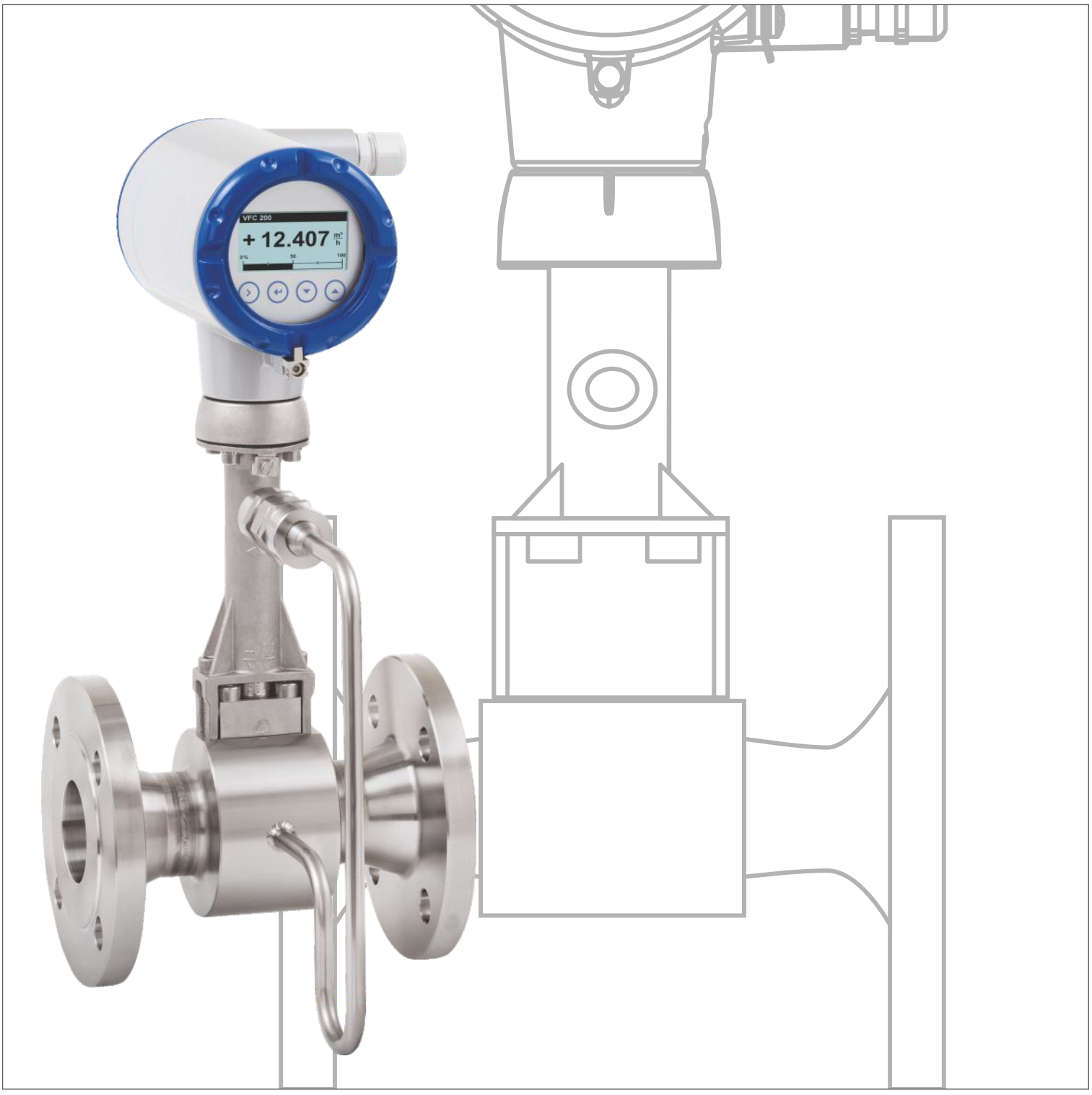
# FLOWIRL™ 8400

## Vortex Flowmeter




Energy Conservation | Environment | Process Efficiency

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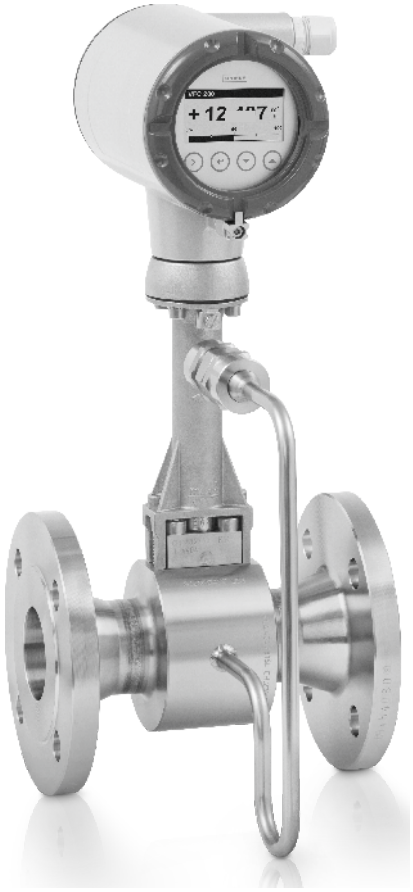
# Flowirl™ 8400

**The All-in-one Solution**



The FLOWIRL™ 8400 is suitable for a wide range of media. This versatile vortex flowmeter is capable of mastering fluctuating pressures and temperatures and is the ideal choice for measurement of energy carriers in auxiliary and supply processes.

The basic version is equipped with temperature compensation for saturated steam applications. The optional pressure sensor provides for an integrated density compensation which provides exact measurement of gases and superheated steam even in varying process conditions.

The additional integrated gross and net heat measurement makes this flowmeter a reliable partner for advanced energy management systems.

## Features

Advanced technology for signal filtering - AVFD (advanced vortex frequency detection)

Integrated pressure and temperature compensation

Temperature compensation for saturated steam included as standard

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

## Applications

Measurement of saturated steam and superheated steam

Steam boiler monitoring

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

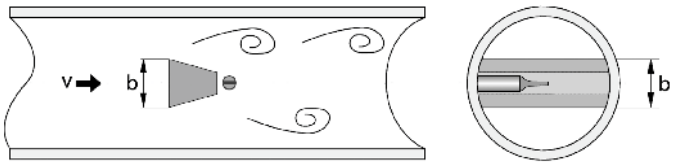
## Functional Principle

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:

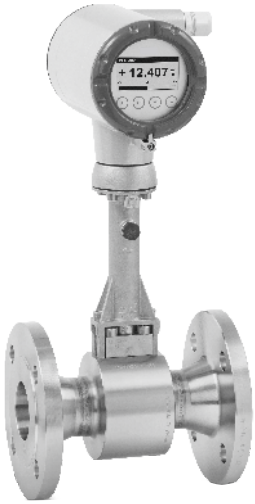
$$f = \frac{S \cdot v}{b}$$

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




## Variants

### Standard Version: Universal Device with Temperature Compensation for Saturated Steam



The FLOWIRL™ 8400 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 density. Mass and energy can also be measured.

The advanced signal filter technology AVFD complements the accurate measurements.

### Sandwich Version with Optimised Central Rings

The FLOWIRL™ 8400 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. It can be aligned centrically by turning the centering rings, eliminating any offset between the flowmeter and the pipeline.

## The One-of-a-kind 2-Wire Device with Integrated Pressure and Temperature Compensation

The FLOWIRL™ 8400 as a flange or sandwich flowmeter is optionally available with integrated pressure and temperature compensation for gases, wet gases, gas mixtures or steam.

The advantages of this unique design include

- No additional cost-intensive installation of pressure and temperature sensors
- No additional cabling work
- Direct measurement of mass
- Pressure, temperature and volume flow can be read at a single point, hence no possibility of faulty results

## Remote Version

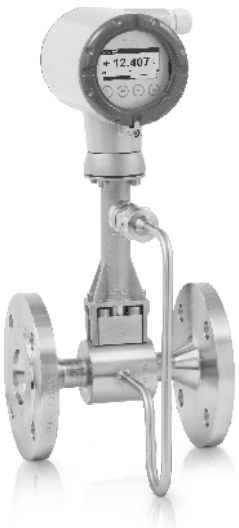
The FLOWIRL™ 8400 is also available as a remote version with field housing converter

This version is suitable in cases where the flow sensor is mounted in inaccessible areas. The signal converter can be installed up to a distance of 50 m / 164 ft from the sensor.

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

In addition to the flow rates, measurements of the integrated pressure and temperature sensors can be displayed

## FLOWIRL™ 8400 F1R / F2R with Integrated Nominal Diameter Reduction



The FLOWIRL™ 8400 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, designed for low pressure loss.

These flowmeters do not require complex pipeline reduction installations, hence save space and cost, and reduce the possibility of leakage to a minimum.

**Devices with Integrated Nominal Diameter Reduction**

| Nominal Diameter of Flow Sensor | Nominal Size of Process Connections | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **DN15** | **DN25** | **DN40** | **DN50** | **DN80** | **DN100** | **DN150** | **DN200** | **DN250** | **DN300** |
| DN15 | StV | F1R | F2R | - | - | - | - | - | - | - |
| DN25 | - | StV | F1R | F2R | - | - | - | - | - | - |
| DN40 | - | - | StV | F1R | F2R | - | - | - | - | - |
| DN50 | - | - | - | StV | F1R | F2R | - | - | - | - |
| DN80 | - | - | - | - | StV | F1R | F2R | - | - | - |
| DN100 | - | - | - | - | - | StV | F1R | F2R | - | - |
| DN150 | - | - | - | - | - | - | StV | F1R | F2R | - |
| DN200 | - | - | - | - | - | - | - | StV | F1R | F2R |
| DN250 | - | - | - | - | - | - | - | - | StV | F1R |
| DN300 | - | - | - | - | - | - | - | - | - | StV |

StV - Standard Vortex, F1R - Single Reduction, F2R - Double Reduction.

| | |
|---|---|
| **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 |
| | Remote version<br>Cable length: = 50 m / 164 ft |
| **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 |
| | 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 Language | English |

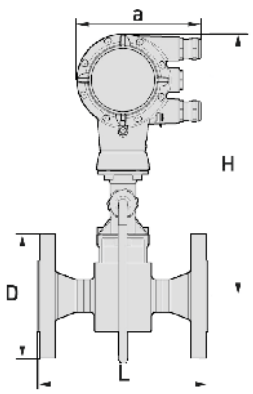
| Measuring Accuracy | |
|---|---|
| **Reference Condition** | |
| Reference Conditions | Water at +20°C / +68°F |
| | Air at +20°C / +68°F and 1.013 bara / 14.7 psia |
| **Maximum Measuring Error** | |
| Volume Flow (Liquid) | ±0.75% of measured value (Re = 20000) |
| Volume Flow | ±1.0% of measured value (Re = 20000) |
| Mass Low (Gases and Steam) | ±1.5% of measured value (Re = 20000) |
| Mass Flow (Liquid / Water) | ±1.5% of measured value (Re = 20000) |
| Normalised Volume Flow (Gas) | ±1.5% of measured value (Re = 20000) |
| Repeatability (Volume Flow) | ±0.1% of measured value |

| Operating Conditions | |
|---|---|
| Medium Temperature | -40…+240°C / -40…+465°F |
| Ambient Temperature | -40…+85°C / -40…+185°F |
| Storage Temperature | -40...+85°C / -40...+185°F |
| **Pressure** | |
| Medium Pressure | Max. 100 bar / 1450 psi (higher pressures on request) |
| Ambient Pressure | Atmosphere |
| **Media Properties** | |
| Density | Taken into consideration when sizing |
| Viscosity | < 10 cP |
| Reynold's Number | > 1000 |

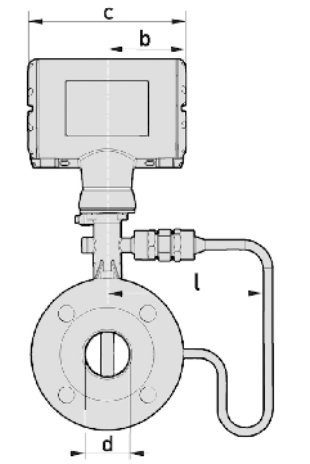
| Other Conditions | |
|---|---|
| Ingress Protection | Compact version: IP66/67 |
| | Remote version: signal converter housing: IP66/67; flow sensor housing: IP66/67 |
| **Installation Conditions** | |
| Inlet Section | = 15 x DN without disturbing flow, after pipe narrowing, after a single 90° bend |
| | = 30 x DN after a double bend 2x90° |
| | = 40 x DN after a double three-dimensional bend 2x90° |
| | = 50 x DN after control valves |
| | = 2 DN before flow straightener; = 8 DN after flow straightener |
| Outlet Section | = 5 x DN |
| **Materials** | |
| Flow Sensor and Process Connections | Standard: 1.4404/316L |
| Electronics Housing | Aluminium die-cast, two-layer coating (epoxy/polyester) |
| Pressure Sensor Gasket | FPM |
| Measuring Tube Gasket (pickup) | Standard: 1.4435/316L |

| | |
|---|---|
| **Process Connections of 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) |
| **Process Connections of Sandwich Version** | |
| DIN | DN15...100 - PN100 (higher pressures on request) |
| ASME | 1/2" ...4" - 600 lb (higher pressures on request) |
| **Electrical Connections** | |
| Power Supply | 12....36 VDC |
| **Inputs and Outputs** | |
| General | All inputs and outputs are electrically isolated from one another. |
| 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 Outputs** | |
| Type | 4...20 mA HART® (passive) |
| Output Data | Volume flow, mass flow, norm. volume flow, free air delivery, density, temperature (internal sensor), pressure, vortex frequency, flow velocity |
| Resolution | 5 µA |
| Linearity / Accuracy | 0.1% (of read value) |
| Error Signal | According to NE 43 |
| Description of Abbreviations | Uext = external voltage; |
| | RL = load + resistance |
| Load | Minimum RL = 0 O; maximum RL = (Uext - 12 VDC) / 22 mA) |
| **HART®** | |
| | HART® protocol via passive current output |
| HART® Revision | HART® 7 |
| | Burst mode |
| | Catch device |
| System Requirements | Load min. 250 O |
| Multidrop Operation | 4 mA |
| **Binary Output** | |
| Function | Pulse, frequency, status, limit switch |
| Type | Passive |
| | Proximity sensor acc. to DIN EN 60947-5-6 (NAMUR sensor) or pulse output signal acc. to VDI/VDE 2188 (category 2) |
| Pulse | width 0.5...2000 ms |
| **Current Input** | |
| Type | 4...20 mA (passive) |
| Resolution | 6 µA |
| Linearity / Accuracy | 0.1% (of read value) |
| Voltage Drop | 10 V |
| **Approvals and Certificates** | |
| IBR | Indian boiler regulation - For steam systems |

**Flange Version**
**Dimensions**




a = 148.5 mm / 5.85"




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

**Dimensions of Flange Version ASME B16.5 (mm)**

| Nominal size DN | Pressure Rating Class | d | D | L | H | H F1R ① | H F2R ② | l | l F1R ① | l F2R ② |
|---|---|---|---|---|---|---|---|---|---|---|
| ½ | 150 | 16 | 90 | 200 | 358.8 | - | - | 169.3 | - | - |
| ½ | 300 | 16 | 95 | 200 | 358.8 | - | - | 169.3 | - | - |
| ½ | 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 ½ | 150 | 41 | 125 | 200 | 362.3 | 358.3 | 358.8 | 169.5 | 169.3 | 169.3 |
| 1 ½ | 300 | 41 | 155 | 200 | 362.3 | 358.3 | 358.8 | 169.5 | 169.3 | 169.3 |
| 1 ½ | 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 |
| 10 | 300 | 254.6 | 455 | 380 | 468.8 | 442.1 | 416.3 | 229.5 | 202.8 | 191.5 |
| 12 | 150 | 300.0 | 485 | 450 | 442.8 | 468.8 | 442.1 | 255.0 | 229.5 | 202.8 |
| 12 | 300 | 300.0 | 520 | 450 | 442.8 | 468.8 | 442.1 | 255.0 | 229.5 | 202.8 |

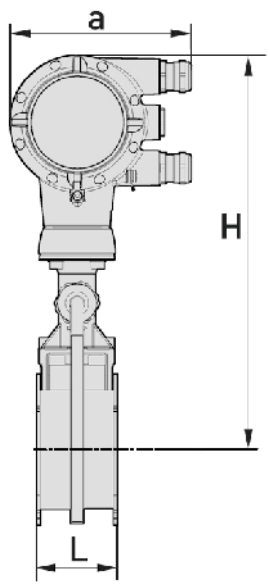
① F1R - Single Reduction

② F2R - Double Reduction

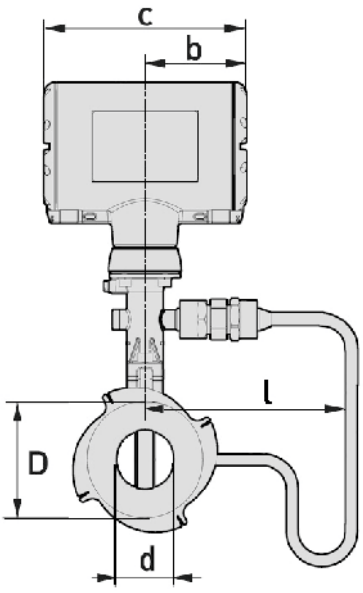
**Weight of Flange Version ASME B16.5 (kg)**

| Nominal size DN | 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 |

**Sandwich Version**




a = 133 mm / 5.24"

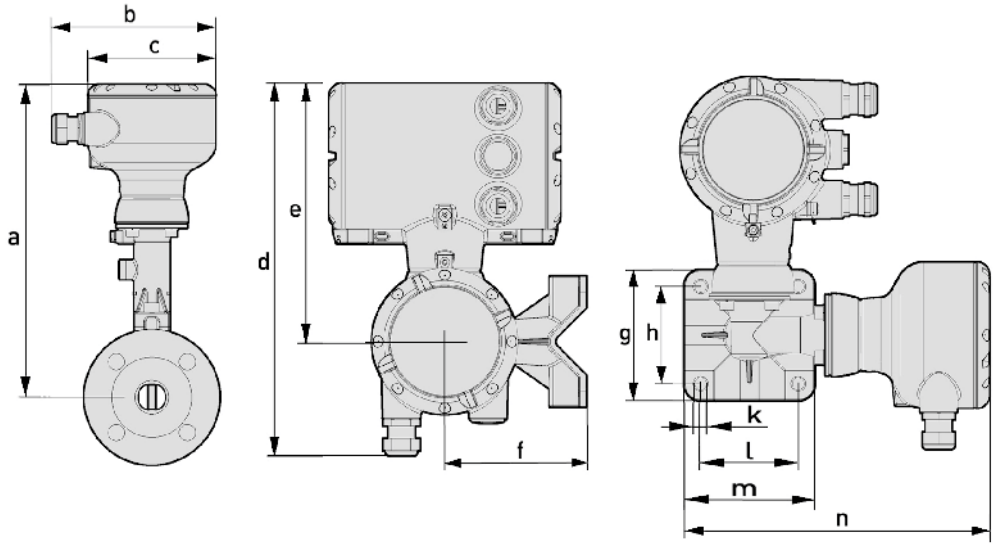



b = 105 mm / 4.13"
c = 179 mm / 7.05"

**Sandwich Version ASME**

| Nominal Size | Pressure Rating | Dimensions [inch] | | | | | Weight [lb] | |
|---|---|---|---|---|---|---|---|---|
| NPS | Class | d | D | L | H | l | with | without |
| | | | | | | | Pressure sensor | |
| ½ | 150 | 0.63 | 1.77 | 2.56 | 14.13 | 6.67 | 9.04 | 7.72 |
| ½ | 300 | 0.63 | 1.77 | 2.56 | 14.13 | 6.67 | 9.04 | 7.72 |
| ½ | 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 ½ | 150 | 1.5 | 3.23 | 2.56 | 14.27 | 6.67 | 12.13 | 10.8 |
| 1 ½ | 300 | 1.5 | 3.23 | 2.56 | 14.27 | 6.67 | 12.13 | 10.8 |
| 1 ½ | 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 |

**Dimensions of Remote Version**




**Dimension a**

| | Flange and Sandwich Version | | | | | | Flange Version | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| DN ▸ | 15 | 25 | 40 | 50 | 80 | 100 | 150 | 200 | 250 | 300 |
| NPS ▸ | ½ | 1 | 1½ | 2 | 3 | 4 | 6 | 8 | 10 | 12 |
| [mm] ▸ | 265.7 | 265.2 | 269.2 | 275.2 | 287.2 | 303.7 | 323.2 | 348.9 | 375.7 | 399.7 |
| [inch] ▸ | 10.5 | 10.4 | 10.6 | 10.8 | 11.3 | 12.0 | 12.7 | 13.7 | 14.8 | 15.7 |

**Dimension a F1/2R**

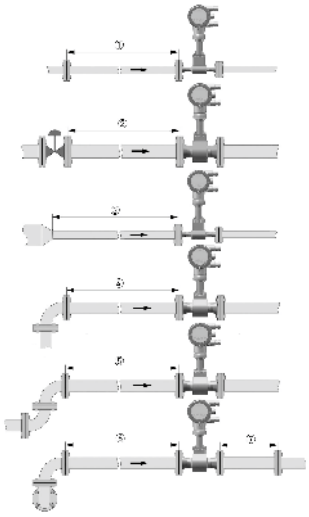
| | Flange Version | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **DN** ▸ | **15** | **25** | **40** | **50** | **80** | **100** | **150** | **200** | **250** | **300** |
| **NPS** ▸ | **½** | **1** | **1½** | **2** | **3** | **4** | **6** | **8** | **10** | **12** |
| F1R ① [mm] ▸ | - | 315.7 | 315.2 | 319.2 | 325.2 | 337.2 | 353.7 | 373.2 | 398.9 | 425.7 |
| F1R ① [inch] ▸ | - | 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 [inch] ▸ | - | - | 12.4 | 12.4 | 12.6 | 12.8 | 13.3 | 13.9 | 14.7 | 15.7 |

① F1R - single reduction -② F2R - double reduction

**Dimensions b...n**

| | 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 |
| [inch] | 5.46 | 4.25 | 10.9 | 7.53 | 4.14 | 3.82 | 2.84 | 4.25 | 0.35 | 2.84 | 3.82 | 8.90 |

**Minimum Inlet Sections**



① General inlet section without disturbing flow ≥15 DN

② After a control valve ≥50 DN

③ After a pipe diameter reduction ≥20 DN

④ After a single bend 90° ≥20 DN

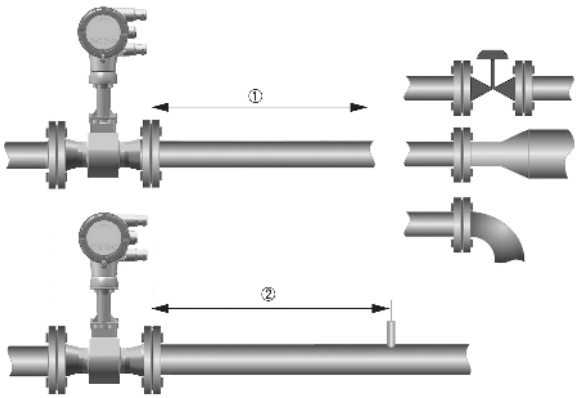
⑤ After a double bend 2x90° ≥30 DN

⑥ After a double three-dimensional bend 2x90° ≥40 DN

⑦ Outlet section: >5 DN

The nominal diameter of the flange is significant for the determination of the minimum inlet and outlet sections for the nominal diameter reduced versions of vortex flowmeter versions F1R and F2R.

**Minimum Outlet Sections**




① Upstream of pipe expanders, pipe bends, control valves,

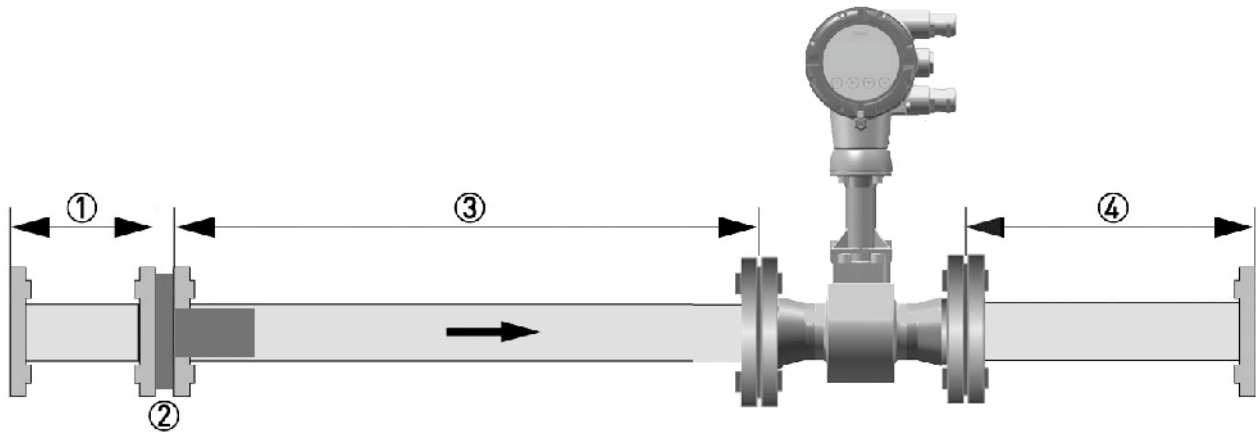
etc. ≥ 5 DN

② Upstream of measuring points ≥5 DN

The interior of the pipe at the metering points must be free of burrs and other flow impediments.

The measuring device has an internal temperature sensor. The distance from external temperature measuring points must be ≥5 DN. Use flow sensors that are as short as possible to avoid disturbances of the flow profile.

## Flow Straightener




If, due to the type of installation, the required inlet sections are not available, the manufacturer recommends using flow straighteners. Flow straighteners are installed between two flanges upstream of the device and shorten the required inlet section.

① Straight inlet section upstream of straightener ≥2 DN

② Flow straightener

③ Straight pipe run between flow straightener and device ≥8 DN

④ Minimum straight outlet section ≥5 DN

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