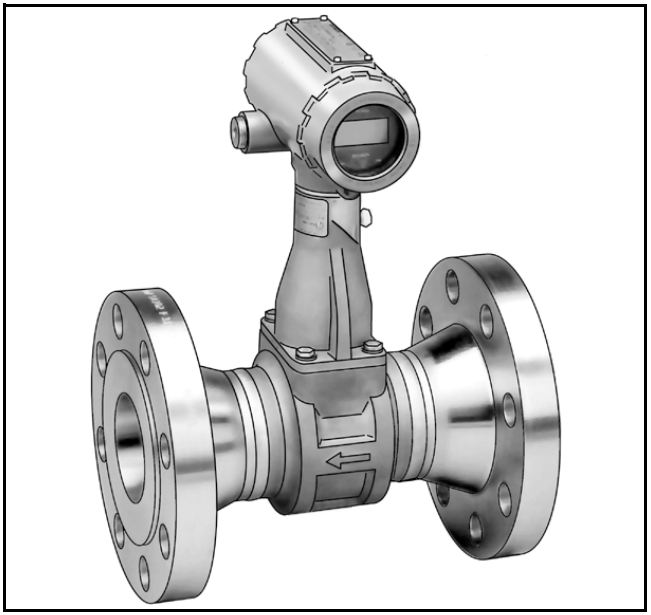
Model 8800C

Smart Vortex Flowmeter

THE MODEL 8800C

- *Fully cast, all welded meter body requires no process seals and eliminates sources of fugitive emissions.*
- *Non-clogging sensor design with no ports or crevices to clog and degrade performance.*
- *Superior vibration immunity with mass balanced sensing design and Adaptive Digital Signal Processing.*
- *Advanced flow simulation diagnostics has a flow signal generator built in for remote verification of electronics.*
- *Communicates digitally using HART® protocol.*



Specifications

FUNCTIONAL SPECIFICATIONS

Service

Liquid, gas, and steam applications. Fluids must be homogeneous and single-phase.

Line Sizes

Wafer

1/2, 1, 1 1/2, 2, 3, 4, 6, and 8 inches (DN 15, 25, 40, 50, 80, 100, 150, and 200)

Flanged, and Dual-Sensor Style

1/2, 1, 1 1/2, 2, 3, 4, 6, 8, 10, and 12 inches (DN 15, 25, 40, 50, 80, 100, 150, 200, 250, and 300)

Pipe Schedules

Process piping Schedules 10, 40, and 80

NOTE
The appropriate bore diameter of the process piping must be entered using the HART Communicator or AMS. Meters will be shipped from the factory at the Schedule 40 default value unless otherwise specified.

Measurable Flow Rates

Capable of processing signals from flow applications which meet the sizing requirements below.

To determine the appropriate flowmeter size for an application, process conditions must be within the Reynolds number and velocity limitations for the desired line size provided in Table 1, Table 2, and Table 3.

NOTE
Consult your local sales representative to obtain a computer sizing program that describes in greater detail how to specify the correct flowmeter size for an application.

The Reynolds number equation shown below combines the effects of density (ρ), viscosity (μ_{cp}), pipe inside diameter (D), and flow rate (V).

$$R_D = \frac{VD\rho}{m_{c\rho}}$$

TABLE 1. Minimum Measurable Reynolds Numbers

Line Sizes (Inches / DN)	Reynolds Number Limitations
1/2 through 4 15 through 100	10000 minimum
6 through 12 150 through 300	20000 minimum

TABLE 2. Minimum Measurable Velocities (Use the larger of the two values)

	Feet per Second	Meters per Second
Liquids(1)	$\sqrt{36/\rho}$ or 0.7	$\sqrt{54/\rho}$ or 0.22
Gases	$\sqrt{36/\rho}$ or 6.5	$\sqrt{54/\rho}$ or 2.0

The ρ is the process fluid density at flowing conditions in lb/ft^3 for ft/s and kg/m^3 for m/s

(1) The minimum measurable velocity for the 10in. line size is 0.9 ft/s (.27m/s) and 1.1 ft/s (.34m/s) for the 12in. line size.

TABLE 3. Maximum Measurable Velocities (Use the smaller of the two values)

	Feet per Second	Meters per Second
Liquids	$\sqrt{90,000/\rho}$ or 25	$\sqrt{134,000/\rho}$ or 7.6
Gases(1)	$\sqrt{90,000/\rho}$ or 250	$\sqrt{134,000/\rho}$ or 76

The ρ is the process fluid density at flowing conditions in lb/ft^3 for ft/s and kg/m^3 for m/s

(1) Accuracy limitations for gas and steam for Dual-style meters (all sizes): max velocity of 100 ft/s (30.5 m/s).

Process Temperature Limits

Standard

–40 to 450 °F (–40 to 232 °C)

Extended

–330 to 800 °F (–200 to 427 °C)

Output Signals

4–20 mA Digital HART Signal

Superimposed on 4–20 mA signal

Optional Scalable Pulse Output

0 to 10000 Hz; transistor switch closure with adjustable scaling via HART communications; capable of switching up to 30 V dc, 120 mA maximum

Analog Output Adjustment

Engineering units and lower and upper range values are user-selected. Output is automatically scaled to provide 4 mA at the selected lower range value, 20 mA at the selected upper range value. No frequency input is required to adjust the range values.

TABLE 4. Water Flow Rate Limits in Schedule 40 Pipe

Line Size (Inches/ DN)	Minimum and Maximum Measurable Water Flow Rates*	
	Gallons/Minute	Cubic Meters/Hour
½/ 15	1.76 to 23.7	0.40 to 5.38
1/ 25	2.96 to 67.3	0.67 to 15.3
1½/ 40	4.83 to 158	1.10 to 35.9
2/ 50	7.96 to 261	1.81 to 59.4
3/ 80	17.5 to 576	4.00 to 130
4/ 100	30.2 to 992	6.86 to 225
6/ 150	68.5 to 2251	15.6 to 511
8/ 200	119 to 3898	27.0 to 885
10/ 250	231 to 6144	52.2 to 1395
12/ 300	391 to 8813	88.8 to 2002

***Conditions: 77 °F (25 °C) and 14.7 psia (1.01 bar absolute)**

Scalable Frequency Adjustment

Value of one pulse can be set to equal desired volume in selected engineering units.

Ambient Temperature Limits

Operating

–58 to 185 °F (–50 to 85 °C)

–4 to 185 °F (–20 to 85 °C) for flowmeters with local indicator

Storage

–58 to 250 °F (–50 to 121 °C)

–50 to 185 °F (–46 to 85 °C) for flowmeters with local indicator

Pressure Limits

Flange and dual-sensor style rated for ASME B16.5 (ANSI) Class 150, 300, 600, and 900, DIN PN 10, 16, 25, 40, 64, 100, and 160, and JIS 10K, 20K, and 40K

Wafer rated for ASME B16.5 (ANSI) Class 150, 300, and 600, DIN PN 10, 16, 25, 40, 64, and 100, and JIS 10K, 20K, and 40K

Power Supply

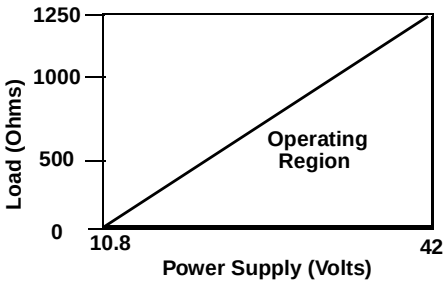
External power supply required. Flowmeter operates on 10.8 to 42 V dc terminal voltage (with 250-ohm minimum load required for HART communications, 16.8 V dc power supply is required)

Power Consumption

One watt maximum

Load Limitations

Maximum loop resistance is determined by the voltage level of the external power supply, as described by:



R_{max} = $41.7(V_{ps} - 10.8)$
V_{ps} = Power Supply Voltage (Volts)
R_{max} = Maximum Loop Resistance (Ohms)

NOTE
HART Communication requires a minimum loop resistance of 250 ohms.

Optional LCD Indicator

Displays flow variable, percent of range, current output, and/or totalized flow.

Enclosure Rating

NEMA Type 4X; CSA Type 4X; IP66

PERFORMANCE SPECIFICATIONS

Accuracy

Includes linearity, hysteresis, and repeatability.

Liquids—for Reynolds Numbers over 20000

Digital and Pulse Output
±0.65% of rate

Analog Output
Same as pulse output plus an additional 0.025% of span

Gas and Steam—for Reynolds Numbers over 15,000

Digital and Pulse Output
±1.35% of rate

Analog Output
Same as pulse output plus an additional 0.025% of span

Accuracy limitations for gas and steam:

- for 1/2- and 1-in. (DN 15 and DN 25): max velocity of 220 ft/s (67.06 m/s)
- for Dual-style meters (all sizes): max velocity of 100 ft/s (30.5 m/s)

NOTE
For 1/2-in. through 4-in. (15 mm through 100 mm) line sizes, as the Reynolds number decreases below the stated limit to 10000, the positive limit of the accuracy error band will increase to 2.1% for the pulse output. Example: +2.1% to –0.65% for liquids.

Repeatability

± 0.1% of actual flow rate

Stability

±0.1% of rate over one year

Process Temperature Effect

Automatic K-factor correction with user-entered process temperature

Table 8 indicates the percent change in K-factor per 100 °F (50 °C) in process temperature from reference temperature of 77 °F (25 °C) for direct pulse, or user-entered process temperature.

TABLE 9. Process Temperature Effect

Material	Percent Change in K-Factor per 100 °F (50 °C)
316L @ < 77 °F (25 °C)	+ 0.23 (+ 0,20)
316L @ > 77 °F (25 °C)	- 0.27 (- 0,24)
Hastelloy® C @ < 77 °F (25 °C)	+ 0.22 (+ 0,20)
Hastelloy® C @ > 77 °F (25 °C)	- 0.22 (- 0,20)

Ambient Temperature Effect

Digital and Pulse Outputs
No effect

Analog Output
±0.1% of span from –40 to 185 °F (–40 to 85 °C)

Vibration Effect

An output with no process flow may be detected if sufficiently high vibration is present.

The meter design will minimize this effect, and the factory settings for signal processing are selected to eliminate these errors for most applications.

If an output error at zero flow is still detected, it can be eliminated by adjusting the low flow cutoff, trigger level, or low-pass filter.

As the process begins to flow through the meter, most vibration effects are quickly overcome by the flow signal. At or near the minimum liquid flow rate in a normal pipe mounted installation, the maximum vibration should be 0.087-inch (2,21 mm) double amplitude displacement or 1 g acceleration, whichever is smaller. At or near the minimum gas flow rate in a normal pipe mounted installation, the maximum vibration should be 0.043-inch (1,09 mm) double amplitude displacement or 1/2 g acceleration, whichever is smaller.

Mounting Position Effect

Meter will meet accuracy specifications when mounted in horizontal, vertical, or inclined pipelines.

EMI/RFI Effect

Output error less than ±0.025% of span with twisted pair from 80-1000 MHz for radiated field strength of 10 V/m and from 0.15-80 MHz for conducted RF of 3V (tested per EN61326).

Magnetic-Field Interference

Output error less than ±0.025% of span at 30 A/m (rms); meets IEC 770-1984, Section 6.2.9.

Series Mode Noise Rejection

Output error less than ±0.025% of span at 1 V rms, 60 Hz; meets IEC 770-1984, Section 6.2.4.2.

Common Mode Noise Rejection

Output error less than ±0.025% of span at 30 V rms, 60 Hz; meets IEC 770-1984, Section 6.2.4.1.

Power Supply Effect

Less than 0.005% of span per volt

Pressure Loss

The approximate pressure loss from the flowmeter can be determined using the following equations:

English

$$(Liquids)\Delta P = \frac{(3.40x10^{-5})x\rho_f x(Q_{gpm})^2}{D^4}$$

$$(Gases)\Delta P = \frac{(1.90x10^{-3})x\rho_f x(Q_{acfm})^2}{D^4}$$

Metric

$$(Liquids)\Delta P = \frac{(0.425)x\rho_f x(Q_{lpm})^2}{D^4}$$

$$(Gases)\Delta P = \frac{(118)x\rho_f x(Q_{acmh})^2}{D^4}$$

where:

- ΔP = Pressure loss (psi or kPa)
- ρ_f = Density at operating conditions (lb/ft^3 or kg/m^3)
- D = Flowmeter bore diameter (in. or mm)
- $Q_{gpm\ or\ lpm}$ = Actual volumetric flow rate (gal/min or l/min)
- $Q_{acfm\ or\ acmh}$ = Actual volumetric flow rate (ft^3/min or m^3/hour)

NOTE
Pressure loss is 1.8 ΔP for the dual sensor meter.

Minimum Back Pressure (Liquids)

Flow metering conditions that would allow cavitation, the release of vapor from a liquid, should be avoided. This flow condition can be avoided by remaining within the proper flow range of the meter and by following appropriate system design.

For some liquid applications, incorporation of a back pressure valve should be considered. To prevent cavitation, the minimum back pressure should be:

$P = 2.9\Delta P + 1.3\ p_v$

- P = Line pressure five pipe diameters downstream of the meter (psia or kPa abs)
- ΔP= Pressure loss across the meter (psi or kPa)
- p_v = Liquid vapor pressure at operating conditions (psia or kPa abs)

NOTE
Pressure loss is 1.8 ΔP for the dual sensor meter.

Failure Mode Alarm

If self-diagnostics detect a gross flowmeter failure, the analog signal will be driven either below 3.75 mA or above 21.75 mA to alert the user. Also, high or low alarm signal is user-selectable through the fail mode alarm jumper on the electronics.

NAMUR-compliant alarm limits are available through the C4 or CN Option. NAMUR-compliant limits are 3.6 mA (low) or 22.5 mA (high).

Saturation Output Values

When the operating flow is outside the range points, the analog output continues to track the operating flow until reaching the saturation value listed below; the output does not exceed the listed saturation value regardless of the operating flow.

The 4–20 mA Saturation Values are 3.9 mA (low) or 20.8 mA (high). The NAMUR-Compliant Saturation Values (Option C4 or CN) are 3.8 mA (low) or 20.5 mA (high).

Damping

Adjustable between 0.2 and 255 seconds

Response Time

Three vortex shedding cycles or 0.2 seconds, whichever is greater, maximum required to reach 63.2% of actual input with the minimum damping (0.2 seconds).

Turn-on Time

Less than four (4) seconds plus the response time to rated accuracy from power up.

Transient Protection

The optional transient terminal block prevents damage to the flowmeter from transients induced by lightning, welding, heavy electrical equipment, or switch gears. The transient protection electronics are located in the terminal block.

The transient terminal block meets the following specifications:

ASME B16.5 (ANSI)/IEEE C62.41 - 1980 (IEEE 587) Categories A, B

3 kA crest (8 × 20 μs)
6 kV crest (1.2 × 50 μs)
6 kV/0.5 kA (0.5 μs, 100 kHz, ring wave)

Security Lockout

When the security lockout jumper is enabled, the electronics will not allow you to modify functions that affect flowmeter output.

Output Testing

Current Source

Flowmeter may be commanded to set the current to a specified value between 4 and 20 mA.

Frequency Source

Flowmeter may be commanded to set the frequency to a specified value between 0 and 10000 Hz.

Low Flow Cutoff

Adjustable over entire flow range. Below selected value, output is driven to 4 mA and zero pulse output frequency (in the scaled pulse mode only).

Humidity Limits

Operates in 0–95% relative humidity under noncondensing conditions (tested to IEC 770, Section 6.2.11).

Overrange Capability

Analog signal output continues to 105 percent of span, then remains constant with increasing flow. The digital and pulse outputs will continue to indicate flow up to the upper sensor limit of the flowmeter and a maximum frequency of 10400 Hz.

Flow Calibration

Meter bodies are flow-calibrated and assigned a unique calibration factor (K-factor) at the factory. The calibration factor is entered into the electronics, enabling interchangeability of electronics and/or meter bodies without calculations or compromise in accuracy.

PHYSICAL SPECIFICATIONS

NACE Compliance

Meets the requirements of NACE (National Association of Corrosion Engineers) Standard MR-01-75 (96)

Electrical Connections

$^1/_2$ –14 NPT, PG 13.5, or M20 × 1.5 conduit threads; screw terminals provided for 4–20 mA and pulse output connections; communicator connections permanently fixed to terminal block

Non-Wetted Materials

Housing

Low-copper aluminum (NEMA 4X, CSA Type 4X, IP66)

Paint

Polyurethane

Cover O-rings

Buna-N

Flanges

316/316L lap joint

Process-Wetted Materials

Meter Body

316L wrought stainless and CF-3M cast stainless or C-22® and C-276 wrought Hastelloy® or CX2MW and CW12MW cast Hastelloy

Flanges

316/316L stainless steel

Collars

Hastelloy C-22©

Surface Finish of Flanges and Collars

Standard: 125 to 250 μ inches (3.1 to 6.3 μ meters) Ra roughness

Smooth: 63 to 125 μ inches (1.6 to 3.1 μ meters) Ra roughness

Process Connections

Mounts between the following flange configurations:

ASME B16.5 (ANSI): Class 150, 300, 600, 900

DIN: PN 10, 16, 25, 40, 64, 100, 160

JIS: 10K, 20K, and 40K

Mounting

Integral (Standard)

Electronics are mounted on meter body

Remote (Optional)

Electronics may be mounted remote from the meter body. Interconnecting coaxial cable available in nonadjustable 10, 20, and 30 ft (3,0, 6,1, and 9,1 m) lengths. Consult factory for non-standard lengths up to 75 ft (22,9 m). Remote mounting hardware includes a polyurethane painted, carbon steel pipe mount bracket with one carbon steel u-bolt.

Pipe Length Requirements

The vortex meter may be installed with a minimum of *ten straight pipe diameters (D) upstream* and f*ive straight pipe diameters (D) downstream.*

Rated accuracy is based on the number of pipe diameters from an upstream disturbance. An additional 0.5% shift in K-factor may be introduced between 10 D and 35 D, depending on disturbance. For more information on installation effects, see Technical Data Sheet 00816-0100-3250.

Tagging

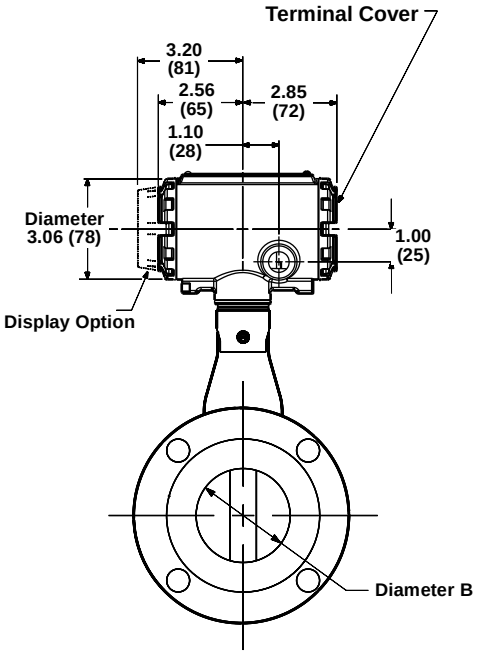
The flowmeter will be tagged at no charge, according to customer requirements. All tags are stainless steel. The standard tag is permanently attached to the flowmeter. Character height is 1/16-inch (1,6 mm). A wired-in tag is available on request.

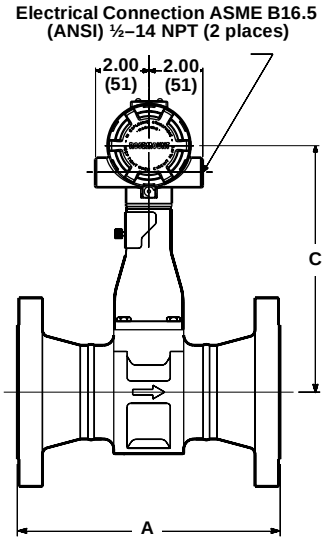
Flow Calibration Information

Flowmeter calibration and configuration information is provided with every flowmeter. For a certified copy of flow calibration data, Option Q4 must be ordered in the model number.

Dimensional Drawings

FIGURE 1. Flanged-Style Flowmeter Dimensional Drawings (1/2- through 12-in./15 through 300 mm Line Sizes)





NOTE
Dimensions are in inches (millimeters)

8800-0002A02B, 0002B02B

TABLE 11. Flanged-Style Flowmeter (1/2-through 3in./15 through 80 mm Line Sizes)

Nominal Size Inch (mm)	Flange Rating	Face-to-face A Inch (mm)(1)	A-ANSI RTJ Inch (mm)	Diameter B Inch (mm)(2)	C Inch (mm)(3)	Weight(4) lb (kg)
½ (15)	Class 150	6.9 (175)	–	0.52 (13,2)	7.6 (193)	9.1 (4,1)
	Class 300	7.2 (183)	7.7 (196)	0.52 (13,2)	7.6 (193)	10.4 (4,7)
	Class 600	7.7 (196)	7.7 (196)	0.52 (13,2)	7.6 (193)	10.8 (4,9)
	PN 16/40	6.1 (155)	–	0.52 (13,2)	7.6 (193)	10.4 (4,7)
	PN 100	6.6 (168)	–	0.52 (13,2)	7.6 (193)	12.3 (5,6)
	JIS 10K/20K	6.3 (160)	–	0.52 (13,2)	7.6 (193)	10.1 (4,5)
	JIS 40K	7.3 (185)	–	0.52 (13,2)	7.6 (193)	13.5 (6,1)
1 (25)	Class 150	7.5 (191)	8.0 (203)	0.95 (24,1)	7.7 (196)	12.3 (5,6)
	Class 300	8.0 (203)	8.5 (216)	0.95 (24,1)	7.7 (196)	15.0 (6,8)
	Class 600	8.5 (216)	8.5 (216)	0.95 (24,1)	7.7 (196)	15.8 (7,2)
	Class 900	9.4 (239)	9.4 (239)	0.95 (24,1)	7.7 (196)	24.3 (11,0)
	PN 16/40	6.3 (160)	–	0.95 (24,1)	7.7 (196)	13.5 (6,1)
	PN 100	7.7 (195)	–	0.95 (24,1)	7.7 (196)	19.5 (8,8)
	PN 160	7.7 (195)	–	0.95 (24,1)	7.7 (196)	19.5 (8,8)
	JIS 10K/20K	6.5 (165)	–	0.95 (24,1)	7.7 (196)	13.7 (6,2)
	JIS 40K	7.9 (200)	–	0.95 (24,1)	7.7 (196)	17.4 (7,9)
1 ½ (40)	Class 150	8.2 (208)	8.7 (221)	1.49 (37,8)	8.1 (206)	17.6 (8,0)
	Class 300	8.7 (221)	9.2 (234)	1.49 (37,8)	8.1 (206)	23.0 (10,4)
	Class 600	9.4 (239)	9.4 (239)	1.49 (37,8)	8.1 (206)	25.3 (11,5)
	Class 900	10.4 (264)	10.4 (264)	1.49 (37,8)	8.1 (206)	36.3 (16,5)
	PN 16/40	6.9 (175)	–	1.49 (37,8)	8.1 (206)	19.3 (8,8)
	PN 100	8.2 (208)	–	1.49 (37,8)	8.1 (206)	27.9 (12,7)
	PN 160	8.4 (213)	–	1.49 (37,8)	8.1 (206)	29.3 (13,3)
	JIS 10K/20K	7.3 (185)	–	1.49 (37,8)	8.1 (206)	18.6 (8,4)
	JIS 40K	8.5 (215)	–	1.49 (37,8)	8.1 (206)	25.6 (11,6)
2 (50)	Class 150	9.3 (236)	9.8 (249)	1.92 (48,8)	8.5 (216)	22.0 (10,0)
	Class 300	9.8 (249)	10.4 (264)	1.92 (48,8)	8.5 (216)	26.0 (11,8)
	Class 600	10.5 (267)	10.7 (271)	1.92 (48,8)	8.5 (216)	29.6 (13,4)
	Class 900	12.8 (325)	12.9 (328)	1.92 (48,8)	8.5 (216)	59.4 (26,9)
	PN 16/40	8.0 (203)	–	1.92 (48,8)	8.5 (216)	23.0 (10,4)
	PN 64	9.2 (234)	–	1.92 (48,8)	8.5 (216)	30.6 (13,9)
	PN 100	9.6 (244)	–	1.92 (48,8)	8.5 (216)	36.4 (16,5)
	PN 160	10.2 (259)	–	1.92 (48,8)	8.5 (216)	38.7 (17,6)
	JIS 10K	7.7 (195)	–	1.92 (48,8)	8.5 (216)	19.5 (8,8)
	JIS 20K	8.3 (210)	–	1.92 (48,8)	8.5 (216)	20.1 (9,1)
	JIS 40K	9.8 (249)	–	1.92 (48,8)	8.5 (216)	28.3 (12,8)
3 (80)	Class 150	9.9 (251)	10.4 (264)	2.87 (72,9)	9.1 (231)	36.9 (16,7)
	Class 300	10.6 (269)	11.2 (284)	2.87 (72,9)	9.1 (231)	46.1 (20,9)
	Class 600	11.4 (290)	11.5 (292)	2.87 (72,9)	9.1 (231)	52.1 (26,6)
	Class 900	12.9 (328)	13.0 (330)	2.87 (72,9)	9.1 (231)	75.5 (34,2)
	PN 16/40	8.9 (226)	–	2.87 (72,9)	9.1 (231)	36.3 (16,5)
	PN 64	10.0 (254)	–	2.87 (72,9)	9.1 (231)	45.1 (20,5)
	PN 100	10.5 (267)	–	2.87 (72,9)	9.1 (231)	54.4 (24,7)
	PN 160	11.2 (284)	–	2.87 (72,9)	9.1 (231)	59.6 (27,0)
	JIS 10K	7.9 (200)	–	2.87 (72,9)	9.1 (231)	27.6 (12,5)
	JIS 20K	9.3 (235)	–	2.87 (72,9)	9.1 (231)	35.0 (15,9)
	JIS 40K	11.0 (280)	–	2.87 (72,9)	9.1 (231)	50.0 (22,7)

(1) ±0.14 inch (3.6 mm)

(2) ±0.03 inch (0.8 mm)

(3) ±0.20 inch (5.1 mm)

(4) Add 0.2 lb (0,1 kg) for display option.

TABLE 12. Flanged-Style Flowmeter (4-through 12-in./100 through 300mm Line Sizes) (Refer to Figure 1)

Nominal Size Inch (mm)	Flange Rating	Face-to-face A Inch (mm)[1]	A ANSI RTJ Inch (mm)	Diameter B Inch (mm)[2]	C Inch (mm)[3]	Weight[4] lb (kg)
4 (100)	Class 150	10.3 (262)	10.8 (274)	3.79 (96,3)	9.6 (244)	50.7 (23,0)
	Class 300	11.0 (279)	11.6 (295)	3.79 (96,3)	9.6 (244)	70.8 (32,1)
	Class 600	12.8 (325)	12.9 (328)	3.79 (96,3)	9.6 (244)	96.5 (43,8)
	Class 900	13.8 (351)	13.9 (353)	3.79 (96,3)	9.6 (244)	119.7 (54,3)
	PN 16	8.4 (213)	–	3.79 (96,3)	9.6 (244)	40.1 (18,2)
	PN 40	9.4 (239)	–	3.79 (96,3)	9.6 (244)	49.2 (22,3)
	PN 64	10.4 (264)	–	3.79 (96,3)	9.6 (244)	62.1 (28,2)
	PN 100	11.3 (287)	–	3.79 (96,3)	9.6 (244)	78.5 (35,6)
	PN 160	12.1 (307)	–	3.79 (96,3)	9.6 (244)	85.8 (38,9)
	JIS 10K	8.7 (220)	–	3.79 (96,3)	9.6 (244)	37.0 (16,8)
	JIS 20K	8.7 (220)	–	3.79 (96,3)	9.6 (244)	44.9 (20,4)
	JIS 40K	11.8 (300)	–	3.79 (96,3)	9.6 (244)	75.3 (34,2)
6 (150)	Class 150	11.6 (295)	12.1 (307)	5.7 (144,8)	10.8 (274)	90.0 (40,8)
	Class 300	12.4 (315)	13.0 (330)	5.7 (144,8)	10.8 (274)	129.5 (58,7)
	Class 600	14.3 (363)	14.5 (368)	5.7 (144,8)	10.8 (274)	195.5 (88,7)
	PN 16	8.9 (226)	–	5.7 (144,8)	10.8 (274)	75.6 (34,3)
	PN 40	10.5 (267)	–	5.7 (144,8)	10.8 (274)	95.3 (43,2)
	PN 64	12.1 (307)	–	5.7 (144,8)	10.8 (274)	138.8 (63,0)
	PN 100	13.7 (348)	–	5.7 (144,8)	10.8 (274)	168.5 (76,4)
	JIS 10K	10.6 (270)	–	5.7 (144,8)	10.8 (274)	79.8 (36,2)
	JIS 20K	10.6 (270)	–	5.7 (144,8)	10.8 (274)	97.7 (44,3)
	JIS 40K	14.2 (360)	–	5.7 (144,8)	10.8 (274)	175.9 (79,8)
8 (200)	Class 150	13.6 (345)	14.1 (358)	7.55 (191,8)	11.7 (297)	139.6 (63,3)
	Class 300	14.3 (363)	15.0 (381)	7.55 (191,8)	11.7 (297)	196.2 (89,0)
	Class 600	16.6 (422)	16.7 (424)	7.55 (191,8)	11.7 (297)	295.0 (133,8)
	PN 10	10.5 (266)	–	7.55 (191,8)	11.7 (297)	109.6 (49,7)
	PN 16	10.5 (266)	–	7.55 (191,8)	11.7 (297)	108.5 (49,2)
	PN 25	11.9 (302)	–	7.55 (191,8)	11.7 (297)	136.3 (61,8)
	PN 40	12.5 (318)	–	7.55 (191,8)	11.7 (297)	154.8 (70,2)
	PN 64	14.2 (361)	–	7.55 (191,8)	11.7 (297)	214.6 (97,3)
	PN 100	15.8 (401)	–	7.55 (191,8)	11.7 (297)	279.9 (127)
	JIS 10K	12.2 (310)	–	7.55 (191,8)	11.7 (297)	109.9 (49,9)
	JIS 20K	12.2 (310)	–	7.55 (191,8)	11.7 (297)	134.3 (60,9)
	JIS 40K	16.5 (420)	–	7.55 (191,8)	11.7 (297)	255.7 (116)
10 (250)	Class 150	14.6 (371)	15.1 (384)	9.56 (243)	12.8 (325)	197.2 (89)
	Class 300	15.8 (401)	16.4 (417)	9.56 (243)	12.8 (325)	285.2 (129)
	Class 600	19.1 (485)	19.2 (488)	9.56 (243)	12.8 (325)	475.3 (216)
	PN 10	11.9 (302)	–	9.56 (243)	12.8 (325)	156.3 (71)
	PN 16	12.1 (307)	–	9.56 (243)	12.8 (325)	161.1 (73)
	PN 25	13.5 (343)	–	9.56 (243)	12.8 (325)	197.4 (90)
	PN 40	14.8 (376)	–	9.56 (243)	12.8 (325)	245.3 (111)
	PN 64	16.4 (417)	–	9.56 (243)	12.8 (325)	306.3 (139)
	PN 100	18.9 (480)	–	9.56 (243)	12.8 (325)	443.0 (201)
	JIS 10K	14.6 (371)	–	9.56 (243)	12.8 (325)	173.3 (79)
	JIS 20K	14.6 (371)	–	9.56 (243)	12.8 (325)	220.5 (100)
	JIS 40K	18.1 (460)	–	9.56 (243)	12.8 (325)	377.3 (171)
12 (300)	Class 150	16.8 (427)	17.3 (439)	11.38 (289)	13.7 (348)	296.0 (134)
	Class 300	18.0 (457)	18.7 (475)	11.38 (289)	13.7 (348)	413.2 (187)
	Class 600	20.5 (521)	20.7 (526)	11.38 (289)	13.7 (348)	592.2 (269)
	PN 10	13.2 (335)	–	11.38 (289)	13.7 (348)	203.1 (92)
	PN 16	13.9 (353)	–	11.38 (289)	13.7 (348)	223.4 (101)
	PN 25	15.0 (381)	–	11.38 (289)	13.7 (348)	267.8 (121)
	PN 40	16.9 (429)	–	11.38 (289)	13.7 (348)	345.7 (157)
	PN 64	18.8 (478)	–	11.38 (289)	13.7 (348)	428.5 (194)
	PN 100	21.2 (538)	–	11.38 (289)	13.7 (348)	640.8 (291)
	JIS 10K	15.7 (399)	–	11.38 (289)	13.7 (348)	224.5 (102)
	JIS 20K	15.7 (399)	–	11.38 (289)	13.7 (348)	287.1 (130)
	JIS 40K	19.7 (500)	–	11.38 (289)	13.7 (348)	504.7 (229)

(1) ±0.14 inch (3.6 mm)

(2) ±0.03 inch (0.8 mm)

(3) ±0.20 inch (5.1 mm)

(4) Add 0.2 lb (0,1 kg) for display option.