeline topology, two SITRANS FS230 can each monitor a defined section of a pipeline up to a distance of 50 km. Deviations in the balance quantity, i.e. the difference between the input measurement and the output measurement of a segment very quickly indicate a leak and the balance difference provides information about the size of the leak. Since both measuring devices use identical technology, the absolute accuracy to each other is extremely high. The very good basic accuracy of the transmitter, the use of the same liquid tables in each transmitter, the fast measuring cycles with an update rate of 100 Hz as well as the use of up to four measuring paths per pipe are of crucial importance for a safe pipeline monitoring. This applies to smaller pipes from DN50 up to DN1000 and beyond. Various operating conditions such as slow or fast transport, changing margins or starting operations are also monitored.

Integrated scraper alarm

The built-in pig alarm on a SITRANS FS230 is another feature relevant for hydrocarbon measurments. Cleaning or LD pigs briefly interrupt the ultrasonic measuring paths and are thus reliably recognized as a pig run. Depending on the pipe size, flow velocities and the type of pig used, this function can be parameterized and adapted in the transmitter. Faults caused by loosened deposits in front of the cleaning pigs are also taken into account. Even newts that have only one rod in the middle are recognized. Thus, false alarms can reliably be avoided.

Multi-path technology guarantees precise and continuous

Clamp-on flowmeters measure through the center of the pipe. This is done with multiple measuring paths. In the event of an unexpected failure of a channel this might cause a decrease in measurement accuracy but never a total loss of the measurement itself. Installing more than one measuring path also compensates adverse run-in conditions. Quintessentially, the measurements get more precise with the number of measuring paths installed. While a single-path measurement does suffice for standard applications and smaller pipes, pipe sizes above DN500 require 4-channel measurements.

New installation or retrofit – the SITRANS FS230 can be used for both

The SITRANS FS230 is of course ideal for new systems, but the greatest strength is actually the possibility to retrofit the device. Without interfering with the pipeline, without interrupting the process, without disrupting existing security measures, LD segments can be integrated into most existing pipeline management systems. The SITRANS FS230 offers a cost-effective way to retrofit existing pipelines, improve safety by reducing risks and and hence making pipeline systems them future-proof.

The measuring system SITRANS FS230 at a glance

Sensor Spotlight - SITRANS FSS200

The SITRANS FSS200 sensors are a continuation of the proven 1011 sensors of the replaced SITRANS FUG1010 family. The new SITRANS FS230 is downward compatible with these older systems, allowing a straightforward plug-and-play startup.
For hydrocarbon measurements, high precision sensors are the devices of choice. These Lambwave sensors are operated using the WideBeam method. Our portfolio offers 10 different types of high precision sensors tailored for different areas of application and tube wall thicknesses. Each sensor can be ordered in two temperature variants, generally from -40 ° C to + 120 ° C.

Possible applications:

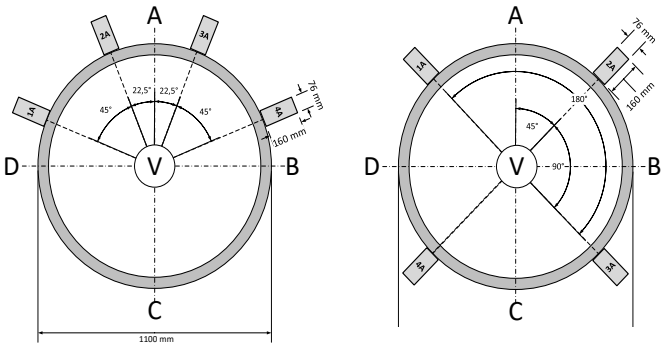
- Operational measurements for product pipelines
- Oil storage: storage, retrieval, relocation, balancing
- Chemical industry: production, process monitoring, internal accounting
- Crude oil pipelines
- Check metering, temporary checks of built-in measurements
- Leak detection
- Newt detection

External DSL Spotlight - SITRANS FS DSL

Measuring in gas applications makes ex protection of all measurements indispensible. The SITRANS FS230 system allows oil flow measurments up to zone 0/1. The external FS-DSL electronics module is encapsulated in a pressure-tight housing. It is mounted as close as possible to the sensors on the pipe. Short analog cables to the sensors on the pipe offer the best possible EMC protection and also reduce the cable costs. Analog inputs for pressure and temperature are available. The power supply is intrinsically safe via the transmitter up to a maximum distance of 150 m. The Siemens sensor link (SSL) cable is connected either via screw terminals or optionally via connectors - at both ends, of course explosion-proof.

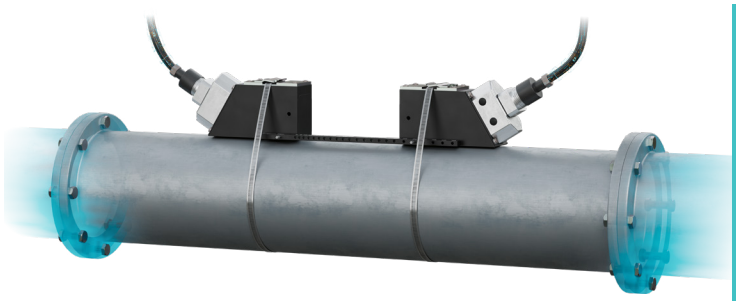
Transmitter Spotlight - SITRANS FST030

The transmitter is the decisive device to receive the transmitted signals by all clamp-on sensors installed and calculate the volume flow and the flow profile based on the Reynolds number.
Per definition, clamp-on field measurements are difficult to calibrate as the pipe that is being used is always part of the measuring system and is difficult to install on a test bench. A very good basic accuracy of the transmitter is hence particularly important for clamp-on measurements. Under laboratory conditions, the measurement deviation of the SITRANS FS230 is < 0.3% from a minimum flow rate of approx. 0.3 m/s.



Sensor mounting options for 4 path measurements:
Reflect mode (left), Direct X mode (right).

Pipe quality plays a major role, but mostly poor measuring accuracy can be attributed to unfavorable inlet and outlet conditions (i.e. pipe bends just before the measuring point, or changes in pipe diameter). A multipath measurement can compensate for unfavourable conditions. The rule of thumb is: the more paths, the better the detection of deviating flow profiles.



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