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РАСХОДОМЕРЫ ВИХРЕВЫЕ OPTISWIRL 4200



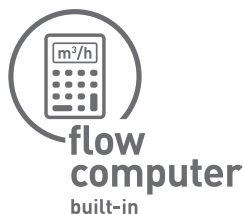
1.1 The all-in-one solution

Vortex flowmeters are suitable for a wide range of media. This is particularly true for the OPTISWIRL 4200. Its capability to master even fluctuating pressures and temperatures turns it into an ideal all-rounder for the measurement of energy carriers in auxiliary and supply processes.

Already the basic version of the **OPTISWIRL 4200** is equipped with a temperature compensation for saturated steam applications. With the optional pressure sensor the flowmeter has an integrated density compensation available, which even allows an exact measurement of gases and superheated steam with varying process conditions. The additional integrated gross and net heat measurement makes this flowmeter to be a reliable partner for advanced energy management systems.

With the innovative AVFD (Advanced Vortex Frequency Detection) the OPTISWIRL 4200 is fitted with an up-to-date signal filter. It analyses the measured signal and eliminates interferences and perturbations. Thereby, stable measurements can even be realised under demanding process conditions.

This vortex flowmeter was designed for the safety-related applications from the very beginning. It was developed according to the standard IEC 61508 edition 2. The certification is effected within the scope of a full assessment by TÜV Sued. Thereby the flowmeter can be used for continuous volume flow measurement in safety-related applications with classification SIL 2/3.



Flow computer built-in

Many KROHNE flowmeters have a built-in flow computer that compensates for the effects of pressure and temperature on the flow measurement or to convert to standard volume. The OPTISONIC 7300/8300 have analogue input for P & T sensors, the OPTISWIRL 4200 has both integrated. This saves both cost and installation efforts for an external flow computer.

Highlights

- Development according to IEC 61508, edition 2
- Advanced technology for signal filtering - AVFD (Advanced Vortex Frequency Detection)
- Integrated pressure and temperature compensation
- Temperature compensation for saturated steam included as standard
- Integrated gross and net heat calculation for steam and hot water
- Comprehensive communication options
- Remote version with field housing converter with cable length up to 50 m / 164 ft
- Integrated reduction of nominal size
- Measurement of conductive and non-conductive liquids, gases and steam
- Communication options: 4...20 mA/HART®, Profibus PA and Foundation Fieldbus

Industries

- Chemicals
- Oil & Gas
- Power plants
- Food & Beverage
- Pharmaceuticals
- Iron, Steel and Metals
- Pulp & Paper
- Water

Applications

- 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
- Safety-related measurement in SIL applications (SIL 2/3)

1.2 Options and variants

1. The universal device with temperature compensation for saturated steam integrated as standard



The **OPTISWIRL 4200 C** as compact flowmeter in a flange version is suitable for universal use in measuring liquids, gases and vapours.

The temperature compensation for saturated steam is integrated as standard, thus enabling direct compensation of the density; the mass and energy can also be measured.

The advanced signal filter technology AVFD (Advanced Vortex Frequency Detection) complements the high accurate measurement.

2. The easy to install sandwich version with optimised centering rings



The **OPTISWIRL 4200 C** as a compact flowmeter in a sandwich version is suitable for universal use in the measurement of liquids, gases and vapours.

The temperature compensation for saturated steam is integrated as standard.

The flowmeter is provided with additional optimised centering rings. The vortex flowmeter can be aligned centrally by turning the centering rings, eliminating any offset between the flowmeter and the pipeline.

3. The one-of-a-kind 2-wire device with integrated pressure and temperature compensation



The **OPTISWIRL 4200** as a flange or sandwich flowmeter is optionally available with integrated pressure and temperature compensation for gases, wet gases, gas mixtures or steam.

The advantage of this unique design couldn't be clearer:

- No additional cost-intensive installation of pressure and temperature sensors
- No additional cabling work
- No faulty measurement results, because pressure, temperature and volume flow can be read at a single point
- Direct measurement of mass and/or energy

4. Vortex flowmeter with shut-off valve for the pressure measurement



As an option, the **OPTISWIRL 4200** can be supplied with a shut-off valve to allow the pressure sensor to be exchanged without interrupting the process.

What is more, the pressure sensor can be shut off for the purpose of pressure or leak testing of the pipeline.

5. Dual measurement for twofold reliability



The **OPTISWIRL 4200** is optionally available as a dual version.

This is a genuine redundant system with two independent flow sensors and two signal converters. This provides twofold functional reliability and availability of the measurement.

This variant is ideally suited for measurements in multi-product pipelines. In such pipelines, two different products are moved through one after the other.

One signal converter can be programmed for one product, and the other signal converter for the other product.

As homogeneous redundant measurement system the dual version fulfills all requirements for the use in SIL 3 applications.

6. The OPTISWIRL 4200 F as remote version



The **OPTISWIRL 4200** is also available as a remote version with field housing converter.

This feature allows separating the signal converter from the flow sensor up to a distance of 50 m / 164 ft, in case the flow sensor is mounted in inaccessible areas.

The remote mounted signal converter allows easy operation and reading of values at eye level.

Additionally to the flow rates, measurements of the integrated pressure and temperature sensors can be displayed.

7. OPTISWIRL 4200 F1R / F2R with integrated nominal diameter reduction



The **OPTISWIRL 4200 F1R / F2R** with integrated nominal diameter reduction up to two nominal diameter sizes assures best results in accuracy and optimal measuring ranges even in pipelines with large diameters, which have been designed for a 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.

8. OPTISWIRL 4200 with converter housing in stainless steel



The **OPTISWIRL 4200** with stainless steel housing are suitable for very harsh environmental conditions or in applications where resistance to chemical cleaning agents is required.

Consequently, the operating conditions here include outdoor use in offshore applications as well as in food or pharmaceutical production thanks to the IP66 and IP68 protection class.

High-pressure cleaning is also possible with the option of IP69K protection class.

1.3 Devices with integrated nominal diameter reduction

The device versions F1R and F2R offer an integrated nominal diameter reduction up to two nominal diameter sizes to assure best results in accuracy and optimum measuring ranges; even in pipelines with large diameters, which have been designed for a low pressure loss.

Nominal diameter of flow sensor	Nominal size of process connections									
	DN15	DN25	DN40	DN50	DN80	DN100	DN150	DN200	DN250	DN300
DN15	StV ①	F1R	F2R	-	-	-	-	-	-	-
DN25	-	StV ①	F1R	F2R	-	-	-	-	-	-
DN40	-	-	StV ①	F1R	F2R	-	-	-	-	-
DN50	-	-	-	StV ①	F1R	F2R	-	-	-	-
DN80	-	-	-	-	StV ①	F1R	F2R	-	-	-
DN100	-	-	-	-	-	StV ①	F1R	F2R	-	-
DN150	-	-	-	-	-	-	StV ①	F1R	F2R	-
DN200	-	-	-	-	-	-	-	StV ①	F1R	F2R
DN250	-	-	-	-	-	-	-	-	StV ①	F1R
DN300	-	-	-	-	-	-	-	-	-	StV ①

Table 1-1: Integrated nominal diameter reduction

① Standard version

1.4 Functional principle

Vortex flowmeters are used to measure the flow of gases, vapours and liquids at completely filled pipes.

The measuring principle is based on the Karman vortex street. The measuring tube contains a bluff body at which vortex shedding occurs and which is detected by a sensor unit located behind. The frequency f of the vortex shedding is proportional to the flow velocity v . The non-dimensional Stouhal number S describes the relationship between vortex frequency f , width b of the bluff body and the average flow velocity v :

$$f = \frac{S \cdot v}{b}$$

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

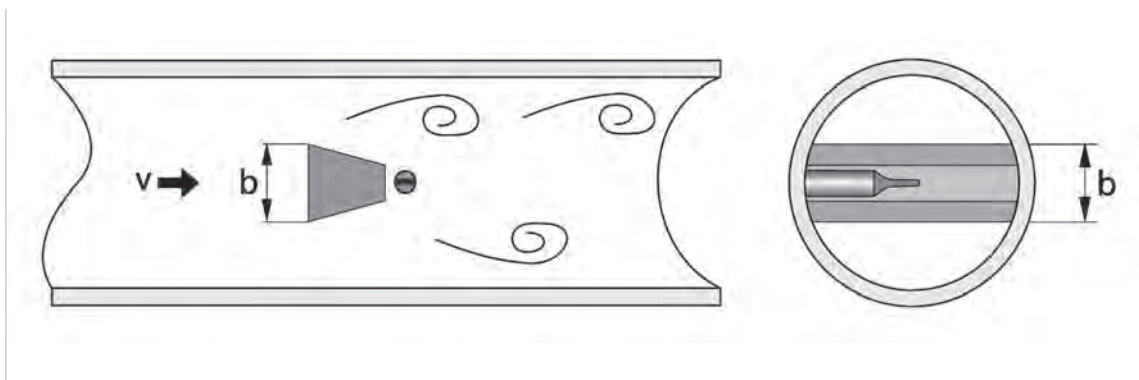


Figure 1-1: Functional principle

2.1 Technical data

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).*

Measuring system

Application range	Flow measurement of liquids, gases and vapours
Function / Measuring principle	Karman vortex street
Measurement	
Primary measured value	Number of separated vortices
Secondary measured value	Operating and standard volume flow and mass flow
Signal converter	
Versions	Compact version
	Remote version
Weather protection cover	Optional available cover to protect the signal converter housing against intense solar radiation or vandalism
Flow sensor	
Standard	Flange version (with integrated temperature measurement), flow sensor: F
	Sandwich version (with integrated temperature measurement), flow sensor: S
Option	Basic device with additional pressure measurement
	Basic device with additional pressure measurement and shut-off valve for pressure sensor
	Dual measuring device in both flange and sandwich version (redundant measurement)
	Dual measuring device with additional pressure measurement
	Flange version with single reduction of nominal diameter, flow sensor: F1R
	Flange version with double reduction of nominal diameter, flow sensor: F2R
Display and user interface	
Local display	Graphic display
Interface and display languages	The availability is depending on the language package and the communication options. German, English, French, Italian, Spanish, Russian, Chinese, Swedish, Danish, Czech, Polish, Turkish, Slovenian
Communication interfaces	HART [®] , Foundation Fieldbus and Profibus PA

Measuring accuracy

Reference condition	
Reference conditions	Water at +20°C / +68°F
	Air at +20°C / +68°F and 1.013 bara / 14.7 psia
Maximum measuring error	
Volume flow (liquid)	±0.75% of measured value (Re ≥ 20000)
	±2.0% of measured value (10000 < Re < 20000)
Volume flow (gases and steam)	±1.0% of measured value (Re ≥ 20000)
	±2.0% of measured value (10000 < Re < 20000)
Mass flow (gases and steam)	±1.5% of measured value (Re ≥ 20000) ①
	±2.5% of measured value (10000 < Re < 20000) ①
Mass flow (liquid / water)	±1.5% of measured value (Re ≥ 20000)
	±2.5% of measured value (10000 < Re < 20000)
Normalised volume flow (gas)	±1.5% of measured value (Re ≥ 20000) ①
	±2.5% of measured value (10000 < Re < 20000) ①
Repeatability (volume flow)	±0.1% of measured value
① The maximum error of measurement refers to measurement at an operating pressure >65% of the full scale value of the applied pressure sensor.	
Note: In SIL mode, deviating measuring errors have to be taken into account. For details refer to the "Safety Manual".	

Operating conditions

Temperature	
Medium temperature	-40...+240°C / -40...+465°F
Ambient temperature ②	Non-Ex: -40...+85°C / -40...+185°F
	Ex: -40...+65°C / -40...+140°F
Storage temperature	-40...+85°C / -40...+185°F
② Decreasing display contrast outside of the temperature range of 0...+60°C / +32...+140°F.	
Pressure	
Medium pressure	Max. 100 bar / 1450 psi (higher pressures on request)
Ambient pressure	Atmosphere: altitude up to 4000 m / 13123 ft above sea level
Media properties	
Density	Taken into consideration when sizing.
Viscosity	< 10 cP
Reynold's number	> 10000
Other conditions	
Use	Indoor / Outdoor
Humidity	Annual average ≤ 90% RH (no condensation)

Recommended flow velocities	
Liquids ③, ④	0.3...7 m/s / 0.98...23 ft/s (optional up to 10 m/s / 32.8 ft/s taking cavitation into account)
Gases and steam ③	2.0...80 m/s / 6.6...262.5 ft/s
	DN15: 3.0...45 m/s / 9.8...148 ft/s; DN25: 2.0...70 m/s / 6.6...230 ft/s
③ These values represent the absolute limits of flow velocities. For more detailed information for your specific application refer to <i>Intended use</i> on page 30.	
④ $v_{\min} = 0.7 \text{ m/s} / 2.3 \text{ ft/s}$ in SIL mode	
Other conditions	
Ingress protection	Compact version: Signal converter in aluminium housing, IP66/67 Signal converter in stainless steel housing, IP66, IP68, IP69K
	Remote version: Signal converter in aluminium housing, IP66/67; flow sensor housing, IP66/67 Signal converter in stainless steel housing, IP66, IP68, IP69K; flow sensor housing, IP66, IP68, IP69K

Installation conditions

Inlet section	≥ 15 DN without disturbing flow
	≥ 20 DN after a pipe diameter reduction
	≥ 20 DN after a single bend 90°
	≥ 30 DN after a double bend 2 x 90°
	≥ 40 DN after a double three-dimensional bend 2 x 90°
	≥ 50 DN after a control valve
	≥ 2 DN before a flow straightener; ≥ 8 DN after a flow straightener
Outlet section	≥ 5 x DN

Materials

Flow sensor and process connections	Standard: 1.4404 / 316L
	Option: Hastelloy® C-22 on request
Electronics housing	Aluminium die-cast, two-layer coating (epoxy/polyester)
	Option: 1.4409 / 316L / A 351-CF3M
	Option: die-cast aluminium with finish for advanced requirements
Pressure sensor gasket	Standard: FPM
	Option: FFKM
Measuring tube gasket (Pick-up)	Standard: 1.4435 / 316L
	Option: Hastelloy® C-276
	Selection depends on flow sensor material / medium.

Process connections

Flange version	
DIN EN 1092-1	DN15...300, PN16...100 (higher pressures on request)
ASME B16.5	1/2...12", 150...600 lb (higher pressures on request)
JIS B2220	DN15...300, 10...20 K (higher pressures on request)
For detailed information on combination flange/pressure rating, refer to section "Dimensions and weights".	

Sandwich version	
DIN	DN15...100, PN100 (higher pressures on request)
ASME	1/2...4", 600 lb (higher pressures on request)
JIS	DN15...100, 10...20 K (higher pressures on request)

Electrical connections

Power supply (current output version)	The power supply has to be able to supply a minimum of 22 mA.
	Non-Ex: 12...36 VDC
	Ex i: 12...30 VDC
	Ex d: 12...32 VDC
Connection terminals	For wire cross-sections 0.5...2.5 mm ²
	Fastening torque: 0.6 N
Cable entries	Standard: M20 x 1.5
	Option: 1/2 NPT and G1/2 adapters
Connecting cable	Only for remote versions.
	Cable length: ≤ 50 m / 164 ft

Inputs and outputs

General	All inputs and outputs are electrically isolated from each other and from all other circuits.
Time constant	The time constant corresponds to 63% of the elapsed time of a processor procedure. 0...100 seconds (rounded up to 0.1 seconds)
Current output	
Type	4...20 mA HART® (passive)
Output data	Volume flow, mass flow, norm. volume flow, gross/net power, free air delivery, density, temperature (internal sensor), pressure, vortex frequency, flow velocity
Resolution	5 µA
Linearity / accuracy	0.1% (of read value)
Temperature coefficient	50 ppm/K (typically), 100 ppm/K (max.)
Error signal	According to NE 43
Description of abbreviations	U_{ext} = external voltage; R_L = load + resistance
Load	Minimum 0 Ω; maximum $R_L = [(U_{ext} - 12 \text{ VDC}) / 22 \text{ mA}]$
HART®	
General	HART® protocol via passive current output
HART® revision	HART® 7; Burst mode; Catch device
System requirements	Load min. 250 Ω
Multidrop operation	4 mA
Binary output	
Function	Pulse output, frequency output, status output, limit switch
Type	Passive
	Proximity sensor according to DIN EN 60947-5-6 (NAMUR sensor) or pulse output signal according to VDI/VDE 2188 (category 2)
Temperature coefficient	50 ppm/K
Residual current	< 0.2 mA at 32 V ($R_i = 180 \text{ k}\Omega$)
Pulse width	0.5...2000 ms

Pulse output	
Output data	Volume, mass, norm. volume, gross/net energy
Pulse rate	Max. 1000 pulses/s
Power supply	Non-Ex: 24 VDC as NAMUR or open < 1 mA, maximum 36 V, closed 120 mA, U < 2 V
	Ex: 24 VDC as NAMUR or open < 1 mA, maximum 30 V, closed 120 mA, U < 2 V
Frequency output	
Output data	Volume flow, mass flow, norm. volume flow, gross/net power, free air delivery, density, temperature (internal sensor or via external input), pressure, vortex frequency, flow velocity, spec. enthalpy, spec. heat capacity, Reynolds number
Max. frequency	1000 Hz
Status output	
Output data	Status according to NE 107 (F, S, C), flow totalizer overflow, energy totalizer overflow, fluid type (in steam applications)
Limit switch	
Output data	Volume flow, mass flow, norm. volume flow, volume, mass, norm. volume, gross/net power, gross/net energy, free air delivery, density, temperature (internal sensor or via external input), pressure, vortex frequency, flow velocity, spec. enthalpy, spec. heat capacity, Reynolds number
Current input	
Type	4...20 mA (passive)
Resolution	6 µA
Linearity / accuracy	0.1% (of read value)
Temperature coefficient	100 ppm/K (typically), 200 ppm/K (max.)
Voltage drop	10 V

Communication interface

Profibus PA	
Description	Galvanically isolated according to IEC 61158-2
	Profile version: 3.02
	Current consumption: 16 mA
	Permissible bus voltage: 9...32 V; intrinsically safe: 9...24 V
	Independent of polarity at electrical connection
	Typical error current FDE (Fault Disconnection Electronic): 6 mA
	Bus address adjustable via local display at the measuring device
Function blocks	5 x analog input (AI), 2 x totaliser, 1 x analog output (AO)
Output data	Volume flow, norm. volume flow, mass flow, gross/net power, FAD, density, temperature 1, temperature 2, pressure, vortex frequency, velocity, specific enthalpy, specific heat capacity, Reynolds number, diagnostic data

Foundation Fieldbus	
Description	Galvanically isolated according to IEC 61158-2
	Current consumption: 16 mA
	Permissible bus voltage: 9...32 V; intrinsically safe: 9...24 V
	Bus interface with integrated reverse polarity protection
	Link Master function (LM) supported
	Tested with Interoperable Test Kit (ITK) version 6.1
Function blocks	5 x analog input (AI), 2 x Integrator (IT), 1 x PID, 1 x analog output (AO)
Output data	Volume flow, mass flow, norm. volume flow, corrected volume flow, temperature 1, temperature 2, pressure, density, velocity, gross power, net power, FAD, vortex frequency, Reynolds number, specific heat capacity, specific enthalpy, sensor electronics temperature, converter electronics temperature, diagnostic data

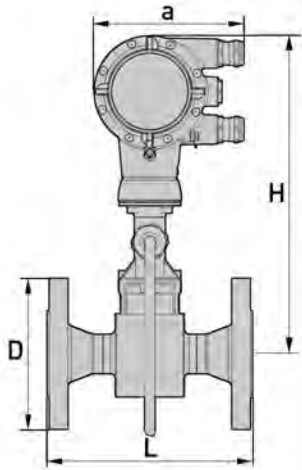
Approvals and certificates

Declaration of conformity	This device fulfils the statutory requirements of the relevant directives. The manufacturer certifies successful testing of the product by applying the conformity mark on the device.
	For full information of the directives and standards and the approved certifications, please refer to the declaration of conformity which can be downloaded from the manufacturer's website.
Standard version	Non-Ex
Functional safety according to IEC 61508	Depends on I/O variant and flow sensor. For detailed information refer to the "Safety manual".
Hazardous areas	
ATEX	ATEX II2 G - Ex ia IIC T6...T2 Gb ATEX II2 G - Ex d ia IIC T6...T2 Gb (not for signal converter in stainless steel housing) ATEX II3 G - Ex nA IIC T6...T2 Gc (not for signal converter in stainless steel housing) ATEX II2 D - Ex tb IIIC T70 Db (not for signal converter in stainless steel housing)
IECEX	IECEX - Ex ia IIC T6...T2 Gb IECEX - Ex d ia IIC T6...T2 Gb (not for signal converter in stainless steel housing) IECEX - Ex nA IIC T6...T2 Gc (not for signal converter in stainless steel housing) IECEX - Ex tb IIIC T70°C Db (not for signal converter in stainless steel housing)
QPS (USA & Canada)	QPS IS Class I Div 1 QPS XP Class I Div 1 (not for signal converter in stainless steel housing) QPS NI Class I Div 2 (not for signal converter in stainless steel housing) QPS DIP Class II, III Div 1 (not for signal converter in stainless steel housing)
Other standards and approvals	
QPS (USA & Canada)	QPS Ordinary Locations
NAMUR	NE 06, NE 21, NE 23, NE 32, NE 43, NE 53, NE 107
Further approvals on request.	

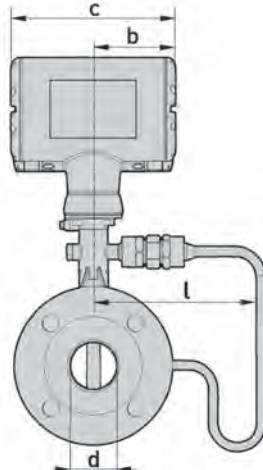
2.2 Dimensions and weights

2.2.1 Flange versions

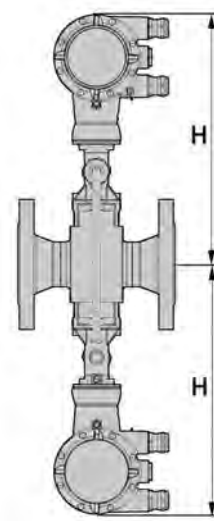
Flange version EN 1092-1



a = 148.5 mm / 5.85"



b = 85.8 mm / 3.38"
c = 171.5 mm / 6.76"



Option:
Version with two signal converter

Nominal size DN	Pressure rating PN	d	D	L	H	H F1R ①	H F2R ②	l	l F1R ①	l F2R ②
15	40	17.3	95	200	358.8	-	-	169.3	-	-
15	100	17.3	105	200	358.8	-	-	169.3	-	-
25	40	28.5	115	200	358.3	358.8	-	169.3	169.3	-
25	100	28.5	140	200	358.3	358.8	-	169.3	169.3	-
40	40	43.0	150	200	362.3	358.3	358.8	169.5	169.3	169.3
40	100	42.5	170	200	362.3	358.3	358.8	169.5	169.3	169.3
50	16	54.5	165	200	368.3	362.3	358.3	169.5	169.5	169.3
50	40	54.5	165	200	368.3	362.3	358.3	169.5	169.5	169.3
50	63	54.5	180	200	368.3	362.3	358.3	169.5	169.5	169.3
50	100	53.9	195	200	368.3	362.3	358.3	169.5	169.5	169.5
80	16	82.5	200	200	380.3	368.3	362.3	169.3	169.5	169.5
80	40	82.5	200	200	380.3	368.3	362.3	169.3	169.5	169.5
80	63	81.7	215	200	380.3	368.3	362.3	169.3	169.5	169.5
80	100	80.9	230	200	380.3	368.3	362.3	169.3	169.5	169.5
100	16	107	220	250	396.8	380.3	368.3	171.5	169.3	169.5
100	40	107	235	250	396.8	380.3	368.3	171.5	169.3	169.5
100	63	106.3	250	250	396.8	380.3	368.3	171.5	169.3	169.5
100	100	104.3	265	250	396.8	380.3	368.3	171.5	169.3	169.5
150	16	159.3	285	300	416.3	396.8	380.3	191.5	171.5	169.3

Nominal size DN	Pressure rating PN	d	D	L	H	H F1R ①	H F2R ②	l	l F1R ①	l F2R ②
150	40	159.3	300	300	416.3	396.8	380.3	191.5	171.5	169.3
150	63	157.1	345	300	416.3	396.8	380.3	191.5	171.5	169.3
150	100	154.1	355	300	416.3	396.8	380.3	191.5	171.5	169.3
200	10	206.5	340	300	442.1	416.3	396.8	202.8	191.5	171.5
200	16	206.5	340	300	442.1	416.3	396.8	202.8	191.5	171.5
200	25	206.5	360	300	442.1	416.3	396.8	202.8	191.5	171.5
200	40	206.5	375	300	442.1	416.3	396.8	202.8	191.5	171.5
250	10	260.4	395	380	468.8	442.1	416.3	229.5	202.8	191.5
250	16	260.4	405	380	468.8	442.1	416.3	229.5	202.8	191.5
250	25	258.8	425	380	468.8	442.1	416.3	229.5	202.8	191.5
250	40	258.8	450	380	468.8	442.1	416.3	229.5	202.8	191.5
300	10	309.7	445	450	492.8	468.8	442.1	255	229.5	202.8
300	16	309.7	460	450	492.8	468.8	442.1	255	229.5	202.8
300	25	307.9	485	450	492.8	492.8	442.1	255	229.5	202.8
300	40	307.9	515	450	492.8	492.8	442.1	255	229.5	202.8

Table 2-1: Dimensions of flange version EN 1092-1 [mm]

① F1R - single reduction

② F2R - double reduction

Nominal size DN	Pressure rating PN	with	without	F1R ① with	F1R ① without	F2R ② with	F2R ② without
		Pressure sensor		Pressure sensor		Pressure sensor	
15	40	6.1	5.5	-	-	-	-
15	100	7.1	6.5	-	-	-	-
25	40	7.9	7.3	7.2	6.6	-	-
25	100	9.9	9.3	9.7	9.1	-	-
40	40	10.8	10.2	9.7	9.1	8.9	8.3
40	100	14.8	14.2	13.3	12.7	12.5	11.9
50	16	12.7	12.1	11.4	10.8	10.6	10.0
50	40	12.9	12.3	11.9	11.3	11.2	10.6
50	63	16.9	16.3	15.0	14.4	14.3	13.7
50	100	18.4	17.8	17.2	16.6	16.6	16.0
80	16	17.4	16.8	15.6	15.0	14.2	13.6
80	40	19.4	18.8	17.1	16.5	15.8	15.2
80	63	23.4	22.8	20.3	19.7	19.0	18.4
80	100	27.4	26.8	24.0	23.4	22.8	22.2
100	16	22.0	21.4	21.5	20.9	18.7	18.1
100	40	25.0	24.4	24.9	24.3	22.1	21.5
100	63	30.0	29.4	30.1	29.5	27.4	26.8
100	100	36.0	35.4	36.7	36.1	34.0	33.4
150	16	35.8	35.2	33.9	33.3	32.3	31.7
150	40	41.8	41.2	41.4	40.8	40.2	39.6
150	63	59.8	59.2	58.3	57.7	59.0	58.4
150	100	67.8	67.2	69.2	68.6	70.8	70.2
200	10	38.4	37.8	40.7	40.1	43.1	42.5
200	16	38.4	37.8	40.3	39.7	44.3	43.7
200	25	47.4	46.8	49.5	48.9	50.8	50.2
200	40	55.4	54.8	58.0	57.4	58.5	57.9
250	10	58.0	57.4	63.1	62.5	59.8	59.2
250	16	59.0	58.4	64.7	64.1	61.5	60.9
250	25	75.0	74.4	78.5	77.9	76.8	76.2
250	40	93.0	92.4	96.3	95.7	96.1	95.5
300	10	76.3	75.7	81.1	80.5	85.8	85.2
300	16	82.8	82.2	87.6	87.0	92.9	92.3
300	25	99.3	98.7	105.1	104.5	113.0	112.4
300	40	128.1	127.5	132.0	131.4	143.2	142.6

Weight specifications for version with two signal converters + 3.2 kg / 7.05 lb

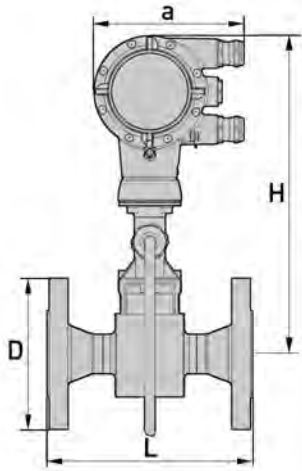
Table 2-2: Weight of flange version EN 1092-1 with signal converter in aluminium housing [kg]

① F1R - single reduction

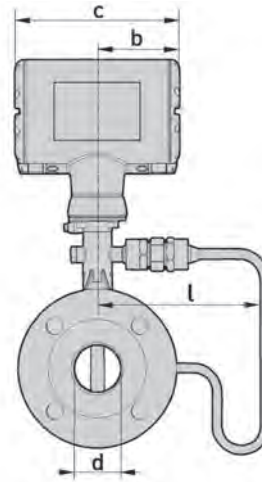
② F2R - double reduction

Weight for signal converter in stainless steel housing:
values of table above + 3 kg

Flange version ASME B16.5, metric



a = 148.5 mm / 5.85"



b = 85.8 mm / 3.38"
c = 171.5 mm / 6.76"

Nominal size NPS	Pressure rating Class	d	D	L	H	H F1R ①	H F2R ②	l	l F1R ①	l F2R ②
1/2	150	16	90	200	358.8	-	-	169.3	-	-
1/2	300	16	95	200	358.8	-	-	169.3	-	-
1/2	600	16	95	200	358.8	-	-	169.3	-	-
1	150	26.6	110	200	358.3	358.8	-	169.3	169.3	-
1	300	26.6	125	200	358.3	358.8	-	169.3	169.3	-
1	600	24	125	200	358.3	358.8	-	169.3	169.3	-
1 1/2	150	41	125	200	362.3	358.3	358.8	169.5	169.3	169.3
1 1/2	300	41	155	200	362.3	358.3	358.8	169.5	169.3	169.3
1 1/2	600	41	155	200	362.3	358.3	358.8	169.5	169.3	169.3
2	150	52.5	150	200	368.3	362.3	358.3	169.5	169.5	169.3
2	300	52.5	165	200	368.3	362.3	358.3	169.5	169.5	169.3
2	600	49.2	165	200	368.3	362.3	358.3	169.5	169.5	169.3
3	150	77.9	190	200	380.3	368.3	362.3	169.3	169.5	169.5
3	300	77.9	210	200	380.3	368.3	362.3	169.3	169.5	169.5
3	600	74.0	210	200	380.3	368.3	362.3	169.3	169.5	169.5
4	150	102.3	230	250	396.8	380.3	368.3	171.5	169.3	169.5
4	300	102.3	255	250	396.8	380.3	368.3	171.5	169.3	169.5
4	600	97.0	275	250	396.8	380.3	368.3	171.5	169.3	169.5
6	150	154.1	280	300	416.3	396.8	380.3	191.5	171.5	169.3
6	300	154.1	320	300	416.3	396.8	380.3	191.5	171.5	169.3
6	600	146.0	355	300	416.3	396.8	380.3	191.5	171.5	169.3
8	150	202.7	345	300	442.1	416.3	396.8	202.8	191.5	171.5
8	300	202.7	380	300	442.1	416.3	396.8	202.8	191.5	171.5
10	150	254.6	405	380	468.8	442.1	416.3	229.5	202.8	191.5

Nominal size NPS	Pressure rating Class	d	D	L	H	H F1R ①	H F2R ②	l	l F1R ①	l F2R ②
10	300	254.6	455	380	468.8	442.1	416.3	229.5	202.8	191.5
12	150	300.0	485	450	492.8	468.8	442.1	255.0	229.5	202.8
12	300	300.0	520	450	492.8	468.8	442.1	255.0	229.5	202.8

Table 2-3: Dimensions of flange version ASME B16.5 [mm]

① F1R - single reduction

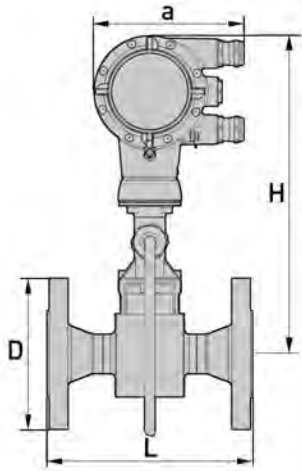
② F2R - double reduction

Nominal size NPS	Pressure rating Class	with	without	F1R with	F1R without	F2R with	F2R without
		Pressure sensor		Pressure sensor		Pressure sensor	
1/2	150	5.1	4.5	-	-	-	-
1/2	300	5.5	4.9	-	-	-	-
1/2	600	5.7	5.1	-	-	-	-
1	150	6.8	6.2	6.6	6.0	-	-
1	300	7.8	7.2	7.6	7.0	-	-
1	600	8.1	7.5	7.9	7.3	-	-
1 1/2	150	8.9	8.3	8.6	8.0	7.7	7.1
1 1/2	300	11.0	10.4	10.9	10.3	10.0	9.4
1 1/2	600	12.0	11.4	11.8	11.2	11.0	10.4
2	150	11.6	11.0	11.0	10.4	10.3	9.7
2	300	13.0	12.4	12.6	12.0	11.9	11.3
2	600	14.5	13.9	14.0	13.4	13.4	12.8
3	150	20.4	19.8	16.9	16.3	15.6	15.0
3	300	23.4	22.8	20.4	19.8	19.2	18.6
3	600	24.4	23.8	22.9	22.3	21.8	21.2
4	150	24.0	23.4	25.3	24.7	22.7	22.1
4	300	32.0	31.4	33.9	33.3	31.2	30.6
4	600	41.0	40.4	44.1	43.5	41.2	40.6
6	150	36.8	36.2	37.8	37.2	36.9	36.3
6	300	51.8	51.2	56.1	55.5	55.8	55.2
6	600	76.8	76.2	79.8	79.2	82.6	82.0
8	150	50.6	50.0	48.8	48.2	52.5	51.9
8	300	75.4	74.8	72.2	71.6	78.1	77.5
10	150	75.0	74.4	75.2	74.6	73.9	73.3
10	300	107.0	106.4	112.4	111.8	113.5	112.9
12	150	107.0	106.4	109.8	109.2	120.4	119.8
12	300	152.0	151.4	165.4	155.8	171.7	171.1

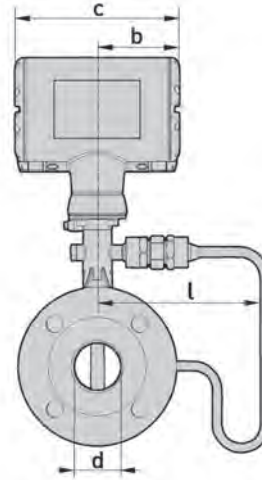
Table 2-4: Weight of flange version ASME B16.5 with signal converter in aluminium housing [kg]

Weight for signal converter in stainless steel housing:
values of table above + 3 kg

Flange version ASME B16.5, imperial



a = 148.5 mm / 5.85"



b = 85.8 mm / 3.38"
c = 171.5 mm / 6.76"

Nominal size NPS	Pressure rating Class	d	D	L	H	H F1R ①	H F2R ②	l	l F1R ①	l F2R ②
1/2	150	0.63	3.5	7.9	14.1	-	-	6.67	-	-
1/2	300	0.63	3.7	7.9	14.1	-	-	6.67	-	-
1/2	600	0.63	3.7	7.9	14.1	-	-	6.67	-	-
1	150	1.05	4.3	7.9	14.1	14.1	-	6.67	6.67	-
1	300	1.05	4.9	7.9	14.1	14.1	-	6.67	6.67	-
1	600	1.0	4.9	7.9	14.1	14.1	-	6.67	6.67	-
1 1/2	150	1.6	4.9	7.9	14.3	14.1	14.1	6.67	6.67	6.67
1 1/2	300	1.6	6.1	7.9	14.3	14.1	14.1	6.67	6.67	6.67
1 1/2	600	1.6	6.1	7.9	14.3	14.1	14.1	6.67	6.67	6.67
2	150	2.07	5.9	7.9	14.5	14.3	14.1	6.67	6.67	6.67
2	300	2.07	6.5	7.9	14.5	14.3	14.1	6.67	6.67	6.67
2	600	1.9	6.5	7.9	14.5	14.3	14.1	6.67	6.67	6.67
3	150	3.07	7.5	7.9	15.0	14.5	14.3	6.67	6.67	6.67
3	300	3.07	8.3	7.9	15.0	14.5	14.3	6.67	6.67	6.67
3	600	2.9	8.3	7.9	15.0	14.5	14.3	6.67	6.67	6.67
4	150	4.0	9.1	9.8	15.6	15.0	14.5	6.76	6.67	6.67
4	300	4.0	10	9.8	15.6	15.0	14.5	6.76	6.67	6.67
4	600	3.8	11	9.8	15.6	15.0	14.5	6.76	6.67	6.67
6	150	6.1	11	12	16.4	15.6	15.0	7.54	6.76	6.67
6	300	6.1	13	12	16.4	15.6	15.0	7.54	6.76	6.67
6	600	5.8	14	12	16.4	15.6	15.0	7.54	6.76	6.67
8	150	8.0	14	12	17.4	16.4	15.6	8.0	7.54	6.76
8	300	8.0	15	12	17.4	16.4	15.6	8.0	7.54	6.76
10	150	10	16	15	18.5	17.4	16.4	9.04	8.0	7.54

Nominal size NPS	Pressure rating Class	d	D	L	H	H F1R ①	H F2R ②	l	l F1R ①	l F2R ②
10	300	10	18	15	18.5	17.4	16.4	9.04	8.0	7.54
12	150	12	19	18	19.4	18.5	17.4	10.0	9.04	8.0
12	300	12	21	18	19.4	18.5	17.4	10.0	9.04	8.0

Table 2-5: Dimensions of flange version ASME B16.5 [inch]

① F1R - single reduction

② F2R - double reduction

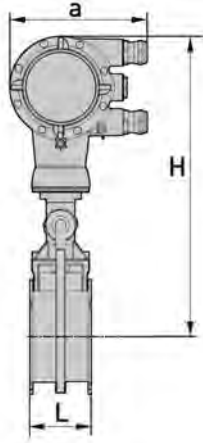
Nominal size NPS	Pressure rating Class	with	without	F1R with	F1R without	F2R with	F2R without
		Pressure sensor		Pressure sensor		Pressure sensor	
1/2	150	11	9.9	-	-	-	-
1/2	300	12	11	-	-	-	-
1/2	600	13	11	-	-	-	-
1	150	15	14	14.6	13.2	-	-
1	300	17	16	16.8	15.4	-	-
1	600	18	17	17.4	16.1	-	-
1 1/2	150	20	18	19.0	17.6	17.0	15.7
1 1/2	300	24.3	22.9	24.0	22.7	22.1	20.7
1 1/2	600	26.5	25.1	26.0	24.7	24.1	22.9
2	150	25.6	24.3	24.3	22.9	22.7	21.4
2	300	28.7	27.3	27.8	26.5	26.2	24.9
2	600	32.0	30.7	30.9	29.6	29.6	28.2
3	150	45.0	43.7	37.3	36.0	34.4	33.1
3	300	51.6	50.3	45.0	43.7	42.3	41.0
3	600	53.8	52.5	50.5	49.2	48.1	46.8
4	150	52.9	51.6	55.8	54.5	50.1	48.7
4	300	70.6	69.3	74.8	73.4	68.8	67.5
4	600	90.4	89.1	97.3	95.9	91.0	89.5
6	150	81.2	79.8	83.4	82.0	81.4	80.0
6	300	114.2	112.9	123.7	122.4	123.1	121.7
6	600	169.4	168.1	176	174.7	182.2	181.0
8	150	111.6	110.3	107.6	106.3	115.8	114.5
8	300	166.3	165.0	159.2	157.9	172.2	171.0
10	150	165.4	164.1	165.9	164.5	163.0	161.7
10	300	236.0	234.7	247.9	246.6	250.3	249.0
12	150	236.0	234.7	242.2	240.8	265.5	264.2
12	300	335.2	333.9	364.8	343.6	378.7	377.4

Table 2-6: Weight of flange version ASME B16.5 with signal converter in aluminium housing [lb]

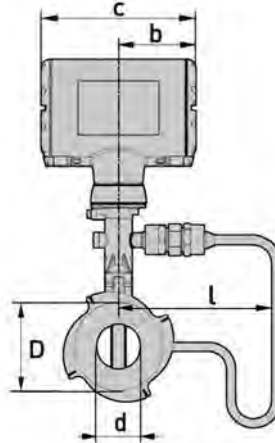
Weight for signal converter in stainless steel housing:
values of table above + 6.61 lb

2.2.2 Sandwich versions

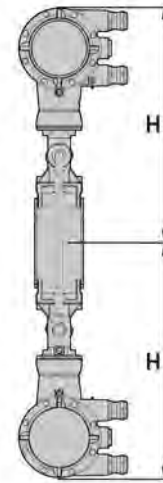
Sandwich version EN



a = 133 mm / 5.24"



b = 105 mm / 4.13"
c = 179 mm / 7.05"



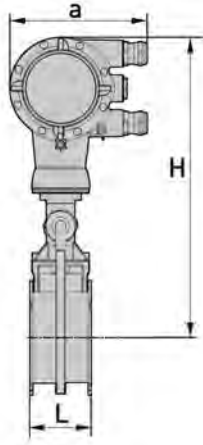
Dimension H x 2
Specified weight: + 2.8 kg / 6.2 lb

Nominal size	Pressure rating	Dimensions [mm]					Weight [kg]			
		DN	PN	d	D	L	H	l	with	without
									Pressure sensor	
15	100	16	45	65	358.8	169.3	4.1	3.5		
25	100	24	65	65	358.3	169.3	4.9	4.3		
40	100	38	82	65	362.3	169.5	5.5	4.9		
50	100	50	102	65	368.3	169.5	6.6	6.0		
80	100	74	135	65	380.3	169.3	8.8	8.2		
100	100	97	158	65	396.8	171.5	10.1	9.5		

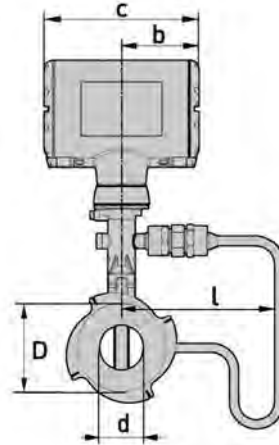
Table 2-7: Dimensions and weight of Sandwich version with signal converter in aluminium housing [mm and kg]

Weight for signal converter in stainless steel housing:
values of table above + 3 kg

Sandwich version ASME



a = 133 mm / 5.24"



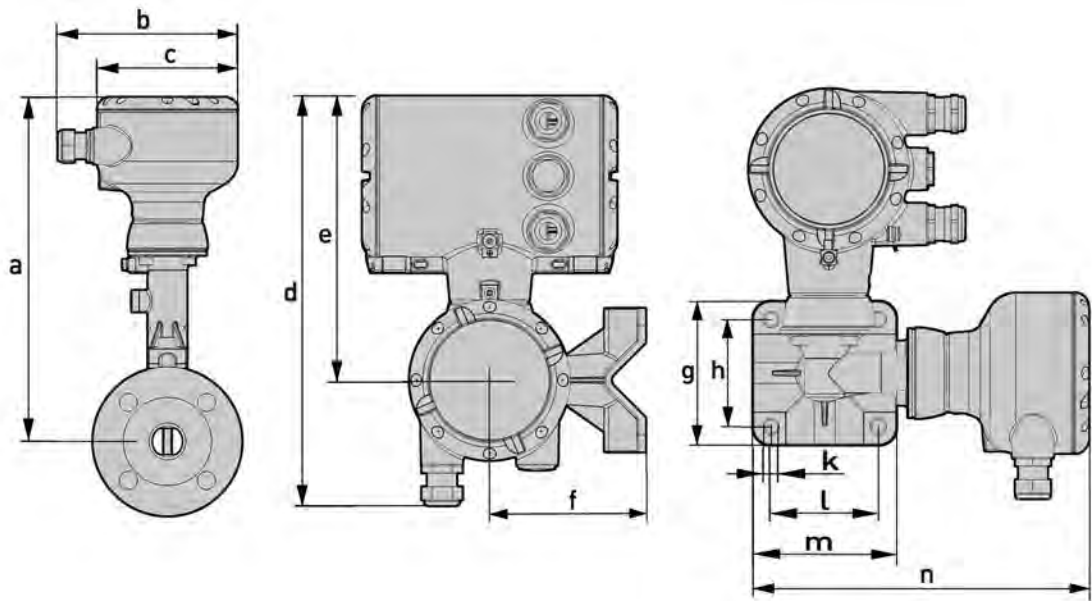
b = 105 mm / 4.13"
c = 179 mm / 7.05"

Nominal size	Pressure rating	Dimensions [inch]					Weight [lb]	
		d	D	L	H	l	with	without
NPS	Class						Pressure sensor	
1/2	150	0.63	1.77	2.56	14.13	6.67	9.04	7.72
1/2	300	0.63	1.77	2.56	14.13	6.67	9.04	7.72
1/2	600	0.55	1.77	2.56	14.13	6.67	9.04	7.72
1	150	0.94	2.56	2.56	14.13	6.67	10.8	9.48
1	300	0.94	2.56	2.56	14.13	6.67	10.8	9.48
1	600	0.94	2.56	2.56	14.13	6.67	10.8	9.48
1 1/2	150	1.5	3.23	2.56	14.27	6.67	12.13	10.8
1 1/2	300	1.5	3.23	2.56	14.27	6.67	12.13	10.8
1 1/2	600	1.5	3.23	2.56	14.27	6.67	12.13	10.8
2	150	1.97	4.02	2.56	14.50	6.67	14.55	13.23
2	300	1.97	4.02	2.56	14.50	6.67	14.55	13.23
2	600	1.97	4.02	2.56	14.50	6.67	14.55	13.23
3	150	2.91	5.31	2.56	14.98	6.67	19.4	18.08
3	300	2.91	5.31	2.56	14.98	6.67	19.4	18.08
3	600	2.91	5.31	2.56	14.98	6.67	19.4	18.08
4	150	3.82	6.22	2.56	15.63	6.75	22.27	20.94
4	300	3.82	6.22	2.56	15.63	6.75	22.27	20.94
4	600	3.82	6.22	2.56	15.63	6.75	22.27	20.94

Table 2-8: Dimensions and weight of Sandwich version with signal converter in aluminium housing [inch and lb]

Weight for signal converter in stainless steel housing:
values of table above + 6.61 lb

2.2.3 Remote version



	Flange & sandwich version						Flange version			
DN ▶	15	25	40	50	80	100	150	200	250	300
NPS ▶	1/2	1	1 1/2	2	3	4	6	8	10	12
[mm] ▶	315.7	315.2	319.2	325.2	337.2	353.7	373.2	398.9	425.7	449.7
["] ▶	12.4	12.4	12.6	12.8	13.3	13.9	14.7	15.7	16.8	17.7

Table 2-9: Dimension a [mm and inch]

	Flange version									
DN ▶	15	25	40	50	80	100	150	200	250	300
NPS ▶	1/2	1	1 1/2	2	3	4	6	8	10	12
F1R ① [mm] ▶	-	315.7	315.2	319.2	325.2	337.2	353.7	373.2	398.9	425.7
F1R ① ["] ▶	-	12.4	12.4	12.6	12.8	13.3	13.9	14.7	15.7	16.8
F2R ② [mm] ▶	-	-	315.7	315.2	319.2	325.2	337.2	353.7	373.2	398.9
F2R ② ["] ▶	-	-	12.4	12.4	12.6	12.8	13.3	13.9	14.7	15.7

Table 2-10: Dimension a F1/2R [mm and inch]

- ① F1R - single reduction
- ② F2R - double reduction

	b	c	d	e	f	g	h	j	k	l	m	n
[mm]	138.5	108.0	275.6	191.2	105.0	97.0	72.0	108.0	9.0	72.0	97.0	226.0
["]	5.46	4.25	10.9	7.53	4.14	3.82	2.84	4.25	0.35	2.84	3.82	8.90

Table 2-11: Dimension b...n [mm and inch]

2.3 Flow tables

Nominal size		Q_{min}	Q_{max}	Q_{min}	Q_{max}
DN - EN 1092-1	NPS - ASME B16.5	[m ³ /h]		[gph]	

Water

15	1/2	0.45	5.04	120	1331
25	1	0.81	11.34	215	2996
40	1 1/2	2.04	28.43	539	7512
50	2	3.53	49.22	934	13005
80	3	7.74	107.8	2045	28487
100	4	13.3	185.2	3514	48947
150	6	30.13	419.7	7961	110890
200	8	56.55	787.6	14954	208089
250	10	90.49	1260	23905	332989
300	12	127.3	1772	33611	488200

Values based on water at +20°C / +68°F

Air

15	1/2	6.8	32.4	1797	8561
25	1	10.21	113.4	2696	29966
40	1 1/2	24.5	324.5	6472	85856
50	2	42.42	562.6	11205	148644
80	3	92.91	1232	24543	325589
100	4	159.7	2117	42170	559436
150	6	361.7	4797	95536	1267398
200	8	678.7	9002	179275	2378304
250	10	1086	14406	286880	3805822
300	12	1527	20255	403369	5351184

Values based on air at +20°C / +68°F and 1.013 bara / 14.7 psia and density 1.204 kg/m³ / 0.0751 lb/ft³

Table 2-12: Measuring ranges for water and air

Gauge pressure [barg]		1		3.5		5.2		7	
Density [kg/m ³]		1.134		2.419		3.272		4.166	
Temperature [°C]		120.4		148.0		160.2		170.5	
Flow rate		min.	max.	min.	max.	min.	max.	min.	max.
DN EN 1092-1	NPS ASME B16.5	[kg/h]		[kg/h]		[kg/h]		[kg/h]	
15	1/2	5.88	36.79	7.42	78.5	8.62	106.6	9.73	134.9
25	1	11.43	128.7	16.69	274.6	19.40	371.2	21.89	472.3
40	1 1/2	28.65	368.9	41.83	786.7	48.63	1063	54.86	1353
50	2	49.60	638.8	72.41	1362	84.19	1841	94.97	2343
80	3	108.7	1399	158.7	2983	184.5	4033	208.1	5132
100	4	186.7	2404	272.6	5126	316.9	6930	357.5	8818
150	6	422.8	5446	617.4	11614	717.9	15700	809.8	19977
200	8	793.4	10220	1159	21794	1347	29461	1520	37488
250	10	1270	16355	1854	34876	2156	47145	2432	59990
300	12	1786	22996	2607	49037	3031	66288	3419	84350

Table 2-13: Measuring range for saturated steam: 1...7 barg

Gauge pressure [barg]		10.5		14		17.5		20	
Density [kg/m ³]		5.883		7.588		9.304		10.53	
Temperature [°C]		186.1		198.3		208.5		214.9	
Flow rate		min.	max.	min.	max.	min.	max.	min.	max.
DN EN 1092-1	NPS ASME B16.5	[kg/h]		[kg/h]		[kg/h]		[kg/h]	[kg/h]
15	1/2	12.78	190.6	16.49	246.0	20.21	301.5	22.87	341.3
25	1	26.01	667.2	29.55	853.0	32.71	950.0	34.80	1014
40	1 1/2	65.20	1867	74.07	2138	82.0	2381	87.24	2543
50	2	112.9	3233	128.3	3702	142.0	4123	151.1	4403
80	3	247.3	7083	280.9	8109	311.0	9032	330.8	9644
100	4	424.9	12170	482.7	13934	534.3	15519	568.4	16571
150	6	962.4	27572	1094	31567	1211	35158	1288	37542
200	8	1806	51741	2052	59237	2272	65975	2417	70450
250	10	2890	82797	3284	94792	3635	105576	3867	112736
300	12	4064	116418	4617	133283	5111	148445	5437	158512

Table 2-14: Measuring range for saturated steam: 10.5...20 barg

Gauge pressure [psig]		15		50		75		100	
Density [lb/ft ³]		0.0721		0.1496		0.2033		0.2564	
Temperature [°F]		249.0		297.7		320.0		337.9	
Flow rate		min.	max.	min.	max.	min.	max.	min.	max.
DN EN 1092-1	NPS ASME B16.5	[lb/h]		[lb/h]		[lb/h]		[lb/h]	[lb/h]
15	1/2	12.32	82.42	16.26	171.1	18.97	232.8	21.32	293.8
25	1	25.4	288.4	36.59	598.8	42.68	814.9	47.95	1028
40	1 1/2	63.66	826.5	91.72	1715	107.0	2334	120.2	2947
50	2	110.3	1430	158.8	2970	185.3	4042	208.1	5102
80	3	241.4	3134	347.9	6506	405.8	8854	455.9	11175
100	4	414.8	5385	597.7	11180	697.2	15214	783.2	19202
150	6	939.7	12201	1354	25329	1580	34367	1775	43503
200	8	1764	22895	2541	47530	2964	64679	3330	81634
250	10	2822	36638	4066	76060	4743	103501	5329	130634
300	12	3968	51515	5717	106944	6669	145528	7492	183678

Table 2-15: Measuring range for saturated steam: 15...100 psig

Gauge pressure [psig]		150		200		250		300	
Density [lb/ft ³]		0.3626		0.4682		0.5727		0.6781	
Temperature [°F]		365.9		387.9		406.0		421.8	
Flow rate		min.	max.	min.	max.	min.	max.	min.	max.
DN EN 1092-1	NPS ASME B16.5	[lb/h]		[lb/h]		[lb/h]		[lb/h]	[lb/h]
15	1/2	27.80	414.8	35.87	353.3	43.94	655.7	52.04	776.6
25	1	56.97	1452	64.71	1867	71.62	2079	78.06	2274
40	1 1/2	142.9	4090	162.3	4681	179.6	5213	195.7	5702
50	2	247.3	7081	280.9	8105	310.9	9025	338.8	9872
80	3	541.6	15510	615.2	17753	680.9	19769	742.1	21624
100	4	930.6	26650	1058	30504	1170	33968	1276	37155
150	6	2109	60375	2395	69107	2651	76956	2889	84176
200	8	3956	113296	4494	129681	4974	144410	5421	157958
250	10	6331	181300	7191	207519	7959	231089	8675	252769
300	12	8901	254917	10111	291783	11191	324923	12197	355406

Table 2-16: Measuring range for saturated steam: 150...300 psig

Алматы (7273)495-231
Ангарск (3955)60-70-56
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Благовещенск (4162)22-76-07
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Владикавказ (8672)28-90-48
Владимир (4922)49-43-18
Волгоград (844)278-03-48
Вологда (8172)26-41-59
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89
Иваново (4932)77-34-06
Ижевск (3412)26-03-58
Иркутск (395)279-98-46
Казань (843)206-01-48

Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Коломна (4966)23-41-49
Кострома (4942)77-07-48
Краснодар (861)203-40-90
Красноярск (391)204-63-61
Курган (3522)50-90-47
Курск (4712)77-13-04
Липецк (4742)52-20-81
Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Новосибирск (383)227-86-73
Ноябрьск(3496)41-32-12

Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Пермь (342)205-81-47
Петрозаводск (8142)55-98-37
Псков (8112)59-10-37
Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
Санкт-Петербург (812)309-46-40
Саранск (8342)22-96-24
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Сургут (3462)77-98-35

Сыктывкар (8212)25-95-17
Тамбов (4752)50-40-97
Тверь (4822)63-31-35
Тольятти (8482)63-91-07
Томск (3822)98-41-53
Тула (4872)33-79-87
Тюмень (3452)66-21-18
Улан-Удэ (3012)59-97-51
Ульяновск (8422)24-23-59
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
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