

Flow Measurement

SITRANS F X

SITRANS FX300

Overview



SITRANS F X vortex flowmeters provide accurate volumetric and mass flow measurement of steam, gases and liquids as an all-in-one solution with integrated temperature and pressure compensation.

Benefits

- 2-wire technology with HART communication
- Integrated temperature compensation for saturated steam as standard feature
- Integrated temperature and pressure compensation enabling direct measurement of mass, standard volume flow rate and energy
- One instrument for measuring pressure, temperature and flow. No additional installation of pressure and temperature sensors
- Maximum process reliability thanks to Intelligent Signal Processing (ISP) - stable readings, free of external disturbances
- Fully welded stainless steel construction with high corrosion, pressure and temperature resistance
- Maintenance-free design
- Ready to use due to plug & play feature
- Minimal pressure drop
- Compact or remote design
- Free Air Delivery (FAD) measurement of a compressor






Application

The SITRANS FX300 is a flowmeter in a single or dual transmitter version, suitable for measuring industrial steam, gases, as well as conductive and non-conductive liquids, e.g. steam (saturated steam, superheated steam), industrial gases (compressed air, nitrogen, liquefied gases, flue gases), and conductive and non-conductive liquids (demineralized water, boiler feed water, solvents, heat transfer oil).

The main applications of SITRANS FX300 can be found in the following sectors:

- Chemical
- Petrochemical
- Oil & Gas
- Power plants
 - Air
 - Heating
 - Cooling
 - Chilling
- Food & beverage
 - Pharmaceutical
 - Sugar refineries
 - Dairies
 - Breweries
 - Production of soft drinks
- Pulp & paper
- Water & waste water

System Overview

Version	Flange	Sandwich	Dual transmitter
Compact			
Remote			

Design

SITRANS FX300 vortex flowmeters are available in the following variants:

SITRANS FX300 Single transmitter

The single transmitter variant exists in flange or sandwich design. In flange design the SITRANS FX300 offers a sensor with integrated nominal diameter reduction up to two nominal diameter sizes. That ensures best results in accuracy and optimal measuring ranges even in pipelines with large diameters, designed for low pressure loss. By forgoing complex pipeline reduction installations, space and cost saving installations can be realized. At the same time the number of potential leakages is reduced to a minimum.

The flowmeters in sandwich design will be supplied with additional optimised centring rings. With installation of the centring rings the SITRANS FX300 can be aligned centrally and eliminates any offset between the sensor and the pipeline.

The SITRANS FX300 is also available as a remote version. This feature allows separating the transmitter from the sensor up to a distance of 15m (49 ft). The remote mounted transmitter allows easy operation and optimal readability.

The following configurations can be selected for the single transmitter variant:

Basic version

Suitable for liquids and gases, integrated temperature compensation included as standard for saturated steam

With integrated pressure compensation

Version with integrated temperature and pressure compensation for gases, wet gases, gas mixtures or steam (energy measurement optional)

With integrated pressure compensation and isolation valve

Allowing the pressure sensor to be shut off for the purpose of pressure and leak testing of the pipeline or for being exchanged without interrupting the process.

Remote version

With this version transmitter and sensor are locally separated. In addition, it offers the same features as the compact version (integrated temperature and pressure compensation, isolation valve).

SITRANS FX300 Dual transmitter

This is a genuine redundant system with two independent sensors and transmitters providing twofold functional reliability and availability of the measurement. This variant is optimally suited for measurements in multi-product pipelines.

The dual transmitter version is available as:

Basic version

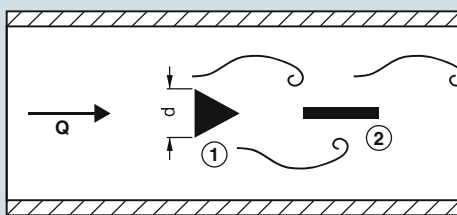
Suitable for liquids and gases, temperature compensation integrated as standard for saturated steam

Function

Operating Principle

SITRANS F X vortex flowmeters measure flow rate by detecting the frequency at which alternating vortices are shed from a bluff body inserted into the flow stream. This principle of measurement is derived from the Karman phenomenon of vortex shedding. The frequency of the alternating vortices is proportional to the flow rate.

The passage of a vortex causes a slight stress on a pick-up sensor placed downstream of the bluff body. The stress is detected by piezo-electric crystals placed inside the pick-up sensor.



1 = Bluff Body, 2 = Pick-up

The flowmeter calculates the flow velocity using the following equation:

$$Q = A \cdot V = A \cdot d / St \cdot f = 101.93 \cdot f / K \text{ [m}^3\text{/h]}$$

Where:

Q = flow rate [m³/h]

f = vortex shedding frequency [Hz]

K = calibration constant [pulses/m³]

d = width of the bluff body [m]

St = Strouhal Number

A = cross-section area [m²]

V = flow velocity [m/s]

Requirements

In order to generate the vortex streets, the medium must have a minimum velocity:

For steam and gases, the flow velocity must be 2 to 80 m/s (6.6 to 262 ft/s)

For liquids the flow velocity must be 0.4 to 10 m/s (1.3 to 32.8 ft/s)

Technical specifications

Input	
Measuring range limits	See Dimensional Drawings
Media pressure	1 ... 100 bar (14.5 ... 1450 psi) (Higher pressures on request)
Output	
Current output	
Measuring range	4 ... 20 mA
Over range	20.8 mA ± 1 % (105 % ± 1 %)
Load	
- min.	100 Ω
- max.	$R_{\text{max}} = (U_{\text{Power Supply}} - 14 \text{ V}) / 22 \text{ mA}$
Error signal	NAMUR NE 43
Maximum output	22 mA (112.5 %)
Multidrop mode	4 mA
Digital output	
Communication	HART
Physical layer	FSK
Device category	Transmitter
Pulse output	
Passive pulse output, setting pulse value (meter factor) for totalized flow or heat quantity (energy) with option Y47 (e.g.: 1 pulse/kg or 1 pulse/kWh)	
Pulse frequency	Max. 0.5 Hz
Power supply	Min. 24 V DC as NAMUR or
Non-Ex version	open < 1 mA, max. 36 V, closed 100 mA, U < 2 V
Ex version	open < 1 mA, max. 30 V, closed 100 mA, U < 2 V
Accuracy	
Standard version	
For liquids	
- Re ≥ 20 000	± 0.75 %
For steam and gases	
- Re ≥ 20 000	± 1 %
For steam, gases and liquids	
- 10 000 < Re < 20 000	± 2 %
Pressure and temperature-compensated version	
For liquids	
- 10 000 < Re < 20 000	± 2 %
- Re ≥ 20 000	± 0.75 %
For gases and steam	
- 10 000 < Re < 20 000	± 2.5 %
- Re ≥ 20 000	± 1.5 %
Repeatability	± 0.1 %
Installation conditions (At different conditions, e.g. installation after control valve, bends or reductions, please refer to the operating instructions.)	
Inlet run	≥ 20 x DN
Outlet run	≥ 5 x DN

Flow Measurement

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SITRANS FX300

Software		Design	
Uncompensated for liquids and gases, density-compensated by temperature for saturated steam	Order option 1	Material	
Density-compensated by temperature and pressure for superheated steam	Order option 4	Sensor/Pick-up	AISI 316L (1.4404)/ AISI 316L (1.4435)
Gross heat meter		Transmitter housing	Aluminum
When the thermal energy of steam is to be measured	Order option 5	Sensor gaskets (Pick-up/Pressure sensor)	AISI 316L (1.4435) / FPM or FFKM
Following information is required at option Y51 to Y56	Y51 Variable current output: Flow rate, power Y52 Power unit Select one of the following units: kJ/h, MJ/h, GJ/h, Btu/h, kcal/h, kW, MW or special (custom) Y53 Fullscale value power Y54 Variable pulse output: Totalized flow, energy Y55 Totalizer on/off Y56 Energy unit Select one of the following units: kJ, MJ, GJ, Btu th, kcal, kWh, MWh or special (custom).	Process connections	FPM (Viton) for steam and non-aggressive gases. FFKM (Kalrez) for chlorine and other aggressive gases. (The meter is fitted with FPM/FFKM gasket only when configured with pressure sensor)
Density compensated by temperature and pressure for gases, wet gases	Order option 7	Flange version	Flange norm EN 1092-1 form B1/B2 or ANSI B16.5 RF.
Wet gases	Select Y49 and enter relative humidity of process medium in %	Sandwich version	Other flanges on request (contact your local Siemens representative)
FAD - Free Air Delivery		Degree of protection	DN 15 300 (½ 12") DN 15 100 (½ 4")
When the delivered air of a compressor is to be measured	Order option 8	Dimensions and weights	IP66/IP67
In Y81 to Y87 add information regarding:	Y81 Inlet suction temperature Y82 Atmospheric pressure Y83 Pressure drop at inlet suction filter Y84 Inlet relative humidity Y85 Actual compressor rotation (rpm) Y86 Rated compressor rotation (rpm) Y87 Relative humidity at compressor output	Display and operating interface	See Dimensional Drawings
Mixed gases	When fluid is a gas mixture, specify the single gas components and their amount/concentration in %.	Local display	2 lines, 10 characters per line
Rated operation conditions		Languages	German, English, French
Ambient temperature		Power supply	
Non-Ex version	-40 +85 °C (-40 +185 °F)	Standard version	14 36 V DC
Ex version	-40 +65 °C (-40 +149 °F)	Ex version	14 30 V DC
Storage temperature	-50 +85 °C (-58 +185 °F)	Certificates and approvals	
Media temperature	-40 +240 °C (-40 +464 °F)	Explosion protection	
Density	Taken into consideration when dimensioning	ATEX	II 2G EEx d ia [ia] IIC T6
Viscosity	<10 cP	FM US/C	Class I, II, III, Div. 1 and 2
Reynolds number	10 000 2 300 000	Calibration	All flowmeters will be delivered with a 3 point calibration certificate
Media pressure limit	Max. 100 bar (1450 psi) Higher pressure on request (contact your local Siemens representative)	Material Certificate	Certificate of compliance, pressure test, material certificate, material in acc. of NACE and PMI of pressure bearing metal parts.
		Cleaning	Choose Cleaning Class1 when fluid is oxygen or contains chloride.
		Certificates	X-ray and dye penetration test on pressure bearing weldings

Valid combinations of sensor/connections size with flange norm/nominal pressure are shown in the following table.

Sensor size	Connection size	EN 1092-1, Form B1/B2, PN 10	EN 1092-1, Form B1/B2, PN 16	EN 1092-1, Form B1/B2, PN 25	EN 1092-1, Form B1/B2, PN 40	EN 1092-1, Form B1/B2, PN 63	EN 1092-1, Form B1/B2, PN 100	ANSI B16.5, class 150	ANSI B16.5, class 300	ANSI B16.5, class 600
SITRANS FX Flanged - Single transmitter (7ME2600-...)										
DN 15	DN 15	-	-	-	●	-	●	●	●	●
	DN 25	-	-	-	●	-	●	●	●	●
	DN 40	-	-	-	●	-	●	●	●	●
DN 25	DN 25	-	-	-	●	-	●	●	●	●
	DN 40	-	-	-	●	-	●	●	●	●
	DN 50	-	●	-	●	●	●	●	●	●
DN 40	DN 40	-	-	-	●	-	●	●	●	●
	DN 50	-	●	-	●	●	●	●	●	●
	DN 80	-	●	-	●	●	●	●	●	●
DN 50	DN 50	-	●	-	●	●	●	●	●	●
	DN 80	-	●	-	●	●	●	●	●	●
	DN 100	-	●	-	●	●	●	●	●	●
DN 80	DN 80	-	●	-	●	●	●	●	●	●
	DN 100	-	●	-	●	●	●	●	●	●
	DN 150	-	●	-	●	●	●	●	●	●
DN 100	DN 100	-	●	-	●	●	●	●	●	●
	DN 150	-	●	-	●	●	●	●	●	●
	DN 200	●	●	●	●	-	-	●	●	-
DN 150	DN 150	-	●	-	●	●	●	●	●	●
	DN 200	●	●	●	●	-	-	●	●	-
	DN 250	●	●	●	●	-	-	●	●	-
DN 200	DN 200	●	●	●	●	-	-	●	●	-
	DN 250	●	●	●	●	-	-	●	●	-
	DN 300	●	●	●	●	-	-	●	●	-
DN 250	DN 250	●	●	●	●	-	-	●	●	-
	DN 300	●	●	●	●	-	-	●	●	-
DN 300	DN 300	●	●	●	●	-	-	●	●	-

● available
- not available

Flow Measurement SITRANS F X

SITRANS FX330

Overview



SITRANS FX vortex flowmeters are designed for use in industrial applications and optimally suited to the demands in auxiliary supply systems.

The proven principle of vortex flowmeters is suitable for measurement of liquids, gases and vapors unaffected by conductivity, viscosity, temperature and pressure.

Benefits

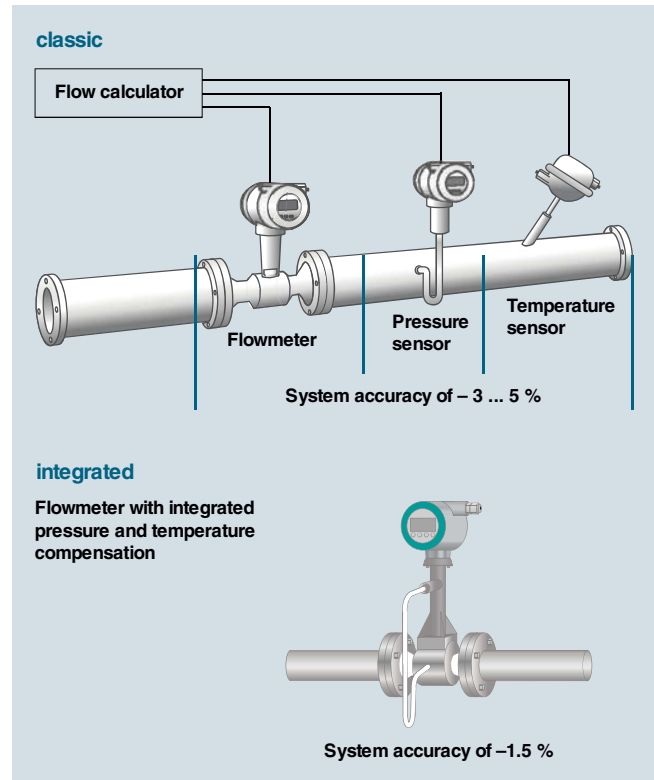
- Integrated pressure and temperature compensation
- Temperature compensation for saturated steam included as standard
- High measuring accuracy
- Maintenance-free sensor
- Non-wearing, fully welded stainless steel construction with high resistance to corrosion, pressure and temperature
- SIL2 certified according to IEC 61508 Edition 2
- Use in hazardous areas
- Integrated reduction of nominal diameter for space-saving and economic installation and large measuring ranges
- Redundant data management: Easy exchange of electronics without loss of calibration and configuration data
- FAD (Free Air Delivery) functionality
- Gross and net heat calculation to support advanced energy management
- Remote version with cable length up to 50 m (164 ft)

Even the basic version of the vortex flowmeter SITRANS FX330 is equipped with temperature compensation for saturated steam applications. With the optional pressure sensor the SITRANS FX330 has integrated density compensation for calculation of corrected volume and mass (online density compensation). The density compensation for calculation of corrected volume and mass is based on the standards of NIST for gases and IAPWS for steam.

Higher measuring accuracy with the use of compact measuring systems

With the classic installation of a vortex flowmeter and separate pressure and temperature sensor as well as flow calculator, all errors occurring in the measuring chain must be taken into account when determining system accuracy. This can result in a measuring error between – 3 to 5 %.

Using a vortex flowmeter with integrated pressure and temperature compensation such as the SITRANS FX330 allows you not only to lower installation costs but also increase the measuring accuracy of the measuring point. In this case the accuracy is – 1.5 % of the measured value.



The SITRANS FX330 in flanged design is available with integrated reduction of nominal diameter for space-saving installations and large measuring spans. About 90% of all vortex flowmeters are ordered one size smaller than the line diameter in order to increase the flow speed and to get a wider measuring range. Here, the line has to be reduced before and widened after the sensor, typically including 20x DN inlet and 5x DN outlet run. With the reduction and widening of nominal diameter included in the sensor, it is no longer necessary. To compensate the non-existent straight inlet run between reduction and the vortex bluff body, these devices are specially calibrated and linearized.

A new feature of the SITRANS FX330 is the advanced signal processing and filtering called AVFD (Advanced Vortex Frequency Detection): Interferences and disturbances in the measuring signal are suppressed, signals outside of the relevant frequency band are filtered out.

Redundant data management prevents loss of calibration and configuration data when changing electronics or display.

By default, all SITRANS FX330 meters are factory-calibrated (traceable to international standards) and pre-set according to customer specifications. The SITRANS FX330 also comes with an installation wizard to ease installation; e.g. in a steam application it will only show related settings.

Developed according to the standard IEC 61508 edition 2, the SITRANS FX330 can be used in safety-related application with classification SIL2 for continuous volume flow measurement.

Application

Measurement of saturated steam and superheated steam
 Steam boiler monitoring
 Heat metering of steam and hot water
 Measurement of consumption of industrial gases
 Measurement of consumption in compressed air systems
 Monitoring of compressor output
 Evaluation of Free Air Delivery (FAD)
 SIP and CIP processes in the food, beverage and pharmaceutical industries
 Measuring of conductive and non-conductive liquids
 Safety-related measurement in SIL applications (SIL2)

Gross and net heat quantity calculation

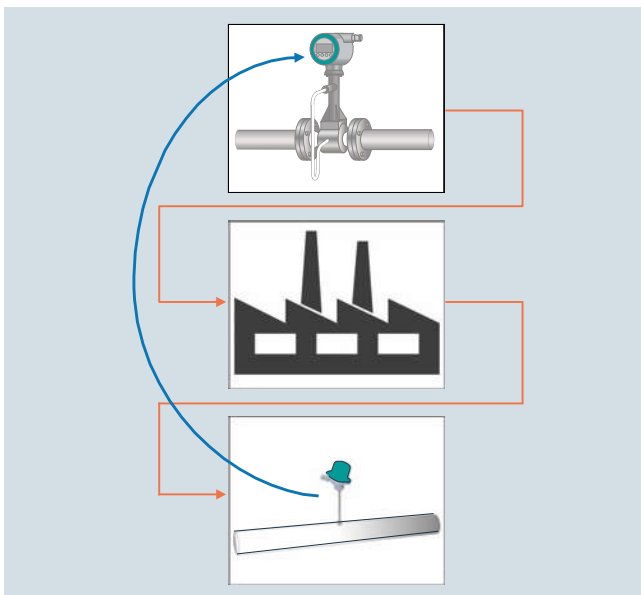
The SITRANS FX330 was designed for applications in auxiliary and supply service lines, such as internal monitoring of energy flows for saturated and superheated steam or hot water. Equipped with temperature sensor as standard, the device can be installed as heat meter in the feed line directly connected with an external temperature sensor in the return line. The gross and net heat calculation can be fed into a DCS to support advanced energy management.



When it comes to energy, the most accurate measurement of consumption is essential. By combining flow, temperature and pressure measurements in one device, SITRANS FX330 provides the basis for a precise mass flow calculation.

In steam applications, the software even determines the enthalpy - the heat content - of the steam. Therefore, SITRANS FX330 is able to calculate the gross heat quantity.

In case net heat quantity consumption of process is asked for, a single temperature sensor can be added to the return line. SITRANS FX330 uses the readings to calculate the amount of heat consumed.

The SITRANS FX330 thereby proves itself to be a reliable partner.

**Design**

SITRANS FX330 Flange	SITRANS FX330 Sandwich
	
Flanged version with integrated temperature compensation as standard for saturated steam and optional pressure compensation for superheated steam, gases and wet gases.	All advantages of the flanged version in a space-saving sandwich design; centering rings guarantee an easy installation without any offset.
Integrated reduction of nominal diameter for space-saving and economic installations plus large measuring ranges.	Integrated reduction of nominal diameter not available
Also in remote design with field housing and connection cable up to 50 m/164 ft	
With shut-off valve allowing exchange and calibration of pressure sensor pressure and leak testing of pipeline without interrupting the process	

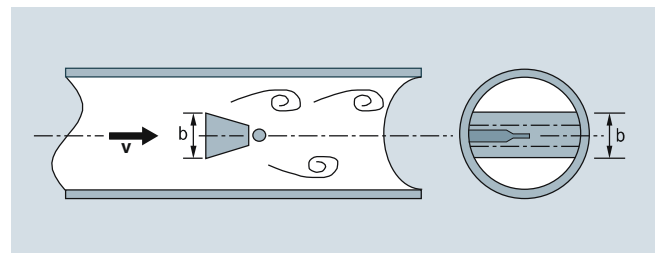
Function

Vortex flowmeters are used to measure the flow of gases, vapors and liquids in completely filled pipes. The measuring principle is based on the principle of the Karman vortex street. Inside the measuring sensor vortices are shed from a bluff body and are detected by a sensor located behind. The frequency f of the vortex shedding is proportional to the flow velocity v .

The nondimensional Strouhal number S describes the relationship between vortex frequency f , width b of the bluff body and the mean flow velocity v :

$$f = (S \cdot v) / b$$

The vortex frequency is recorded at the sensor and evaluated at the converter.



Functional principle

Flow Measurement

SITRANS F X

SITRANS FX330

Technical data

Range of application	Flow measurement of liquids, gases and vapors	
Mode of operation	Karman vortex street	
Measuring principle	Volume flow	
Primary measured value	Mass flow	
	Corrected volume flow	
	Density	
	Temperature	
	Pressure	
	Heat energy	
Design		
Transmitter	Cable length up to 50 m (164 ft)	
Compact and remote version		
Sensor	Flanged version	Sandwich version
Integrated temperature measurement	•	•
Reduction of nominal diameter	•	
Pressure and temperature compensation	•	•
Isolation valve	•	•
Dual measuring device	• ¹⁾	
	¹⁾ Only available as PVR (product variant request - special request)	
Display	4-line graphical display (backlit) with control keys	
Operation	Via local display (languages: German, English, French)	
	Via SIMATIC PDM	
Accuracy		
Volume flow		
Liquids		
- Re ≥ 20 000	± 0.75 % of measured value	
- 10000 < Re < 20 000	± 2.0 % of measured value	
Gases and vapors		
- Re ≥ 20 000	± 1.0 % of measured value	
- 10000 < Re < 20 000	± 2.0 % of measured value	
Mass flow/Corrected volume flow		
Gases and vapors		
- Re ≥ 20 000	± 1.5 % of measured value	
- 10000 < Re < 20 000	± 2.5 % of measured value	
Mass flow		
Liquids/water		
- Re ≥ 20 000	± 1.5 % of measured value	
- 10000 < Re < 20 000	± 2.5 % of measured value	
Repeatability (Volume flow)	± 0.1 % of measured value	

Operating conditions

Temperature ratings	
Medium	-40 +240 °C (-40 +465 °F)
Ambient	
- Non-Ex	-40 +85 °C (-40 +185 °F)
- Ex	-40 +65 °C (-40 +140 °F)
Storage	-50 +85 °C (-58 +185 °F)
Pressure ratings	Max. 100 bar (1450 psi), higher pressure rates on request
Max. allowable test pressure	
With integrated pressure sensor and isolation valve (closed)	1.5 x PN
With integrated pressure sensor and without isolation valve	2 times the measuring range of pressure sensor
Process medium	
Density	Taken into consideration when sizing
Viscosity	< 10 cP
Reynold s number	> 10000
Recommended flow velocities	
Liquids	0.25 ... 7 m/s (0.82 ... 23 ft/s)
Gases and vapors	2.0 ... 80 m/s (6.6 ... 262.5 ft/s)
DN 15:	3.0 ... 45 m/s (9.8 ... 148 ft/s)
DN 25:	2.0 ... 70 m/s (6.6 ... 230 ft/s)
	For detailed information see operating instructions "Intended use"
Installation conditions	
Inlet run	
For undisturbed flow profile, after pipe section with reducer, after 1 x 90° pipe bend	≥ 15 x DN
After 2 x 90° pipe bend	≥ 30 x DN
After 2 x 90° three-dimensional pipe bend	≥ 40 x DN
After control valves	≥ 50 x DN
Before flow conditioner	≥ 2 x DN
After flow conditioner	≥ 8 x DN
Outlet run	≥ 5 x DN
Material	
Sensor and process connections	
Standard	1.4404/316L
Option	Hastelloy C22 (on request)
Transmitter housing	
Standard	Aluminum die-cast, two-layer coating (epoxy/polyester)
Option	Die-cast aluminum with finish for advanced requirements
Pressure sensor gasket	
Standard	FPM
Option	FFKM
Sensor gasket (Pick-up)	
Standard	1.4435/316L
Option	Hastelloy C276
Process connections	
DIN EN 1092-1	DN 15 ... DN 300/PN 16 ... PN 100
ANSI B16.5	½" ... 12"/150 ... 600 lb
	For valid combinations of connection size and pressure rating see table "Sensor variants"

Enclosure rating	
Standard	Compact and remote version: IP66/IP67
Option	Remote version: IP66/IP68 for sensor
Power supply	
Non-Ex version	12 ... 36 V DC
Ex version	12 ... 30 V DC
Inputs/Outputs	
Current output	4 ... 20 mA, HART
Binary output	Pulse/Frequency/Status/Limit switch
Current input	4 ... 20 mA, passive
Communication	HART 7
Calibration	
Standard calibration	3-point calibration: 3 x 15 %, 3 x 50 %, 3 x 80 %
Special calibration	5-point calibration: 3 x 15 %, 3 x 30 %, 3 x 50 %, 3 x 60 %, 3 x 80 %
Certificates and approvals	
Ex approvals	ATEX, QPS, IECEx
CE declaration of conformity	PED 2014/68/EU EMC 2014/30/EU
Safety integration level (SIL)	SIL2 according to IEC 61508

Flow Measurement SITRANS F X

SITRANS FX330

Available combinations of sensor and connection size for SITRANS FX330 in flanged design are shown in the table below.

Sensor size	Connection size	EN 1092-1, Form B1/B2, PN 10	EN 1092-1, Form B1/B2, PN 16	EN 1092-1, Form B1/B2, PN 25	EN 1092-1, Form B1/B2, PN 40	EN 1092-1, Form B1/B2, PN 63	EN 1092-1, Form B1/B2, PN 100	ANSI B16.5, Class 150	ANSI B16.5, Class 300	ANSI B16.5, Class 600
SITRANS FX330 Flanged (7ME2610-...)										
DN 15	DN 15	-	-	-	●	-	●	●	●	●
	DN 25	-	-	-	●	-	●	●	●	●
	DN 40	-	-	-	●	-	●	●	●	●
DN 25	DN 25	-	-	-	●	-	●	●	●	●
	DN 40	-	-	-	●	-	●	●	●	●
	DN 50	-	●	-	●	●	●	●	●	●
DN 40	DN 40	-	-	-	●	-	●	●	●	●
	DN 50	-	●	-	●	●	●	●	●	●
	DN 80	-	●	-	●	●	●	●	●	●
DN 50	DN 50	-	●	-	●	●	●	●	●	●
	DN 80	-	●	-	●	●	●	●	●	●
	DN 100	-	●	-	●	●	●	●	●	●
DN 80	DN 80	-	●	-	●	●	●	●	●	●
	DN 100	-	●	-	●	●	●	●	●	●
	DN 150	-	●	-	●	●	●	●	●	●
DN 100	DN 100	-	●	-	●	●	●	●	●	●
	DN 150	-	●	-	●	●	●	●	●	●
	DN 200	●	●	●	●	-	-	●	●	-
DN 150	DN 150	-	●	-	●	●	●	●	●	●
	DN 200	●	●	●	●	-	-	●	●	-
	DN 250	●	●	●	●	-	-	●	●	-
DN 200	DN 200	●	●	●	●	-	-	●	●	-
	DN 250	●	●	●	●	-	-	●	●	-
	DN 300	●	●	●	●	-	-	●	●	-
DN 250	DN 250	●	●	●	●	-	-	●	●	-
	DN 300	●	●	●	●	-	-	●	●	-
DN 300	DN 300	●	●	●	●	-	-	●	●	-

● available
- not available



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