

## I/A Series<sup>®</sup> Intelligent Vortex Flowmeters Foxboro Model 84F Flanged Body Flowmeters and Foxboro Model 84W Wafer Body Flowmeters with HART Communication Protocol



The Foxboro Models 84F and 84W are part of a family of intelligent, high performance, flanged and wafer body vortex flowmeters. They transmit a 4 to 20 mA or digital multidrop, and a pulse output signal, as applicable, using HART communication protocol for remote configuration, calibration, and monitoring. An On-board LCD indicator with pushbuttons is also offered for local configuration.

### FEATURES

- Liquid, gas, or steam applications.
- Flanged or wafer body designs:
  - 3/4 to 12 in (DN 15 to DN 300) flanged body.
  - 3/4 to 8 in (DN 15 to DN 200) wafer body.
- Best in class accuracy:
  - $\pm 0.5\%$  of reading in liquids.
  - $\pm 1.0\%$  of reading in gas and steam.
- Widest rangeability in class.
- Active Tuning<sup>™</sup>:
  - Real time Reynolds number ( $R_D$ ) low flow correction down to  $R_D$  of 5000.
  - Compensation for piping effects.
  - Adaptive filtering and signal conditioning.
  - Tunable for specific operating conditions.
- HART communication protocol.
- *DirectSense*<sup>™</sup> technology with lifetime sensor warranty.
- New Pulse Output provides raw or scaled frequency, or total.
- Conforms to applicable European Union Directives (including PED)
- Invensys Foxboro has a free-to-use, flow sizing program on the internet at [www.FlowExpertPro.com](http://www.FlowExpertPro.com). See next page.

**FlowExpertPro™**

FlowExpertPro is a program primarily used to size Foxboro flowmeters. It also ensures that the user has selected the proper flowmeter type for his application. Invensys provides this meter selection tool as a free web site to all users, without the need for registration. In addition to flowmeter selection and sizing, FlowExpertPro includes the following features:

- Incorporates a large library of the physical properties of typical process fluids.
- Displays results in tabular or graphic format.
- Allows user to save, print, or E-mail results.
- Provides reference to applicable flowmeter PSSs and other related flowmeter documentation.

The program calculates minimum and maximum flow rates, rangeability, pressure loss, and Reynolds Number, using established flow equations. It also allows for material and flange selection, and provides ANSI or metric flange recommendations for predicted flow pressure and temperature. You are invited to visit [www.FlowExpertPro.com](http://www.FlowExpertPro.com) to access this program, or contact Invensys for further information, and technical support.

**WIDE VARIETY OF APPLICATIONS**

The Foxboro Models 84F and 84W set the example for industry standards whether the application requires accuracy for totalizing and batching; utility metering of fluids in the process industries; fuel, air, steam, or gas metering for the measurement of energy in any high use application; or stability and repeatability for process control.

**SIMPLE DESIGN FOR BEST PERFORMANCE AND RELIABILITY**

This patented family of vortex flowmeters has the high accuracy and rangeability of positive displacement and turbine flowmeters without the mechanical complexity and high cost. They provide flow rate accuracy of  $\pm 0.5\%$  in liquids and  $\pm 1.0\%$  in gas and steam. It utilizes patented *DirectSense* technology to eliminate routine problems encountered with other vortex meters. *DirectSense* technology measures pressure pulses from vortex shedding directly, without losses due to mechanical linkages. The benefits of *DirectSense* technology include:

- Provides best performance in class.
- Increased measurement sensitivity for wider rangeability.
- Greater immunity to pipe vibration.
- High reliability backed by lifetime sensor warranty.
- Replaceable sensor without recalibrating.

Because these vortex flowmeters have no moving parts, they are very durable and reliable. The simplicity of design ensures low initial cost, low operating and maintenance costs, which contribute to an overall lower cost of ownership.

**ActiveTuning™** (See Paragraphs below)**Reynolds Number**

Patented algorithm improves accuracy performance down to an  $R_D$  of 5000.

**Compensations for Piping Effects**

When it is not possible to provide the recommended pipe diameters of unobstructed straight pipe upstream of the flowmeter, the 84 Series can be configured to compensate for most of the common non-ideal upstream conditions, such as elbows and reducers. Straight runs as short as 5-pipe diameters can be configured to achieve full accuracy.

**Adaptive Filtering and Signal Conditioning**

A patented, adaptive filtering algorithm provides real-time, dynamic frequency filters that follow the vortex shedding frequency. This results in unsurpassed low-flow measurement capability and vibration immunity. This is incorporated with a digital smoothing algorithm that conditions the raw vortex signal to virtually eliminate dropped or added pulses, further enhancing low-flow performance.

**Tunable for Specific Operating Conditions**

Configurable parameters for Low Flow Cut-in and damping allow tuning for specific flow conditions.

**SIMPLIFIED START-UP**

No primary device calculations or mechanical calibrations are required. The flowmeter is easily installed and configured. Simply wire it to a proper power source, an I/O module, or controller, and it is ready to measure flow.

Invensys will preconfigure the flowmeter using flow data supplied by the customer. Generically preconfigured flowmeters can be used as shipped, but for more precise application, the flowmeter should be configured to specific process usage. The configurator allows selection of the fluid type, and provides general default configurations when process conditions are not available.

**REMOTE MOUNTED ELECTRONICS HOUSING**

Remote mounting is offered to allow access to the amplifier and other housing electronics when the measurement is not in an easily accessible location. The remote housing is supported by a bracket, which in turn mounts to a surface or to a nominal 2-in or DN 50 pipe. This housing can be located up to a cable length of 50 ft (15.2 m) from the flowtube without loss of low level signal.

**ISOLATION VALVE**

An isolation valve allows the sensor to be removed or replaced without interrupting the flow in the pipe.

## MEASUREMENT INTEGRATION

These flowmeters provide efficient integration of measurements into HART process control schemes, as follows.

### HART -T and -U Versions

These versions operate by using a bidirectional digital signal superimposed on the 4 to 20 mA current signal. They are also offered with or without a pulse output. Remote communication of digital values plus status and configuration information can be achieved via HART communication protocol.

Configurators used with the HART versions are:

- The HART Communicator (users having a HART Communicator for other devices can have them upgraded with Invensys Foxboro software to accommodate these flowmeters).
- The Local Digital Indicator/Configurator with pushbuttons.

With HART, digital multidropping is permitted. This is the connection of several transmitters to a single communications line. Up to fifteen transmitters can be connected on a single twisted pair of wires or over leased telephone lines.

### COMPACT, EFFICIENT, AND DURABLE DESIGN

The flowmeter mounts between ANSI or EN 1092-1 raised face flanges. See Model Code section for end connections offered with each line size. Other flange face surfaces can be used as a custom design.

The electronics housing is of explosionproof and flameproof construction and provides environmental protection to the enclosed electronics. It is offered integrally mounted to the flowtube, or can be mounted remotely.

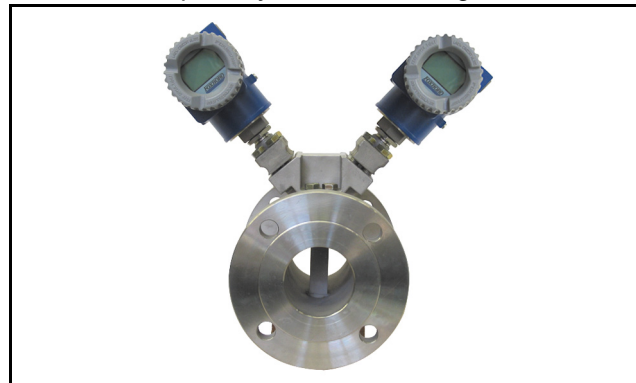
The flowmeter's simple, modular design requires minimum maintenance. Common, field replaceable parts are used, including the sensor assembly and amplifier. The amplifier can be replaced without interrupting the flow in the pipe, and sensor can be replaced without process shutdown when an isolation valve is installed. Since a single device is used for multiprocess-fluid applications, ordering is simplified and spare part needs minimized.

## LOCAL DIGITAL INDICATOR/CONFIGURATOR

This is a full feature, 16-character digital indicator and configurator. Total flow and/or the instantaneous flow rate may be displayed in user-selected flow units. The display may be configured for either flow or total, or to toggle between them. Four pushbuttons on the indicator are used to configure the flowmeter.

### DUAL MEASUREMENT FLOWMETER (84F ONLY)

Dual measurement flowmeters provide the user with redundant sensors and electronics. Two electronics housings and sensors are mounted to a common flowmeter body assembly. Should one transmitter fail, the redundant measurement avoids the necessity of shutting down the process. The failed transmitter can then be replaced at some later noncritical time. Applications include Safety Shutdown Systems (independent of Process Measurement Network), Safety Backup for critical flow loops, Comparative Verification of Measurement for high accuracy precision loops, or just for dual communications paths with the same primary element. See figure below.



### USABLE IN HAZARDOUS AREA LOCATIONS

Meet numerous Agency requirements for hazardous locations. Versions available to meet Agency flameproof and zone requirements.

### “CE” COMPLIANCE

These flowmeters comply with applicable European Community Standards for immunity to EMI emissions, and pressure equipment directive (PED) 97/23/EC.

**OPERATING CONDITIONS (a)**

Influence	Factory Calibration Conditions (b)	Operating Limits
Process Fluid	Clear Water	Liquid, Gas, and Steam
Process Temperature • Std. Temp. Version/Fluorolube Fill • Std. Temp. Version/Silicone Fill • High Temp. Version/Unfilled	• 70 to 85°F (20 to 30°C) • 70 to 85°F (20 to 30°C) • 70 to 85°F (20 to 30°C)	• 0 and +200°F (-20 and +90°C) • 0 and +400°F (-20 and +200°C) • 400 and 800°F (200 and 430°C)
Ambient Temperature (Housing) • with Indicator/Configurator • without Indicator/Configurator	• 70 to 85°F (20 to 30°C) • 70 to 85°F (20 to 30°C)	• 0 and +176°F (-20 and +80°C) (c) • -40 and +176°F (-40 and +80°C) (c)
Relative Humidity	50 to 90%	0 and 100%
Supply Voltage - mA Output	24 ±0.5 V dc	15.5 and 42 V dc (see Figure 2)

- (a) Limit are based on nonflashing, noncavitating conditions. A minimum positive back pressure is required for proper operation to avoid these effects.
- (b) Assumes ANSI Schedule 40 process piping; flanges bored to interfacing pipe I.D.; piping and flowmeter body bores aligned to within 2% of meter bore; gaskets to be 3.18 mm (0.125 in) thick and not protruding into pipeline; a minimum of thirty pipe diameters of straight pipe upstream and five pipe diameters downstream of flowmeter; clear water is free from air or particles.
- (c) The 176°F (80°C) temperature is extended to 185°F (85°C) with certain electrical approvals or certifications. Refer to Electrical Safety Specifications table further in document.

**PERFORMANCE SPECIFICATIONS**

**(Under Calibrated Operating Conditions unless Otherwise Stated)**

**Factory Calibrated Flow Ranges**

Nominal Meter Size	Nominal Mean K-Factor in Pulses/ft <sup>3</sup> (Pulses/L) (a)	Factory-Calibrated Flow Range for Water (c)		
		Range in US gpm	Range in L/s	Range Reynolds Number (R <sub>D</sub> )
3/4 in (DN 15)	5580 (197)	6.9 to 34	0.43 to 2.1	30 000 to 150 000
1 in (DN 25)	2250 (79.5)	8.9 to 56	0.56 to 3.5	30 000 to 190 000
1 1/2 in (DN 40)	570 (20.1)	14 to 140	0.88 to 8.7	30 000 to 300 000
2 in (DN 50)	258 (9.11)	18 to 230	1.1 to 15	30 000 to 380 000
3 in (DN 80)	78.7 (2.78)	34 to 500	2.1 to 32	38 000 to 570 000
4 in (DN 100)	34.8 (1.23)	59 to 890	3.7 to 56	50 000 to 750 000
6 in (DN 150)	10.00 (0.353)	140 to 2000	8.5 to 130	76 000 to 1 100 000
8 in (DN 200)	4.26 (0.150)	240 to 3600	15 to 220	100 000 to 1 500 000
10 in (DN 250) (b)	1.99 (0.0703)	390 to 5800	24 to 370	130 000 to 1 900 000
12 in (DN 300) (b)	1.16 (0.0410)	560 to 8400	36 to 530	160 000 to 2 300 000

- (a) The K-factor is the relationship between input (volumetric flow rate) and the output (pulse rate).  
Reference K-factor is the arithmetic mean value of K-factor over a designated flow rate range (reference conditions).  
The mean K-factor is derived as:  
$$\text{Mean K-factor} = (\text{KMAX} + \text{KMIN}) / 2$$
  
Where KMAX is the Maximum K-factor and KMIN is the Minimum K-factor over the calibrated flow range.
- (b) The 10 and 12 in (DN 250 and DN 300) flowmeters are available with the Model 84F only.
- (c) Factory calibrated Reynolds Number range applies to standard temperature sensor without isolation valve. Other sensor selections and manifold selections may alter the calibration range. See FlowExpertPro for specific calibration ranges.

**PERFORMANCE SPECIFICATIONS (Cont.)**

**Accuracy for Liquids**

Accuracy within the calibrated range is as follows (also see Figure 1):

- Above 30 000  $R_D$ ;  $\pm 0.5\%$
- Between 20 000 and 30 000  $R_D$ ;  $\pm 1.0\%$
- Between 5 000 and 20 000  $R_D$ ;  $\pm 2.0\%$

**Accuracy for Gases and Steam**

Accuracy within the calibrated range is as follows:

- Above 20 000  $R_D$ ;  $\pm 1.0\%$
- Between 5 000 and 20 000  $R_D$ ;  $\pm 2.0\%$

**NOTE**

To achieve the fluid accuracies listed above, the flowing density and viscosity must be entered in the database configuration. Also, refer to FlowExpertPro.com to determine accuracy for specific applications.

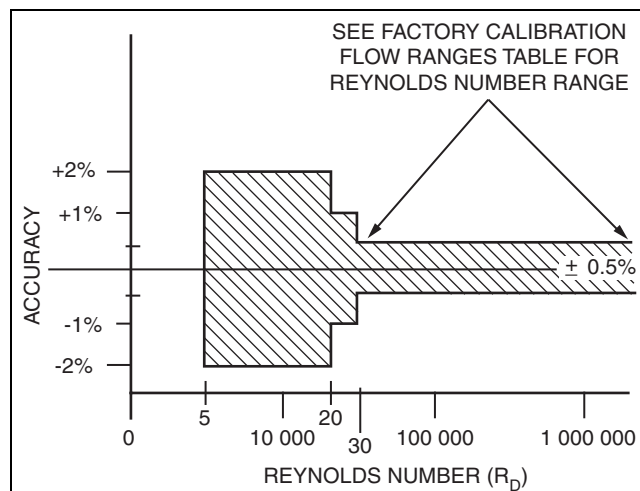


Figure 1. Flowmeter Accuracy for Liquids

**Supply Voltage Effect (Within Stated Limits)**

WITH PULSE OUTPUT

No effect on accuracy

WITH ANALOG OUTPUT

Less than 0.005% per volt

WITH DIGITAL OUTPUT

No effect on accuracy

**Process Temperature Effect on K-Factor**

There is an effect on the reference K-factor due to a diameter change of the flowtube bore with temperature. The effect is -0.3% of flow rate per 100°F (55°C) increase in temperature. These flowmeters will automatically recompute a flowing K-factor when process temperature is entered in the database fluid definition.

**Ambient Temperature Effect (Amplifier only)**

WITH PULSE OUTPUT

$\pm 0.01\%$  of reading from  
-40° to +176°F (-40° to +80°C)<sup>(1)</sup>

WITH ANALOG OUTPUT

For 50°F (28°C) change in ambient temperature within operative limits.

*Zero (4 mA)*

$\pm 0.02\%$  of span maximum

*Span (16 mA)*

$\pm 0.1\%$  of span maximum

WITH DIGITAL OUTPUT

$\pm 0.01\%$  of reading from  
-40° to +176°F (-40° to +80°C)<sup>(1)</sup>

**Relative Humidity Effect**

No effect if covers and conduit seals are properly installed.

**EMI and RFI Effects**

The flowmeters meet the EMI and RFI requirements of EN 61326.

**Vibration Effect**

Vibration can affect the flow measurement output of a Vortex flowmeter in the form of added pulses, but with the built-in Tuning functions and Low Flow Cut-in adjustability, these effects can be minimized. Invensys Foxboro has tested this meter with vibrations up to 3 “g” of acceleration with no physical damage, no shift in calibration after the test, and no loss of communications throughout the test.

**Position Effect (Filled Pipe Conditions)**

For most applications, the flowmeter can be mounted in a pipeline which may run in any direction from the vertical (flow in upward direction) to the horizontal. Measurement of liquid and gas streams is not effected by the pipeline orientation or the flowmeter orientation in the pipeline.

For saturated steam, the recommended flowmeter position is in a horizontal pipe with the electronics housing located below the pipeline.

For superheated steam, the electronics housing may be left or right or below the pipeline. The flowmeter should be insulated to maintain superheat conditions within the flowmeter, as well as insulating the electronics away from the rising heat. The electronics temperature should not exceed 176°F (80°C) under any conditions.

Refer to Recommended Mounting Arrangements section for further information.

(1) The 176°F (80°C) temperature may be extended to 185°F (85°C). Refer to Electrical Safety Specifications table further in the document.

**FUNCTIONAL SPECIFICATIONS**

**Direct Connectivity to Invensys Foxboro I/A Series Open Industrial System**

The Models 84F and 84W can be connected directly to the I/A Series System using I/A Series fieldbus modules (FBMs). Invensys can provide the FBM applicable to your installation.

**Remote Communication/Configuration**

Refer to Table 1 for remote configurators/communicators used with these flowmeters.

**Local Communication/Configuration**

In addition to remote communications, a local digital indicator/configurator with pushbuttons is also available for local interrogation and configuration.

**Password Protection**

This is provided in the local display/configurator mode to assure operating security. A second level of protection is provided for configuration security.

**Write Protect Jumper**

A write protect jumper provides additional security by allowing the user to prevent the local indicator/configurator and remote configurator from writing to the electronics. This write protection capability meets the security requirements of ISA-584.01-1986.

**Communication Format**

Digital communications is provided in both the analog (4 to 20 mA) and digital modes based upon the FSK (Frequency Shift Keying) technique. See Table 1 for communication parameters.

**On-Line Diagnostics**

Flowmeter uses many internal diagnostic functions including hardware checks, and internal code and database validation. Error checking and diagnostic codes are also embedded in the communications protocol. These diagnostics are performed at startup and as continuous background checks.

**Offline Diagnostics (Self-Test)**

The configurators allow self-tests to be initiated to validate the transmitter electronics. This test uses an internally generated frequency signal.

**Supply Current**

- DIGITAL MODE
  - 10 mA dc nominal
- ANALOG MODE
  - 22 mA dc maximum
- PULSE OUTPUT
  - 20 mA dc maximum

**Supply Voltage**

15.5 to 42 V dc, depending on electrical safety approvals and certifications. Refer to Figure 2.

**NOTE**

When operating at ambient temperatures below -29°C (-20°F), it is important to maintain a minimum loop voltage of 15.75 V dc to maintain remote configurator communications capability.

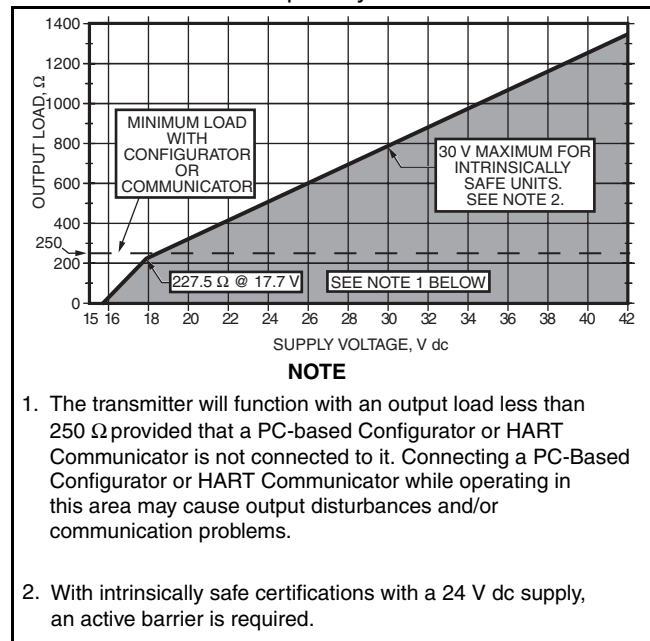


Figure 2. Supply Voltage vs Output Load for 4 to 20 mA Output

Table 1. Remote Communication Parameters

Parameter	HART	
	Analog Mode	Digital Multidrop Mode
Remote Configurator/Communicator	HART Communicator or PC-based Configurator	
Communication Rate	1200 baud	1200 baud
Communication Distance (Rated)	1800 m (6000 ft)	1800 m (6000 ft)
Flow/Total Measurement Update	5 times/s	5 times/s
Raw Pulse Measurement Update	– Vortex Shedding Frequency –	

**FUNCTIONAL SPECIFICATIONS (Cont.)**

**Output Damping**

Damping smooths the flow rate output, and optimizes the flowmeter’s response time to the control system. Damping is an exponential filter with a selectable time constant; it can be set between 0 and 32 seconds. An eight second damping factor will pass 64% of the step change in this time period. Damping applies to all outputs except the Raw Pulse Output where no damping is applied to the direct vortex shedding frequency.

**Response Time (Without Damping)**

**ANALOG MODE**

0.5 second or the vortex shedding period for frequencies less than 2 Hz.

**DIGITAL MODE**

0.5 second or the vortex shedding period for frequencies less than 2 Hz.

**PULSE OUTPUT**

- Raw Pulse: Vortex shedding frequency
- Rate or Total Pulse: 0.25 s or the vortex shedding period for frequencies less than 2 Hz.

**Nominal Flow Velocity Limits**

These limits can be calculated using Table 2. In the table,  $\rho_f$  is the fluid density at flowing conditions in  $\text{kg/m}^3$  or  $\text{lb/ft}^3$ , as applicable. The specifications apply for most applications, but can deviate slightly for some combinations of density and line size. Also refer to FlowExpertPro.

Table 2. Nominal Flow Velocity Limits

Range Limit	Standard Temperature Range		Extended Temperature Range	
	ft/s	m/s	ft/s	m/s
Lower	$2.5/\sqrt{\rho_f}$	$3.0/\sqrt{\rho_f}$	$5.0/\sqrt{\rho_f}$	$6.0/\sqrt{\rho_f}$
Upper	$250/\sqrt{\rho_f}$	$300/\sqrt{\rho_f}$	$250/\sqrt{\rho_f}$	$300/\sqrt{\rho_f}$

**Flowmeter Ranges**

Flowmeter is shipped with flow range specified in the sales order or with a default flow range equal to the meter capacity. It can be reranged by the user keeping the same flow rate units, choosing new flowrate units from a built-in menu-selectable list, or entering custom flow rate units. Also refer to FlowExpertPro.

**Outputs**

These Flowmeters with full-featured electronics can support the following outputs:

- HART Version -T: Digital and 4 to 20 mA Output, with a pulse output
- HART Version -U: Digital and 4 to 20 mA output

**ANALOG OUTPUT**

Flow rate available as a 4 to 20 mA signal with the 20 mA value being set by the configured full range flow rate.

**DIGITAL OUTPUT**

*Models 84F/W-T and -U*

Measurements available via HART. Digital Information is superimposed on a 4 to 20 mA signal at 1200 baud (also see Table 1).

**PULSE OUTPUT**

The pulse output can be configured with the full-function electronics: raw pulse, rate pulse, and total pulse.

*Raw Pulse*

This is the vortex shedding frequency directly passed through providing an instantaneous, nondamped frequency output.

*Rate Pulse*

The frequency of this output is a 50% duty cycle pulse output with a frequency range of 0 to 10, 0 to 100, or 0 to 1000 Hz, proportional to zero flow to the full range flow rate/upper range value (URV).

*Total Pulse*

The frequency of this output is also a 50% duty cycle pulse output that is configured to provide a pulse when a determined volumetric/totalized unit has flowed through the meter.

**Pulse Output Specifications**

The pulse output is an externally powered 2-wire transistor switch type output. This output can be configured using any applicable configuration device to select any one of three types of pulse outputs: raw pulse, rate pulse, and scaled pulse. The following specifications apply to all three types of outputs:

- Isolated 2-Wire Transistor Switch
- Applied Voltage: 5 to 30 V dc
- Maximum “ON” State Voltage Drop: 1.0 V dc
- Maximum “ON” State Current: 20 mA
- Reverse polarity protected
- Short circuit protected
- Connectable to pull up or pull down counters.

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**FUNCTIONAL SPECIFICATIONS (Cont.)**
**Output Combinations (4 to 20 mA Outputs)**

Flowmeter wired as a 2-wire device without pulse output, and as a 4-wire device with pulse output.

**Reference K-Factor**

The reference K-factor is a coefficient that specifies the flowmeter calibration and is expressed as pulses per unit volume, where pulses/unit volume = pulses per second divided by volume flow per second.

The reference K-factor is the arithmetic mean value of K over the factory-calibrated flow range. It is determined at the factory by actual flow calibration with water by comparison to a master flowmeter calibration, or by actual static weight. Both calibrations are traceable to NIST. The reference K-factor is entered in the flowmeter database and stamped on the data plate. Once established, this K-factor is available to gas, liquid, or steam applications.

**Flowing K-Factor**

The flowing K-factor is computed from the K-reference expressed in specified flowing units, and can be corrected for the following:

- Process Temperature
- Mating Pipe
- Upstream Disturbances

**Process Temperature Correction**

The flowmeter computes a corrected K-factor at the specific process temperature entered by the user.

**K-Factor Bias**

Provisions are made in the configuration menu to bias the flowmeter K-factor by a percent (%) value. Flowing K-factor value will be automatically recalculated when the % bias is entered.

**Static Pressure Limits****MINIMUM STATIC PRESSURE**

The minimum static pressure is that pressure which is sufficient to prevent flashing and meet the pressure drop requirements to attain maximum flow rate. Refer to FlowExpertPro sizing program.

**MAXIMUM STATIC PRESSURE**

1500 psig (103.4 bar) (10 340 kPa) or that imposed by flange rating.

**Approximate Pressure Loss (Pressure Drop)**

The maximum pressure loss at maximum flow for any fluid is 8 psi (0.55 bar) (55 kPa). For many flow conditions, however, the actual pressure loss is much less than 8 psi (0.55 bar) (55 kPa). Use the FlowExpertPro Sizing Program to determine actual pressure loss for a given set of flow conditions.

**Minimum Back Pressure (Volatile Liquids or Low Pressure Conditions)**

Any condition that tends to contribute to the release of vapor from the liquid (flashing, which may also induce cavitation) shall be avoided by proper system design and operation of the flowmeter within the rated flow rate range. Location of flowmeter should consider the need for using a back-pressure valve, or for increasing inlet pressure. To avoid flashing and to ensure stable vortex generation, the minimum back pressure should be:

$$P_G = (3)(\Delta P) + (1.25)(p_v) - (p_{atm})$$

where,

$P_G$  = Gauge pressure in psi or kPa five pipe diameters downstream of the flowmeter

$\Delta P$  = Pressure loss in psi or kPa (see "Approximate Pressure Loss" section)

$p_v$  = Vapor pressure at line conditions in psi or kPa absolute

$p_{atm}$  = Atmospheric pressure in psi or kPa absolute

**Flange Pressure-Temperature Ratings**

See Figures 3, 4, and 5 for ANSI flange pressure-temperature ratings. And see Figures 6, 7, and 8 for metric flange pressure-temperature ratings. Also see Figure 9 for pressure-temperature limits when isolation valves are used. Also note the temperature limit when fluorolube fill (200°F/90°C) or silicone fill (400°F/200°C) is used, or when no fill (800°F/430°C) is used with extended temperature applications. The flange ratings in Figures 3 through 8 are also embedded in the FlowExpertPro sizing program.

**Functional Block Diagrams**

Refer to Figures 10 and 11.



FUNCTIONAL SPECIFICATIONS (Cont.)

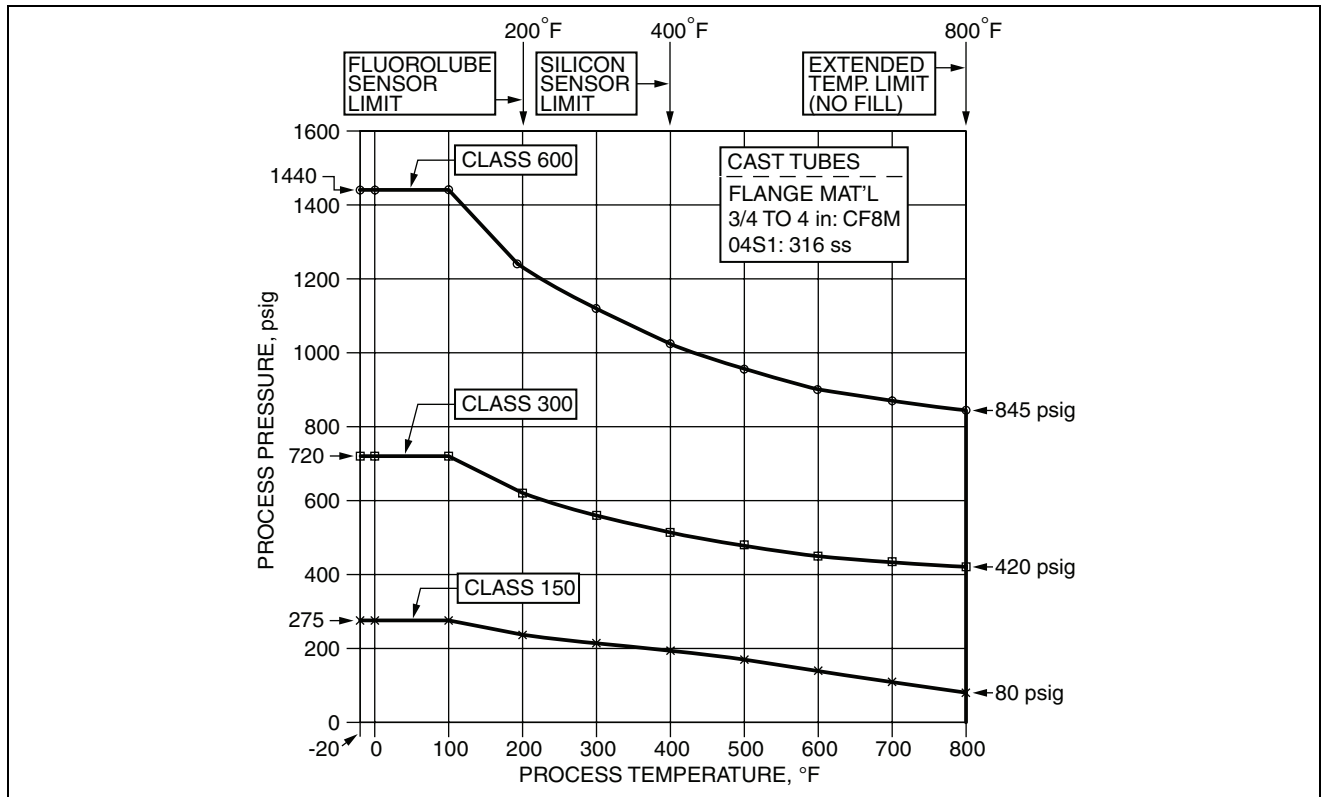


Figure 3. ANSI Flange Ratings; per ASME B16.5; Group 2.2 Materials

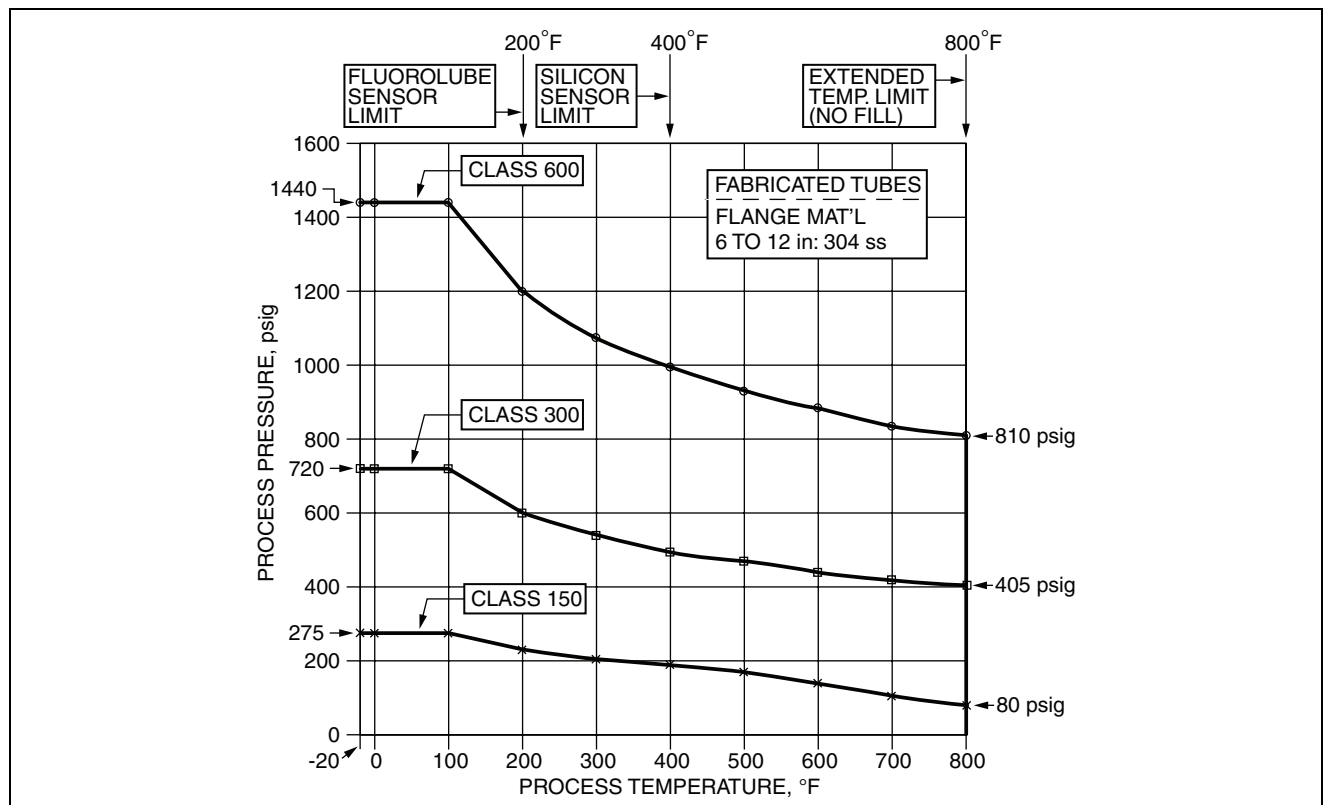


Figure 4. ANSI Flange Ratings; per ASME B16.5; Group 2.1 Materials

FUNCTIONAL SPECIFICATIONS (Cont.)

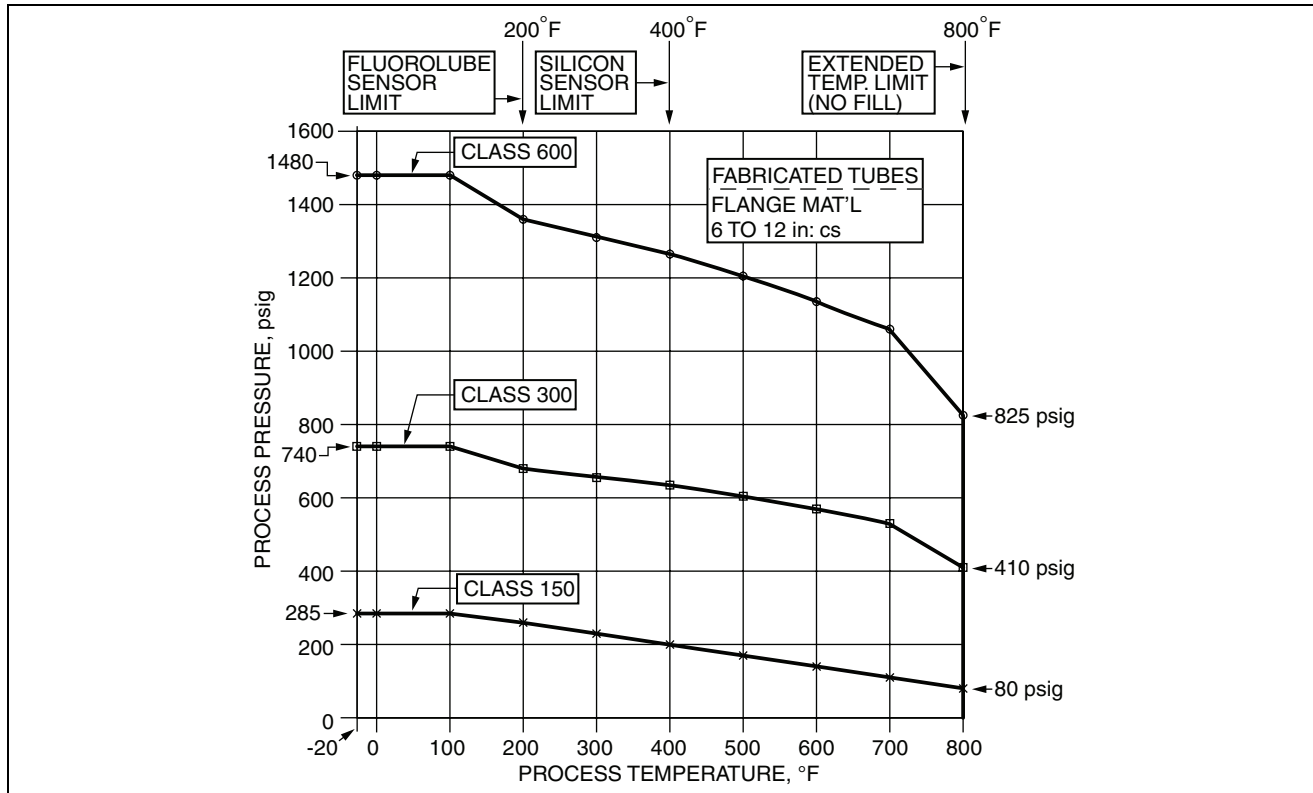


Figure 5. ANSI Flange Ratings; per ASME B16.5; Group 1.1 Materials

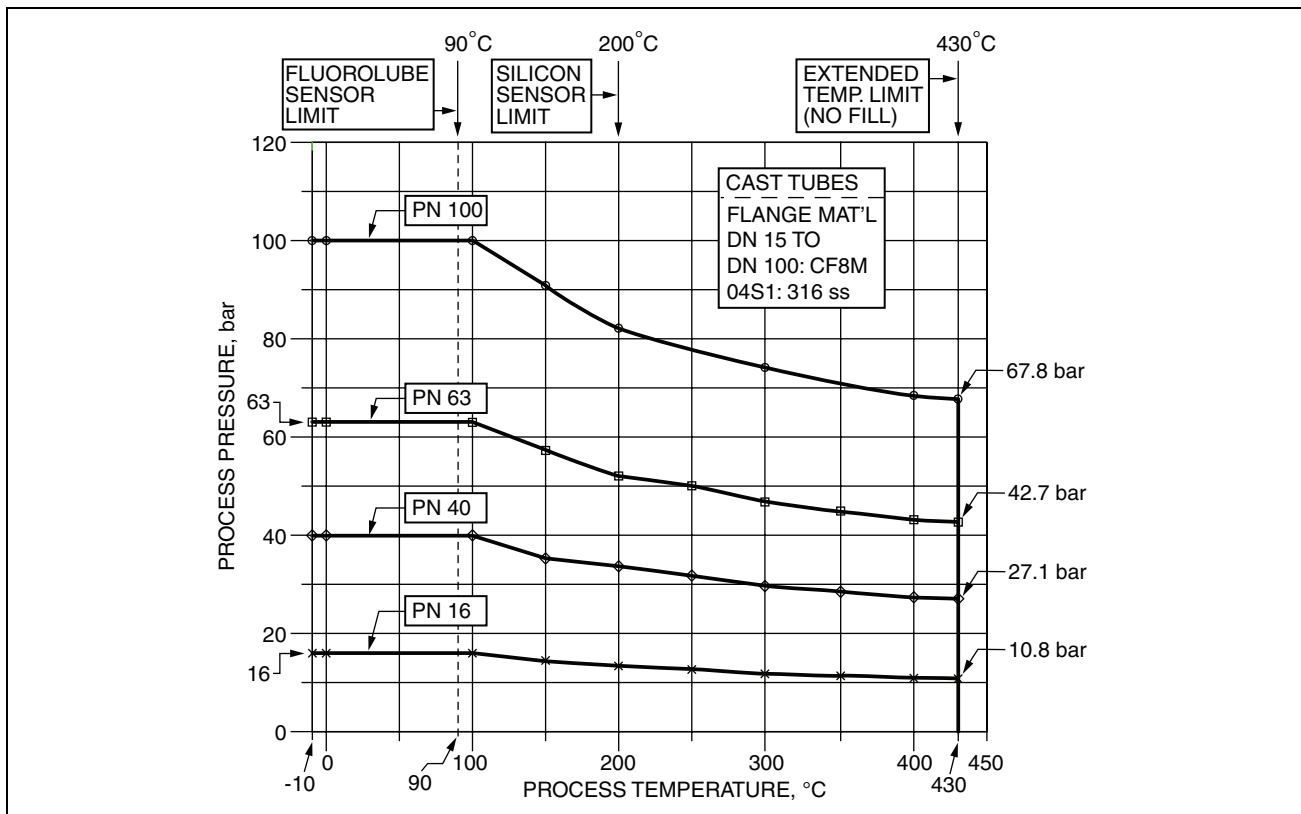


Figure 6. Metric Flange Ratings; per EN 1092-1; Material Group 14E0

FUNCTIONAL SPECIFICATIONS (Cont.)

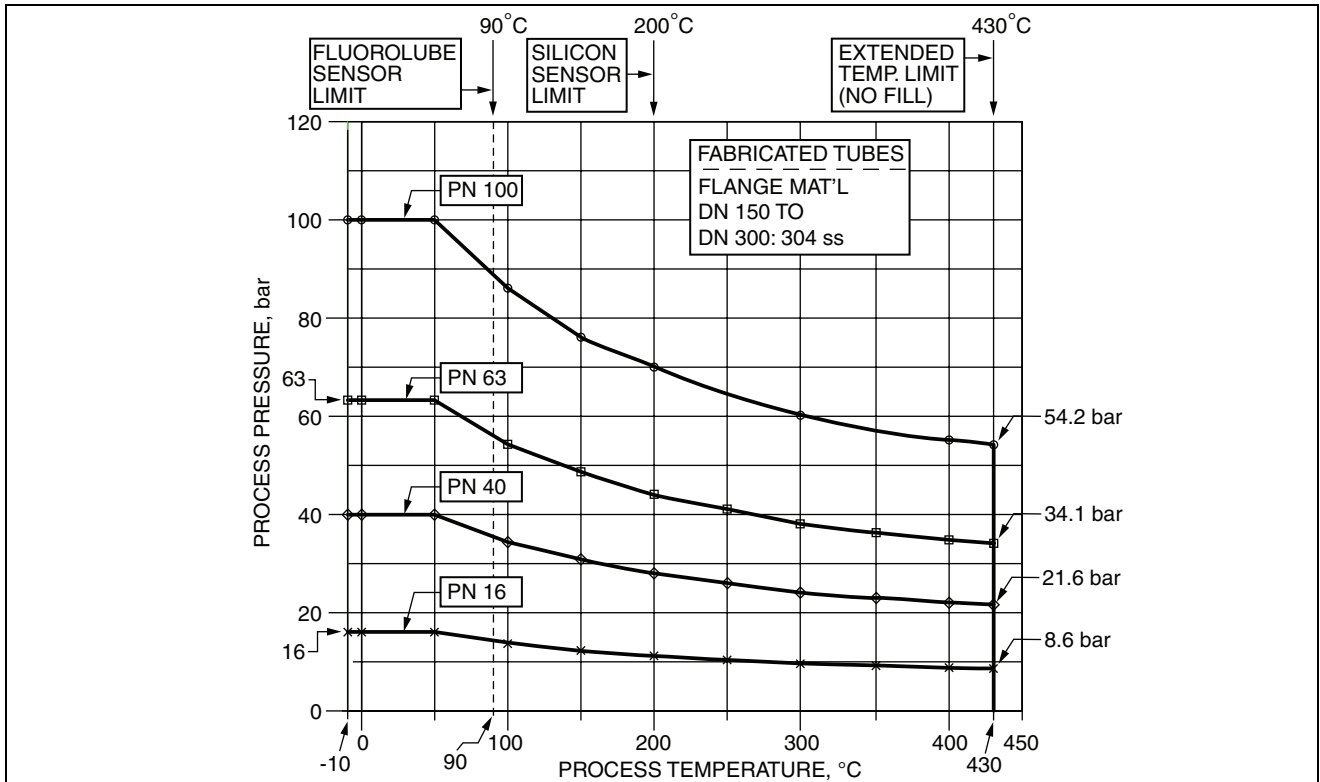


Figure 7. Metric Flange Ratings; per EN 1092-1; Material Group 10E0

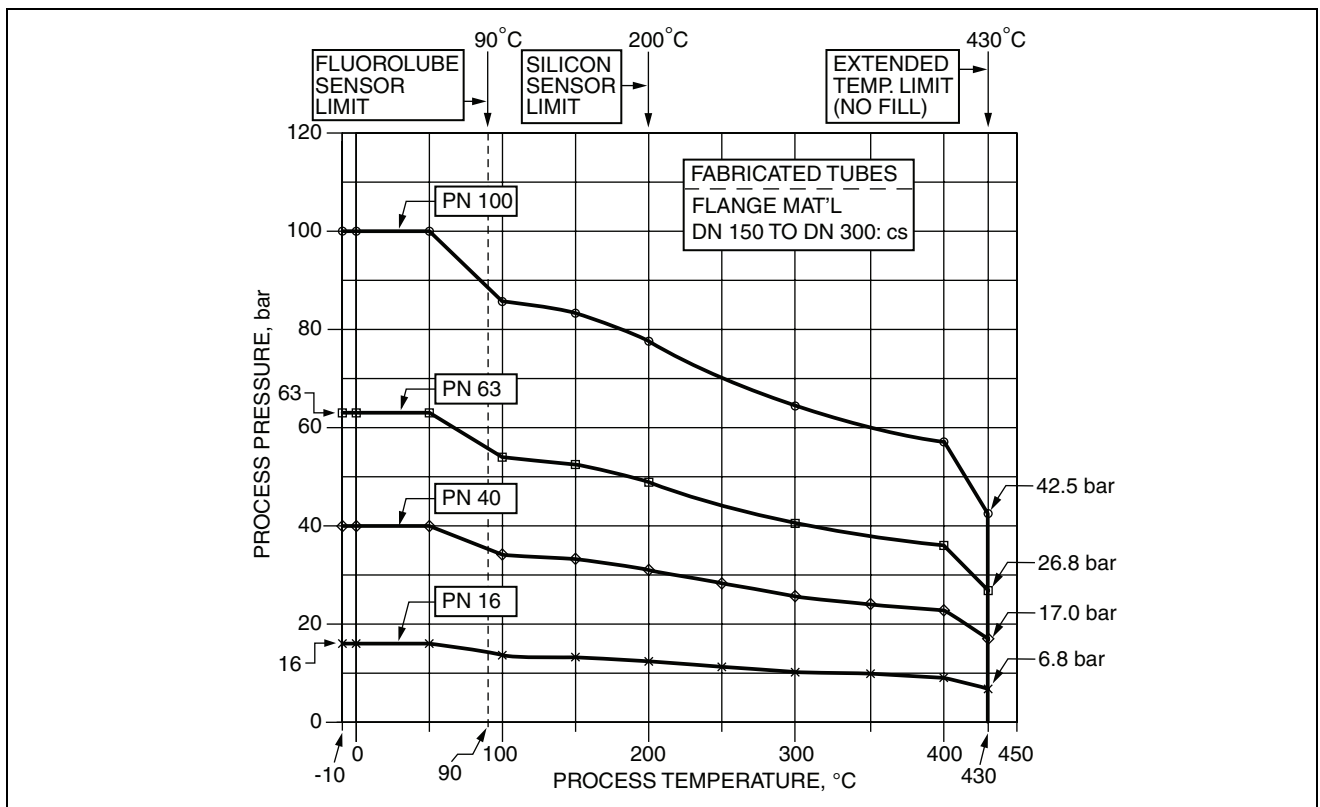


Figure 8. Metric Flange Ratings; per EN 1092-1; Material Group 3E0

FUNCTIONAL SPECIFICATIONS (Cont.)

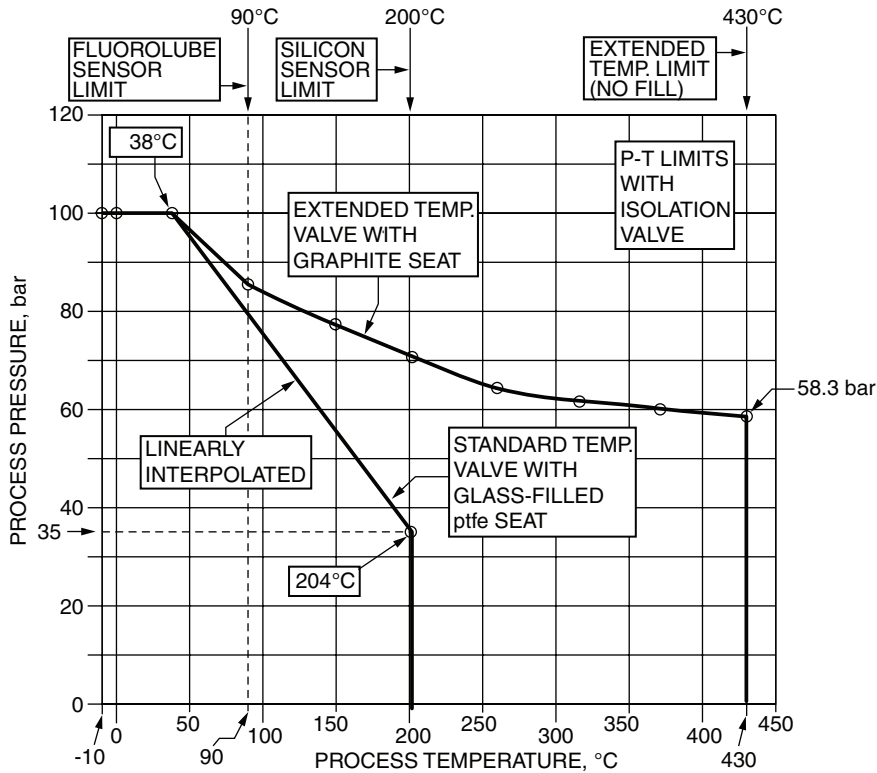
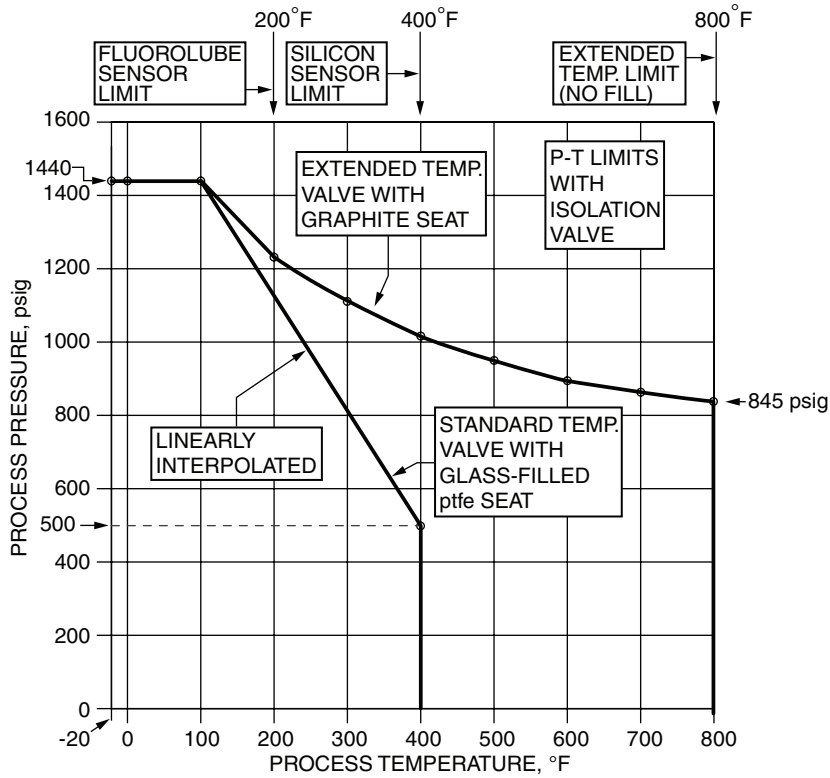


Figure 9. Pressure-Temperature Limits with Isolation Valve; U.S. Customary and Metric Units

FUNCTIONAL SPECIFICATIONS (Cont.)

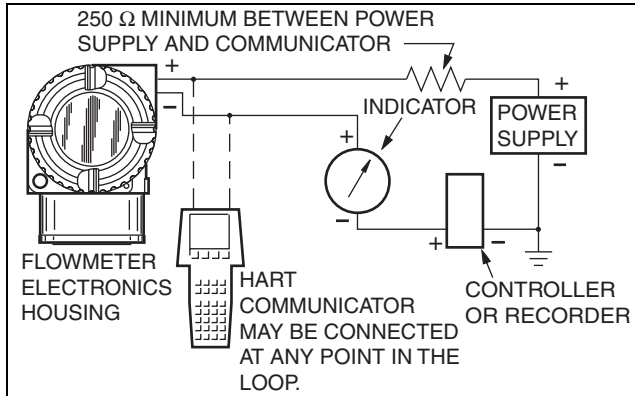


Figure 10. HART 4 to 20 mA Topology

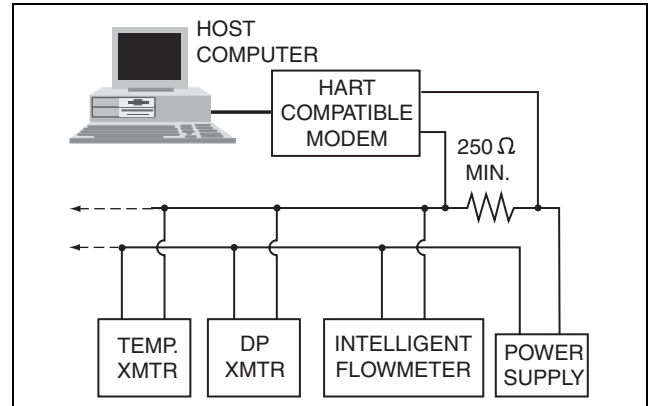


Figure 11. HART Multidrop Topology

**PHYSICAL SPECIFICATIONS**

**Process-Wetted Parts - Model 84F**

FLOWMETER BODY, FLANGES, AND SHEDDING BAR (ALSO SEE MODEL CODE)

- 316 ss up to 4 in (DN 100) sizes;
- 304 ss body and shedder, and cs or ss flange, for sizes >4 in (>DN 100).

GASKETS AND FLOW DAM (SENSOR SEALS)

- Standard Temperature Sensor
  - ptfе gasket and flow dam
- High Temperature Sensor
  - 316 ss gasket; 316 ss/grafoil flow dam
  - Hastelloy C gasket; Hastelloy C/grafoil flow dam

**Process-Wetted Parts - Model 84W**

(ALSO SEE MODEL CODE)  
FLOWMETER BODY AND SHEDDING BAR

- 316 ss for all sizes; or
- Hastelloy C for 3/4 to 4 in (DN 15 to DN 100) sizes.

GASKETS AND FLOW DAM (SENSOR SEALS)

- Standard Temperature Sensor
  - ptfе gasket and flow dam
- High Temperature Sensor
  - 316 ss gasket; 316 ss/grafoil flow dam
  - Hastelloy C gasket; Hastelloy C/grafoil flow dam

**Dual Measurement Manifold - Model 84F Only**

CF8M stainless steel; pressure and temperature rating of dual manifold same as flowmeter body.

**Flowmeter Mounting**

Flowmeter can be located in a pipeline which may run in any direction from the vertical (upward flow) to the horizontal. The electronics housing can also be rotated 270° (in 90° increments) with respect to the body. A vertical pipeline is preferred for batch operations to provide improved full line assurance. See Recommended Mounting Arrangements section.

**Electrical Connections**

Field wires enter through 1/2 NPT or M20 conduit threaded entrances on either side of the electronics housing. Wires terminate under screw terminals and washers on terminal block (see Figure 12) in the field terminal compartment. Unused entrance is plugged to insure moisture and RFI/EMI protection.

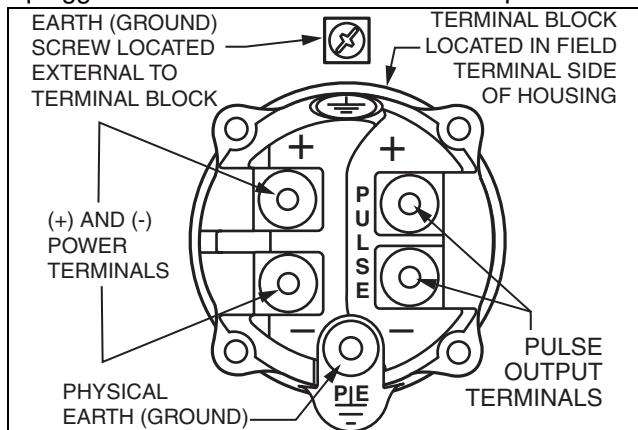


Figure 12. Terminal Block

**Electronics Housing and Housing Covers**

A two compartment housing separates the electronics from the field connections. Housing and covers are low copper, die-cast aluminum alloy with an epoxy finish. Buna-N O-ring seals are used to seal the housing covers, housing neck, and terminal block.

**Electronics Module**

Printed wiring assemblies (PWAs) are conformally coated for moisture and dust protection.

**Environmental Protection**

Electronics housing is dusttight and weatherproof per IEC IP66 and provides the environmental and corrosion resistant protection of NEMA Type 4X.

**Isolation Valve (if specified, see Model Code for Selection Options)**

VALVE BODY

- Grade CF8M stainless steel

VALVE BALL

- 316 ss

VALVE SEATS

- Standard Temperature: Glass-Filled ptfе
- Extended Temperature: Graphite

STEM SEAL

- The valve stem seal meets the external leakage requirements for fire safety per API Standard 607.

VALVE HANDLE

- Use adjustable wrench.

SEAT LEAKAGE

- Standard Temperature
  - Class IV – Less than 5 mL/h per MSS-SPG1.
- High Temperature
  - Class IV per ANSI/FCI-70.2

FLOW VELOCITY LIMITS

- See “Flow Velocity Limits” section.

APPLICATIONS

- Recommended for use with clean liquids, saturated steam, and all gases.

LIMITATIONS

- Not recommended for use with superheated steam without insulation, or liquids with suspended solids.

MOUNTING

- See MI 019-202 for installation guidelines.

PRESSURE/TEMPERATURE RATING

- Both standard and extended (high) temperature isolation valves have a maximum pressure rating of 1440 psi at 100°F (100 bar at 38°C). The standard temperature valve with ptfе seats is further limited to a maximum pressure of 500 psi at 400°F (35 bar at 204°C). The extended temperature valve has an ANSI Class 600 temperature and pressure rating. See Figure 9.

## PHYSICAL SPECIFICATIONS (Cont.)

### Data Plate

Stainless steel data plate encircles and is secured to the lower part of the electronics housing. Includes conventional Model and operating data, including the factory calibration factor (K-factor). If additional tag data space is required, an optional Stainless Steel Customer Tag is offered.

### NACE Certification

The stainless steel material option has been designed, and materials selected, to meet the requirements of NACE (National Association of Corrosion Engineers) Standard MR-01. A NACE compliance certificate is available by selecting the -Q option.

### Approximate Weight

See Table 3.

### Dimensions

Refer to Dimensions - Nominal section for general outline data. For more dimensional details, refer to the following Dimensional Prints (DPs).

Model	Configuration	Dimensional Print
84F	Single Measurement	DP 019-120
84F	Dual Measurement	DP 019-121
84W (a)	Single Measurement (a)	DP 019-122

(a) The 84W is not available as Dual Measurement Flowmeter.

Table 3. Approximate Weight - Models 84W and 84F (a)

Nominal Line Size		Model 84W Wafer Body		Model 84F Flanged Body (b)	
in	mm	lb	kg	lb	kg
3/4	DN 15	5	2.3	9	4.1
1	DN 25	6	2.7	11	5
1 1/2	DN 40	7	3.2	14	6.5
2	DN 50	10	4.5	18	8
3	DN 80	18	8.0	30	14
4	DN 100	25	11.5	45	20
6	DN 150	35	16	70	30
8	DN 200	60	27	125	57
10	DN 250	Not Available	Not Available	190	90
12	DN 300	Not Available	Not Available	260	120

(a) The weights shown are approximate and are meant as a guide to the user. See Notes below.

(b) The weights listed are for the 84F with ANSI Class 150 flanges.

### NOTES

- Standard temperature flowmeter weights are listed for integrally mounted electronics housings. There is a slight weight difference for high temperature flowmeters (adds about 1 lb (0.5 kg)), or for remote mounted housings (housing replaced by connector head assembly (junction box)). The electronics housing itself weighs about 4 lbs (2 kg) and varies slightly depending on whether indicator/configurator, and/or extended housing covers are used.
- For single measurement flowmeters, add approximately 2 lb (1 kg) if an isolation valve is used.
- For dual measurement flowmeters (applicable to 84F flowmeters only):
  - Add approximately 9 lb (4 kg) when a manifold without isolation valves is used.
  - Add approximately 15 lb (7 kg) when a manifold with two isolation valves is used.

## PRODUCT SAFETY SPECIFICATIONS

### Pressure Safety

Designed to withstand pressure within ANSI Class 150, 300, or 600 flange ratings, and metric PN 16, PN 40, PN 63, or PN 100 flange ratings. Refer to Figures 3 to 8. Note, for 84W Wafer Body Flowmeters, the flowtube face outside diameter is designed to center between ANSI Class 150 flanges. For other flange ratings, centering spacers are provided.

### Personnel and Electrical Fire Safety

This device is designed to be a minimum fire hazard by using low energy power and adequate insulation and separation of electrical circuits. The required standards of worldwide testing agencies such as FM, CSA, ATEX, IEC, and OSHA have been fulfilled.

**ELECTRICAL SAFETY SPECIFICATIONS**

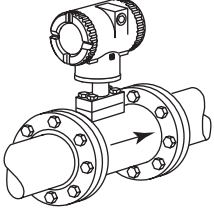
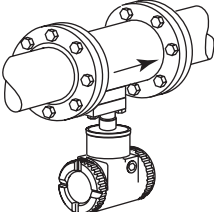
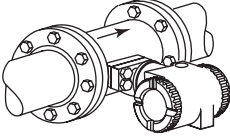
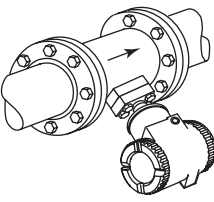
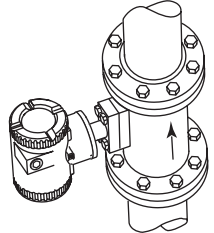
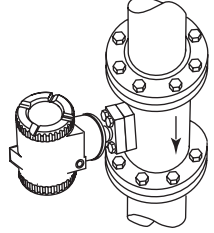
Agency, Types of Protection, and Area Classification	Application Conditions	Elect. Safety Design Code
ATEX intrinsically safe: II 1 GD EEx ia IIC	Integrally mounted or remote mounted (electronics and junction box). Temperature Class T4, T103°C; Ta = -40 to +80°C.	E
ATEX flameproof: II 2/1 (1) GD EEx d [ia] ia	Integrally mounted electronics. Temperature Class T4, T85°C; Ta = -20 to +80°C.	H
ATEX flameproof: II 2 (1) GD EEx d [ia]	Electronics housing of remote mounted version. Temperature Class T4, T85°C; Ta = -20 to +80°C.	
ATEX flameproof: II 1 GD EEx ia IIC.	Flowtube junction box of remote mounted version. Temperature Class T4, T103°C; Ta = -40 to +80°C.	
CSA intrinsically safe for Class I, II, III, Div. 1, Groups A, B, C, D, E, F, G. Also, Zone certified intrinsically safe Ex ia IIC.	Temperature Class T4; Ta = -40 to +80°C.	C
CSA explosionproof with IS sensor connection for Class I, Div. 1, Groups B, C, and D; dust-ignitionproof for Class II, Div. 1, Groups E, F, and G; Class III, Div. 1.	Temperature Class T5. Ta = 60°C	D
Also Zone certified Ex d [ia] IIC.	Temperature Class T5. Ta = -40 to +80°C	
CSA for Class I, Div. 2, Groups A, B, C, and D; Class II, Div. 2, Groups F and G; Class III, Div. 2.	Temperature Class T4. T=80°C	M
FM intrinsically safe for Class I, II, III, Div. 1, Groups A, B, C, D, E, F, G. Also, Zone approved AEx ia IIC.	Temperature Class T4; Ta = 80°C	F
FM explosionproof with IS sensor connection for Class I, Div. 1, Groups B, C, and D; dust-ignitionproof for Class II, Div. 1, Groups E, F, and G; Class III, Div. 1.	Temperature Class T5; Ta = 85°C	G
FM nonincendive for Class I, Div. 2, Groups A, B, C, and D; Class II, Div. 2, Groups F and G; Class III, Div. 2.	Temperature Class T4; T=80°C	K
IECEx intrinsically safe Ex ia IIC Dust-ignitionproof Ex tD A20 IP66	Temperature Class T4, T103°C; Ta = -40 to +80°C.	L
IECEx flameproof: Ex d [ia] ia IIC Dust-ignitionproof Ex tD A20 IP66	Integrally mounted electronics. Temperature Class T4, T85°C; Ta = -20 to +80°C.	B
IECEx flameproof: Ex d [ia] Dust-ignitionproof Ex tD A20 IP66	Electronic housing of remote mounted version. Temperature Class T4, T85°C; Ta = -20 to +80°C.	
IECEx flameproof: Ex ia IIC Dust-ignitionproof Ex tD A20 IP66	Flowtube junction box of remote mounted version. Temperature Class T4, T103°C; Ta = -40 to +80°C.	
Unit with CE mark and PED controls and records.		Y
Unit does not have CE mark; not to be installed in European Union (EU) countries.		Z

**NOTE**

1. The Model 84 has been designed to meet the electrical safety descriptions listed above. For detailed information, or status of the testing laboratory approval/certification, contact Invensys Foxboro.
2. With intrinsically safe approvals and certifications with a 24 V dc supply, an active barrier is required.
3. Refer to MI 019-177 for FM and CSA Connection Diagrams.
4. Refer to MI 019-179 for ATEX and IECEx Safety Information.



**RECOMMENDED MOUNTING ARRANGEMENTS**

Flowmeter Mounting Arrangement Model 84F Single Measurement Flowmeter Shown (Dual Measurement Flowmeters follow same arrangements)		Flowmeter for Use With:			
		Liquid	Gas	Saturated Steam	Superheated Steam
	Housing Above Pipe; Isolation Valve and Dual Measurement Flowmeter NOT Used.	Yes (1)	Yes	No	Yes (2)
	Housing Above Pipe; Isolation Valve and Dual Measurement Flowmeter CAN be Used.	No (5)	Yes	No	Yes (2)
	Housing Below Pipe.	Yes (3) (4) (6)	Yes (4)	Yes	Yes (2)
	Housing to Side of Pipe.	Yes	Yes	No	Yes (2)
	Housing to Side and Below Pipe.	Yes (6)	Yes	No	Yes (2)
	Vertical Pipe, Flow upward.	Yes	Yes	No	Yes (2)
	Vertical Pipe, Flow Downward.	Yes (7)	Yes	No	Yes (2)

- (1) Possibility of temporary start-up error due to trapped air.
- (2) Requires adequate insulation.
- (3) Best choice when errors due to start-up cannot be tolerated.
- (4) Recommended only for clean fluids.

- (5) Not recommended for liquids with isolation valve.
- (6) Preferred for liquids with isolation valve.
- (7) Not preferred; must maintain full pipe with no voids in fluid.

**OPTIONAL SELECTIONS AND ACCESSORIES**

**Options -B, -D, -E, -G: Cable Assembly to Remote Electronics Housing**

When selecting Code -R for a Remote Mounted Housing, a cable length must be selected. Four cable lengths are offered as follows:

Option	Cable Length
-B	20 ft (6 m)
-D	30 ft (9 m)
-E	40 ft (12 m)
-G	50 ft (15 m)

**Option -H: Cleaning for Oxygen or Chlorine Gas Service**

Process wetted parts are cleaned for oxygen or chlorine service in compliance with Compressed Gas Association's CGA-4.1 and ASTM G93. Cleaning is not offered when an isolation valve, or dual measurement or extended temperature meters are selected.. Select Option -H.

**Option -J: Gold Plated Sensor**

This option is recommended for H<sub>2</sub> (Hydrogen) processes. Specify Option -J.

**Options -L, -M, -Q: Foxboro Certificates of Conformance and Compliance**

Three material certificates are offered. Option -L provides a certificate of compliance to Foxboro specifications. The Foxboro quality system conforms to ISO 9001. Option -M is a certification of material for process wetted metal (conforms to BS EN 10204 3.1). And, Option -Q certifies that stainless steel materials meet NACE Std. MR-01.

**Option -N: Certified Calibration Certificate**

A calibration and pressure test sheet come standard with each flowmeter. A certified flow calibrated K-factor and pressure test certificate is available by selecting Option -N.

**Options -F, -V, -X: Welding Certificates – With Flanged Body Flowtubes Only**

Three certificates are available. Option -F certifies that the fabrication of 150 to 300 mm (6 to 12 in) flowtubes by welders is to ASME Boiler Code, Section IX. Option -V provides radiographic examination and certification of circumferential welds (not available with ANSI Class 150 or Metric PN 16 flanges). And Option -X certifies that welding is per ASME Boiler Code and Radiographic Examination (except as noted for Option -F).

**Option -P: Cable Connector - Hawke-Type Cable Gland**

Brass cable gland with 1/2 NPT external thread. Provides support for field cable. Ensure that this cable connector is qualified to meet the electrical safety specification selected. See Electrical Safety Specification section. Available with Electrical Housing Codes T and R only (1/2 NPT). Select Option -P.

**Option -R: Cable Connector - PG11 Cable Gland**

A PG11 cable gland with 1/2 NPT external thread. Provides strain relieved support for field cable. The PG11 is for cable diameters from 8 to 12 mm. Ensure that this cable connector is qualified to meet the electrical safety specification selected. See Electrical Safety Specification section. Available with Electrical Housing Codes T and R only (1/2 NPT). Select Option -R.

**Option -T: Conduit Fitting**

A conduit fitting is available with Remote Mounting Code R only. It is provided when conduit is used to enclose the cable between the flowtube body and remote transmitter. Both ends of the fitting are 1/2 NPT and interconnect the conduit and transmitter at the housing and flowtube ends. Specify Option -T.

**AS Code MTS: Stainless Steel Customer Tag Accessory**

A 1.5 x 3.5 in (40 x 90 mm) stainless steel tag for customer data that does not fit on the standard plate. It is fastened to housing with wire. Accommodates 10 lines of data with 40 characters/spaces per line. Tag will also show customer's K-factor (information with flowing conditions being submitted to Invensys Foxboro with sales order). Specify AS Code MTS.

**Bolting Kits – With Wafer Body Flowtubes Only**

Sets of carbon steel studs and nuts which conform to line size, and ANSI or DIN size and rating, are offered in 3/4 to 4 in line sizes for ANSI flanges, and 50 to 100 mm line sizes for DIN flanges. See tables below to select the kit and part number required.

**ANSI Flange Bolting Kits - Part Numbers**

Size	Cl. 150	Cl. 300	Cl. 600
3/4 in	D0148ZF	D0148ZJ	D0148ZJ
1 in	D0148ZF	D0148ZJ	D0148ZJ
1 1/2 in	D0148ZF	D0148ZK	D0148ZS
2 in	A2044HB	A2044HB (a)	A2044HC (a)
3 in	A2044HC	A2044HD	A2044HD
4 in	A2044HC (a)	A2044HD	A2044HE

(a) Two kits required.

**Metric Flange Bolting Kits - Part Numbers**

Size	PN 16	PN 40	PN 64	PN 100
50 mm	N/A	D0148ZU	N/A	N/A
80mm	N/A	D0148ZZ (a)	N/A	N/A
100 mm	L0114NT	L0114NT	N/A	N/A

(a) Two kits required.

**MODEL CODES****Model 84F Intelligent Vortex Flowmeters – Flanged Body****Description**

84F = Intelligent Vortex Flowmeter – Flanged Body

**Electronics Version**

- T = Intelligent Electronics, HART Communication Protocol, with Pulse Output
- U = Intelligent Electronics, HART Communication Protocol, without Pulse Output

**Nominal Line Size**

- 3Q = 3/4 in (DN 15) Line Size
- 01 = 1 in (DN 25) Line Size
- 1H = 1 1/2 in (DN 40) Line Size
- 02 = 2 in (DN 50) Line Size
- 03 = 3 in (DN 80) Line Size
- 04 = 4 in (DN 100) Line Size
- 06 = 6 in (DN 150) Line Size
- 08 = 8 in (DN 200) Line Size
- 10 = 10 in (DN 250) Line Size
- 12 = 12 in (DN 300) Line Size

**Body, Flange, and Shedder Bar Material**

- S = Sizes 3Q to 04; Cast Body/Flange and Shedder (except Code 04S1); CF8M Material. Size 04S1; Fabricated from 316 ss Tubing and Flanges. Sizes 06 to 12; Body Fabricated from 304 ss Tubing with 304 ss Flanges.
- K = Sizes 06 to 12; Body Fabricated from 304 ss Tubing with carbon steel (A105) Flanges.

**End Connections and Flange Rating****Description**

- 1 = ANSI Class 150 Flange, ASME B16.5
- 2 = ANSI Class 300 Flange, ASME B16.5
- 3 = ANSI Class 600 Flange, ASME B16.5
- 5 = Metric PN 16 Flange, EN1092-1, RF, Type D Nut Groove
- 6 = Metric PN 40 Flange, EN1092-1, RF, Type D Nut Groove
- 7 = Metric PN 63 Flange, EN1092-1, RF, Type D Nut Groove
- 8 = Metric PN 100 Flange, EN1092-1, RF, Type D Nut Groove
- D = Metric PN 16 Flange, EN1092-1, RF, Finish Type B1
- F = Metric PN 40 Flange, EN1092-1, RF, Finish Type B1
- G = Metric PN 63 Flange, EN1092-1, RF, Finish Type B2
- H = Metric PN 100 Flange, EN1092-1, RF, Finish Type B2

**Used with Line Sizes**

- All line sizes
- All line sizes
- Sizes 3Q through 08 only
- Sizes 06 through 12 only
- Sizes 3Q through 08 only
- Sizes 02 through 12 only (a)
- Sizes 3Q through 08 only
- Sizes 06 through 12 only
- All line sizes
- Sizes 02 through 12 only (b)
- Sizes 3Q through 08 only

**Single or Dual Measurement; Isolation Valve and Manifold**

- S = Single Measurement; No Isolation Valve
- D = Dual Measurement; Manifold with no Isolation Valves
- K = Single Measurement; Manifold with one Isolation Valve; CF8M Stainless Steel
- L = Dual Measurement; Manifold with two Isolation Valves; CF8M Stainless Steel

**Sensor Fill, Temperature Range, and Material****Standard Temperature Range (with Fill Fluid)**

- D = Fluorolube Fill, 0 to 200°F (-20 to +90°C) Hastelloy Type CW2M
- F = Fluorolube Fill, 0 to 200°F (-20 to +90°C) Stainless Steel Type CF3M
- R = Silicone Fill, 0 to 400°F (-20 to +200°C) Hastelloy Type CW2M
- S = Silicone Fill, 0 to 400°F (-20 to +200°C) Stainless Steel Type CF3M

**Extended Temperature Range (No Fill Fluid)**

- C = Unfilled, 400 to 800°F (200 to 430°C) Hastelloy Type CW2M (f)
- T = Unfilled, 400 to 800°F (200 to 430°C) Stainless Steel Type CF3M (f)

**Electronics Housing Mounting, Material, and Conduit Connections**

- T = Mounted to Flowtube; Aluminum Housing; 1/2 NPT Conduit Connections (g)
- V = Mounted to Flowtube; Aluminum Housing; M20 Conduit Connections
- R = Remote Mounted; Aluminum Housing; 1/2 NPT Conduit Connections (c)(g)
- W = Remote Mounted; Aluminum Housing; M20 Conduit Connections (c)

Model 84F Code continued on next page

**MODEL CODES (Cont.)****Model 84F Intelligent Vortex Flowmeters - Flanged Body (Cont.)****Local Digital Indicator/Configurator**

- N = No Digital Indicator/Configurator (Blind Unit)  
 J = Full Function Digital Indicator/Configurator

**Electrical Safety (Also see Electrical Safety Specifications section for further details)**

- E = ATEX intrinsically Safe; II 1 GD, EEx ia IIC (not available with mounting Codes T and R).  
 H = ATEX flameproof (not available with Mounting Codes T and R):  
   • for II 2/1 (1) GD, EEx d [ia] ia; with Mounting Code V only.  
   • for II 2 (1) GD, EEx d [ia]; with Mounting Code W only.  
   • II 1 GD, EEx ia IIC; with Mounting Code W only.  
 C = CSA intrinsically safe; Division 1; also zone certified Ex ia IIC.  
 M = CSA suitable for Division 2.  
 D = CSA explosionproof; Division 1.  
 F = FM intrinsically safe; Division 1; also zone approved AEx ia IIC.  
 K = FM nonincendive; Division 2.  
 G = FM explosionproof; Division 1.  
 L = IECEx intrinsically safe; Ex ia IIC; Dust-ignitionproof Ex tD A20, IP66 (not available with Mounting Codes T and R).  
 B = IECEx flameproof (not available with Mounting Codes T and R):  
   • Ex d [ia] ia IIC; Dust-ignitionproof Ex tD A20, IP66; with Mounting Code V only.  
   • Ex d [ia]; Dust-ignitionproof Ex tD A20, IP66; with Mounting Code W only.  
   • Ex ia IIC; Dust-ignitionproof Ex tD A20, IP66; with Mounting Code W only.  
 Y = No Agency Electrical Certifications; (with CE mark, PED Controls and Records).  
 Z = No Agency Certifications; (no CE mark; Units not to be installed in European Union (EU) countries).

**Optional Selections****Cable Length Selection for Remote Electronics Housing**

- B = 20 ft (6 m) Cable to Connect to Remote Electronics Housing  
 -D = 30 ft (9 m) Cable to Connect to Remote Electronics Housing  
 -E = 40 ft (12 m) Cable to Connect to Remote Electronics Housing  
 -G = 50 ft (15 m) Cable to Connect to Remote Electronics Housing

**Cleaning - Oxygen/Chlorine Service**

- H = Cleaning of Process Wetted Parts per Compressed Gas Association's CGA G-4.1 and ASTM G93  
   - Available only with Body/Flange/Shedder Material Code S.  
   - Not available for Sizes -10 and -12 or with Isolation Valve Codes D, K, and L.  
   - Not available with Extended Temperature Codes C and T.

**Sensor Plating**

- J = Gold Plated Sensor

**Foxboro Certificates of Compliance/Conformance**

- L = Standard Certificate of Compliance  
 -M = Foxboro Material Certification of Process Wetted Metal (Conforms to BS EN 10204 3.1)  
 -Q = Process Wetted Parts Conform to NACE Standard MR-01

**Foxboro Calibration Certificate**

- N = Calibration and Pressure Test Certified Copy

**Cable Connectors – with Electrical Housing Codes T and R only (1/2 NPT)**

- P = Hawke-Type Cable Gland (with Electrical Safety Codes E, H, Y, and Z only)  
 -R = PG11 Cable Gland, Trumpet Shaped (not with explosionproof/flameproof certifications)

**Conduit Fitting**

- T = Adapter for use with 1/2 NPT conduit (Available with Remote Mounted Housing Code R only)

**Welding Certificate (Size Codes 06 through 12 only)**

- F = Welding Certified to ASME Boiler Code (d)  
 -V = Radiographic Examination (X-Ray) of Flange Welds (d)  
 -X = Welding Certified to ASME Boiler and Radiographic Examination (X-Ray) of Flange Welds (e)

**Instruction Manual**

- C = Detailed Instruction Manual in place of Universal MI 019-145

Examples: 84F-T02S1SDTNK-X; 84F-T06K7DCRJE-GQNT

- (a) For 3Q, 01, and 1H line sizes, select End Connection Code 8.  
 (b) For 3Q, 01, and 1H line sizes, select End Connection Code H.  
 (c) With remote mounted electronics housing, you must also select Optional Cable Length -B, -D, -E, or -G.  
 (d) Not available with End Connection Codes 1, 5, and D for 6 and 8 inch sizes.  
 (e) Not available with End Connection Codes 1 and 5 for 6 and 8 inch sizes.  
 (f) Application ALERT: For Extended Temperature Range sensors used in hazardous or volatile gas applications, there is the potential of fugitive emissions to occur through the sensor vented restrictor if the sensor diaphragm were to fail.  
 (g) ATEX and IECEx intrinsically safe and flameproof certifications not available with 1/2 NPT openings.

**MODEL CODES (Cont.)****Model 84W Intelligent Vortex Flowmeters – Wafer Body****Description**

84W = Intelligent Vortex Flowmeter – Wafer Body

**Electronics Type**

- T = Intelligent Electronics, HART Communication Protocol, with Pulse Output
- U = Intelligent Electronics, HART Communication Protocol, without Pulse Output

**Nominal Line Size**

- 3Q = 3/4 in (DN 15) Line Size
- 01 = 1 in (DN 25) Line Size
- 1H = 1 1/2 in (DN 40) Line Size
- 02 = 2 in (DN 50) Line Size
- 03 = 3 in (DN 80) Line Size
- 04 = 4 in (DN 100) Line Size
- 06 = 6 in (DN 150) Line Size
- 08 = 8 in (DN 200) Line Size

**Body and Shedder Bar Material**

- S = ASTM A351-CF8M (316 ss) Cast Body and Shedder
- H = ASTM A494-CW2M (Hastelloy C) Cast Body and Shedder; With Size Codes 3Q to 04 only

**Mounting and Centering System**

<b>Description</b>	<b>Used with Line Sizes</b>
1 = Centering for ANSI Class 150, 300, and 600 Flanges	Sizes 3Q through 04 only
Centering for Metric PN 16 Flange	Sizes 01 through 03 only
Centering for Metric PN 40 Flange	Sizes 01 through 03 and 06 and 08 only
Centering for Metric PN 63 and PN 100 Flanges	All line sizes
3 = Centering for ANSI Class 600 Flange	Sizes 06 and 08 only
4 = Centering for Metric PN 16 Flange	Sizes 04, 06, and 08 only
5 = Centering for Metric PN 40 Flange	Size 04 only
9 = Centering for Metric PN 16 and PN 40 Flanges	Size 3Q only

**Isolation Valve and Manifold**

- S = No Isolation Valve or Manifold
- K = Manifold with Isolation Valve, ASTM A 351-CF8M Stainless Steel (316 ss)

**Sensor Fill, Temperature Range, and Material****Standard Temperature Range (with Fill Fluid)**

- D = Fluorolube Fill, 0 to 200°F (-20 to +90°C) Hastelloy Type CW2M
- F = Fluorolube Fill, 0 to 200°F (-20 to +90°C) Stainless Steel Type CF3M
- R = Silicone Fill, 0 to 400°F (-20 to +200°C) Hastelloy Type CW2M
- S = Silicone Fill, 0 to 400°F (-20 to +200°C) Stainless Steel Type CF3M

**Extended Temperature Range (No Fill Fluid)**

- C = Unfilled, 400 to 800°F (200 to 430°C) Hastelloy Type CW2M (b)
- T = Unfilled, 400 to 800°F (200 to 430°C) Stainless Steel Type CF3M (b)

**Electronics Housing Mounting, Material, and Conduit Connections**

- T = Integrally Mounted to Flowtube; Aluminum Housing, 1/2 NPT Conduit Connection (c)
- V = Integrally Mounted to Flowtube; Aluminum Housing, M20 Conduit Connection
- R = Remote Mounted; Aluminum Housing, 1/2 NPT Conduit Connection (a)(c)
- W = Remote Mounted; Aluminum Housing, M20 Conduit Connection (a)

**Local Digital Indicator/Configurator**

- N = No Digital Indicator/Configurator (Blind Unit)
- J = Full Function Digital Indicator/Configurator

Model 84W Code continued on next page

**MODEL CODE (Cont.)****Model 84W Intelligent Vortex Flowmeters - Wafer Body (Cont.)****Electrical Safety (Also see Electrical Safety Specifications section for further details)**

- E = ATEX intrinsically Safe; II 1 GD, EEx ia IIC (not available with Mounting Codes T and R).  
H = ATEX flameproof (not available with Mounting Codes T and R):  
• for II 2/1 (1) GD, EEx d [ia] ia; with Mounting Code V only.  
• for II 2 (1) GD, EEx d [ia]; with Mounting Code W only.  
• II 1 GD, EEx ia IIC; with Mounting Code W only.  
C = CSA intrinsically safe; Division 1; also zone certified Ex ia IIC.  
M = CSA suitable for Division 2.  
D = CSA explosionproof; Division 1.  
F = FM intrinsically safe; Division 1; also zone approved AEx ia IIC.  
K = FM nonincendive; Division 2.  
G = FM explosionproof; Division 1.  
L = IECEx intrinsically safe; Ex ia IIC; Dust-ignitionproof Ex tD A20, IP66 (not available with Mounting Codes T and R).  
B = IECEx flameproof (not available with Mounting Codes T and R):  
• Ex d [ia] ia IIC; Dust-ignitionproof Ex tD A20, IP66; with Mounting Code V only.  
• Ex d [ia]; Dust-ignitionproof Ex tD A20, IP66; with Mounting Code W only.  
• Ex ia IIC; Dust-ignitionproof Ex tD A20, IP66; with Mounting Code W only.  
Y = No Agency Electrical Certifications; (with CE mark, PED Controls and Records).  
Z = No Agency Certifications; (no CE mark; Units not to be installed in European Union (EU) countries).

**Optional Selections****Cable Length Selection for Remote Electronics Housing**

- B = 20 ft (6 m) Cable to Connect to Remote Electronics Housing  
-D = 30 ft (9 m) Cable to Connect to Remote Electronics Housing  
-E = 40 ft (12 m) Cable to Connect to Remote Electronics Housing  
-G = 50 ft (15 m) Cable to Connect to Remote Electronics Housing

**Cleaning - Oxygen/Chlorine Service**

- H = Cleaning of Process Wetted Parts per Compressed Gas Association's CGA G-4.1 and ASTM G93  
Not available with Isolation Valve Code K, or Sensor Codes C and T

**Sensor Plating**

- J = Gold Plated Sensor

**Invensys Foxboro Certificates of Compliance/Conformance**

- L = Standard Certificate of Compliance  
-M = Invensys Foxboro Material Certification of Process Wetted Metal (Conforms to BS EN 10204 3.1)  
-Q = Process Wetted Parts Conform to NACE Standard MR-01

**Invensys Foxboro Calibration Certificate**

- N = Invensys Foxboro Calibration and Pressure Test Certified Copy

**Cable Connectors – with Electrical Housing Codes T and R only (1/2 NPT)**

- P = Hawke-Type Cable Gland (with Electrical Safety Codes E, H, Y, and Z only)  
-R = PG11 Cable Gland, Trumpet Shaped (not with explosionproof/flameproof certifications)

**Conduit Fitting**

- T = Adapter for use with 1/2 NPT conduit (Available with Remote Mounted Housing Code R only)

**Instruction Manual**

- C = Detailed Instruction Manual in place of Universal MI 019-145

Examples: 84W-T02S1SRJF-N; 84W-T06H4SRNF-DLTC

- (a) With remote mounted electronics housing, you must also select Optional Cable Length -B, -D, E, or -G.  
(b) Application ALERT: For Extended Temperature Range sensors used in hazardous or volatile gas applications, there is the potential of fugitive emissions to occur through the sensor vented restrictor if the sensor diaphragm were to fail.  
(c) ATEX and IEC intrinsically safe and flameproof certifications not available with 1/2 NPT conduit openings.

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**SUGGESTED RFQ SPECIFICATIONS FOR VORTEX FLOWMETER**

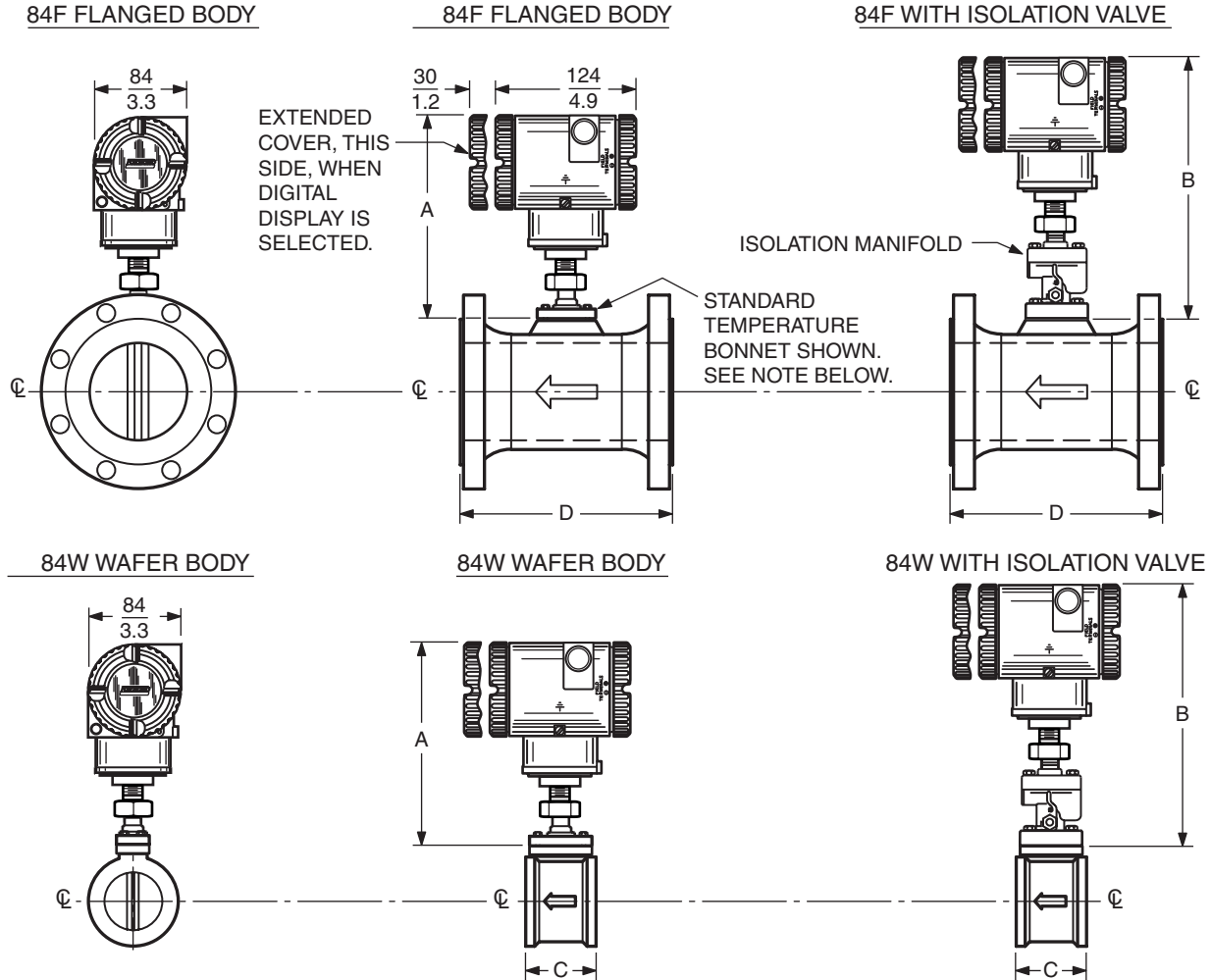
The manufacturer shall provide field-mounted vortex flowmeters featuring digital signal processing techniques capable of accurately measuring liquid, gas, or steam flows. The specifications for these meters are as follows:

<b>Communication Protocol:</b>	HART
<b>Outputs:</b>	Analog (4 to 20 mA) and digital, with or without pulse output.
<b>Remote Communications:</b>	Direct digital with HART Multidrop.
<b>Configuration:</b>	Can be configured from the LCD indicator, HART communicator, or PC-based configurator.
<b>Accuracy:</b>	0.5% of reading in liquids, 1.0% of reading in gas and steam.
<b>Internal Flow Totalizer:</b>	Standard.
<b>Sensor:</b>	Replaceable without meter recalibration required.
<b>EMC Compatibility:</b>	Complies with International and European Union 61326 standards.
<b>Voltage Supply:</b>	2-wire 24 V dc loop powered.
<b>Mounting:</b>	Electronics to accommodate integral or remote mounting.
<b>Housing:</b>	Remote mounted transmitter aluminum housing with epoxy finish, optional flameproof housing.
<b>Electronics:</b>	Enclosed in a NEMA 4X (IEC IP66) housing sealed with O-rings for protection against moisture or other contaminants, optional integral LCD indicator with on-board configuration pushbuttons.
<b>Body and Shedder Bar Materials:</b>	316 or 304 stainless steel, or Hastelloy C.
<b>Electrical Classification:</b>	Must be suitable for Class 1 Division 1, Class 1 Division 2, ATEX zone 1, or ATEX zone 2 hazardous locations, and conform to applicable European Union directives.
<b>Model Code:</b>	Foxboro 84F or 84W Series Vortex Flowmeter, or equivalent.

**DIMENSIONS - NOMINAL**

**mm  
in**

**84F AND 84W FLANGED AND WAFER BODY FLOWMETERS; INTEGRAL MOUNT; SINGLE MEASUREMENT**



Dimension	Dimensions - Nominal Line Size Code (a)									
	3Q	01	1H	02	03	04	06	08	10 (b)	12 (b)
A	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$
B	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$
C	$\frac{79.5}{3.13}$	$\frac{79.5}{3.13}$	$\frac{79.5}{3.13}$	$\frac{79.5}{3.13}$	$\frac{95.3}{3.75}$	$\frac{120.7}{4.75}$	$\frac{177.8}{7.00}$	$\frac{228.6}{9.00}$	N/A	N/A
D	Dimension D varies with flange type, rating, and size used. See Table 4 further in document for dimensions.									

(a) Refer to Model Code section for sizes.

(b) Size Codes 10 and 12 are not available with wafer body flowtubes.

**NOTE:**

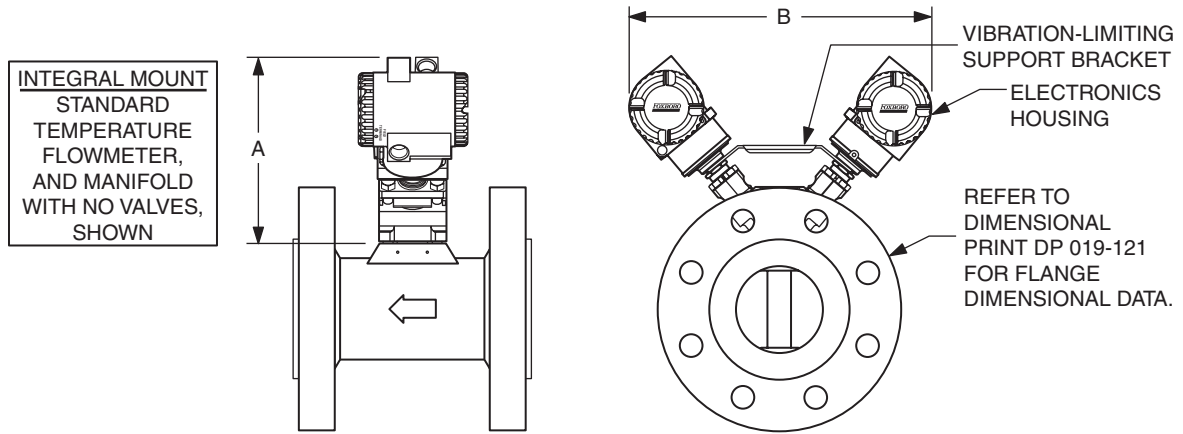
1. Dimensions A and B are shown with the standard temperature bonnet. A longer bonnet is used in extended temperature applications; when this selection is made, add 3.8 in (97 mm) to Dimensions A and B.
2. Also refer to DP 019-120 for 84F dimensions, and DP 019-122 for 84W dimensions.



**DIMENSIONS - NOMINAL (Cont.)**

**mm  
in**

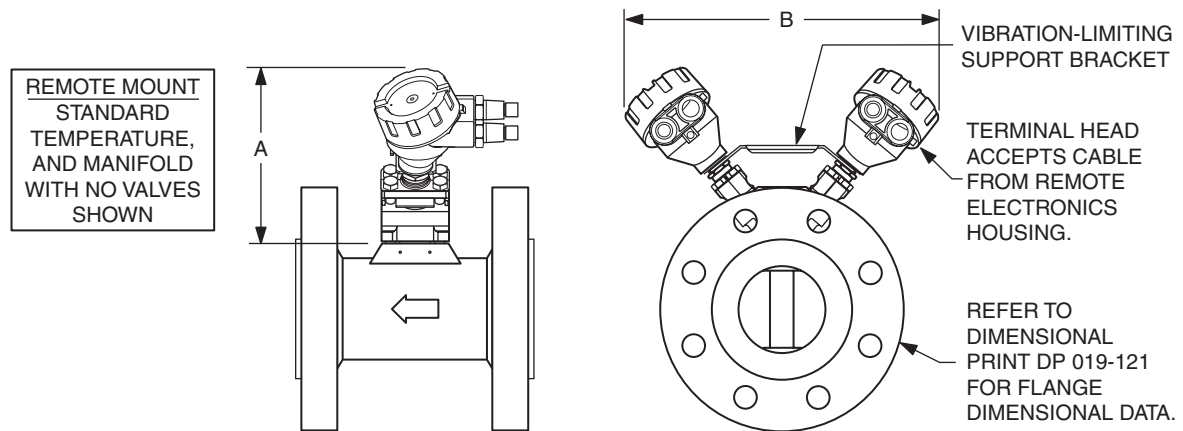
**84F FLANGED FLOWMETER; INTEGRAL MOUNT; DUAL MEASUREMENT**



**Integral Mount Dimensions**

Dimension	Standard Temperature Flowmeter		Extended Temperature Flowmeter	
	No Isolation Valves	With Isolation Valves	No Isolation Valves	With Isolation Valves
A	7.8 in (199 mm)	8.9 in (226 mm)	11.3 in (287 mm)	12.0 in (306 mm)
B	13.9 in (353 mm)	14.3 in (363 mm)	19.7 in (500 mm)	20.7 in (526 mm)

**84F FLANGED FLOWMETER; REMOTE MOUNT; DUAL MEASUREMENT**



**Remote Mount Dimensions**

Dimension	Standard Temperature Flowmeter		Extended Temperature Flowmeter	
	No Isolation Valves	With Isolation Valves	No Isolation Valves	With Isolation Valves
A	7.0 in (178 mm)	8.9 in (226 mm)	11.3 in (287 mm)	12.0 in (306 mm)
B	13.9 in (353 mm)	14.3 in (363 mm)	19.7 in (500 mm)	20.7 in (526 mm)

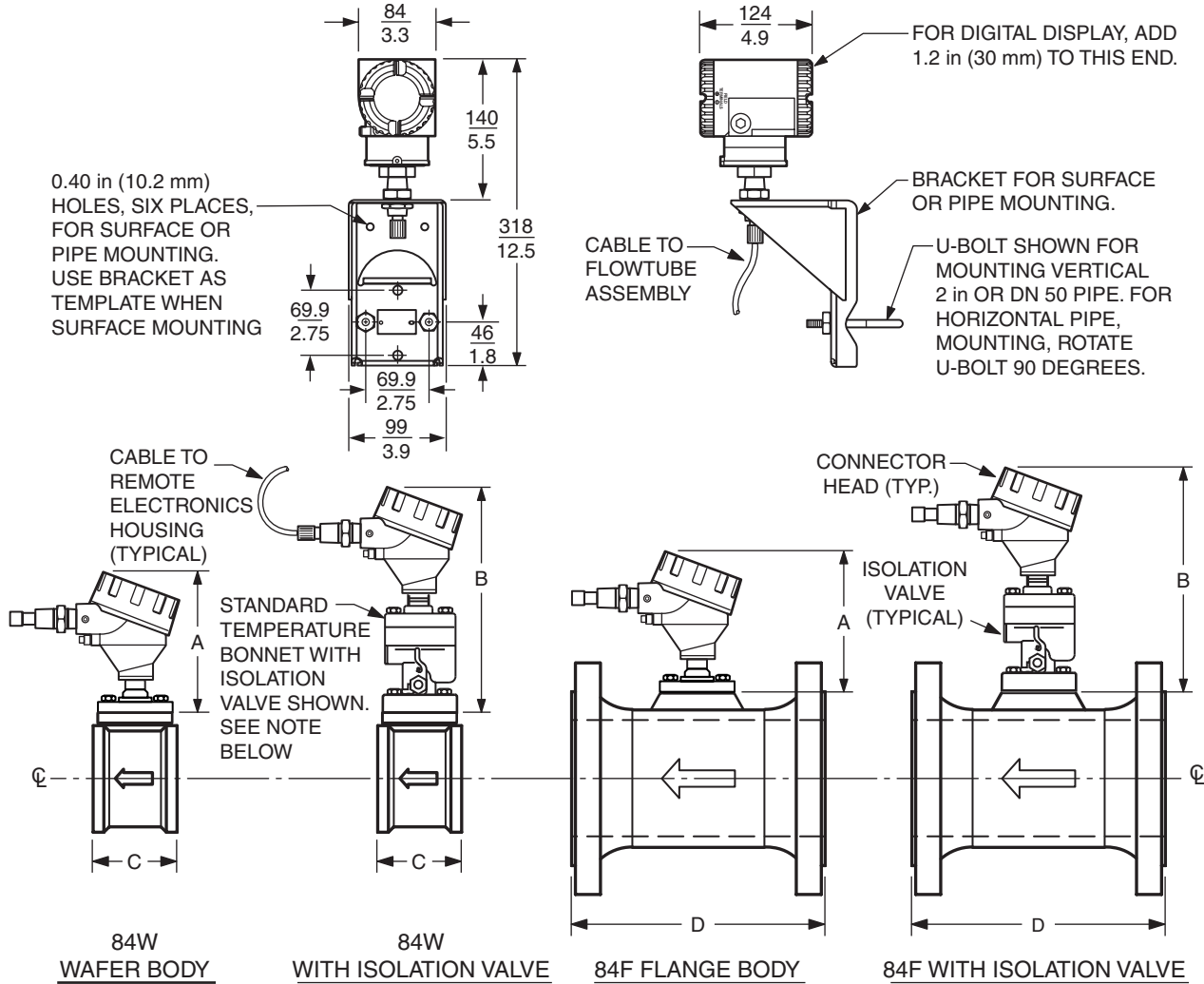
NOTE:

Also refer to DP 019-121 for further dimensions.

**DIMENSIONS - NOMINAL (Cont.)**

**mm  
in**

**84F AND 84W FLANGED AND WAFER BODY FLOWMETERS WITH REMOTE MOUNTED ELECTRONICS**



Dimension	Dimensions - Nominal Line Size Code (a)									
	3Q	01	1H	02	03	04	06	08	10 (b)	12 (b)
A	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$	$\frac{173}{6.8}$
B	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$	$\frac{269}{10.6}$
C (c)	$\frac{79.5}{3.13}$	$\frac{79.5}{3.13}$	$\frac{79.5}{3.13}$	$\frac{79.5}{3.13}$	$\frac{95.3}{3.75}$	$\frac{120.7}{4.75}$	$\frac{177.8}{7.00}$	$\frac{228.6}{9.00}$	N/A	N/A
D (c)	Dimension D varies by with flange type, rating, and size used. See Table 4 further in document for dimensions.									

(a) Refer to Model Code section for sizes.

(b) Size Codes 10 and 12 are not available with wafer body flowtubes.

(c) Dimensions C and D are face-to-face dimensions.

**NOTE:**

1. Dimensions A & B are shown with the standard temperature bonnet with extended temperature applications, add 3.6 in (91.4 mm) to Dimensions A & B because of the longer bonnet.
2. Also refer to DP 019-120 for 84F dimensions, and DP 019-122 for 84W dimensions.

## DIMENSIONS - NOMINAL (Cont.)

Table 4.  
Dimension "D" (Face-to-Face) for Model 84F Flanged Body Flowtubes

ANSI Flanges per ASME B16.5			Metric Flanges per EN 1092-1		
Line Size	Flange Rating	Dimension "D" (a)	Line Size	Flange Rating	Dimension "D" (b)
3/4 in	Class 150	6.00 in	DN 15	PN 40	152 mm
	Class 300	6.00 in		PN 100	160 mm
	Class 600	6.50 in	DN 25	PN 40	179 mm
1 in	Class 150	6.50 in		PN 100	178 mm
	Class 300	6.50 in	DN 40	PN 40	178 mm
	Class 600	7.00 in		PN 100	198 mm
1 1/2 in	Class 150	7.12 in	DN 50	PN 40	189 mm
	Class 300	7.25 in		PN 63	186 mm
	Class 600	7.50 in		PN 100	210 mm
2 in	Class 150	7.75 in	DN 80	PN 40	220 mm
	Class 300	7.75 in		PN 63	230 mm
	Class 600	8.93 in		PN 100	320 mm
3 in	Class 150	8.75 in	DN 100	PN 40	240 mm
	Class 300	8.75 in		PN 63	250 mm
	Class 600	9.43 in		PN 100	260 mm
4 in	Class 150	9.40 in	DN 150	PN 16	305 mm
	Class 300	9.20 in		PN 40	320 mm
	Class 600	10.43 in		PN 63	360 mm
12.00 in		PN 100		360 mm	
6 in	Class 150	12.00 in	DN 200	PN 16	381 mm
	Class 300	12.75 in		PN 40	396 mm
	Class 600	14.75 in		PN 63	443 mm
15.00 in		PN 100		443 mm	
8 in	Class 150	15.00 in	DN 250	PN 40	411 mm
	Class 300	15.75 in		PN 63	481 mm
	Class 600	18.00 in	DN 300	PN 40	459 mm
15.00 in		PN 63		513 mm	
10 in	Class 150	15.00 in			
	Class 300	16.20 in			
12 in	Class 150	17.00 in			
	Class 300	18.20 in			

(a) For 3/4 to 4 in sizes, overall face-to-face length (D) tolerance is  $\pm 0.05$  in.

For 6 to 12 in sizes overall face-to-face length (D) tolerance is  $\pm 0.250$  in.

(b) For DN 15 to DN 100 sizes, overall face-to-face length (D) tolerance is  $\pm 1.3$  mm.

For DN 150 to DN 300 sizes, overall face-to-face length (D) tolerance is  $\pm 6.4$  mm.

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**ORDERING INSTRUCTIONS**

1. Model Number.
2. Flow Data:
  - a. Maximum, minimum, and normal flow rate.
  - b. Fluid composition and viscosity at operating temperatures.
  - c. Fluid density or relative density (specific gravity).
  - d. Maximum, minimum, and normal operating temperatures.
  - e. Maximum, minimum, and normal operating pressures.
  - f. Mating pipe schedule.
  - g. Type and location (distance) of upstream disturbances.
3. Calibration Information (analog output only); maximum flow rate at 20 mA output.
4. Electrical Classification.
5. Optional Selections and Accessories  
Select from Model Code or "Optional Selections and Accessories" section
6. Customer Tag Data.

**PATENT NOTICE**

This product and its components are protected by one or more of the following U.S. Patents.

3,948,098; 4,085,614; 4,520,678; 5,003,827; 5,209,125 and others pending. Corresponding patents have been issued or are pending in other countries.

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Invensys Foxboro provides a broad range of measurement and instrument products, including solutions for pressure, flow, analytical, positioners, temperature, controlling and recording. For a listing of these offerings, visit the Invensys Foxboro web site at:

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