

I/A Series® Coriolis Mass Flow and Density Meters for Standard and 3A Sanitary Applications Models CFS10 and CFS20 Mass Flowtubes



The Model CFS10 or CFS20 Mass Flowtube combines with a Model CFT50 Digital Coriolis Mass Flow Transmitter to form an I/A Series Coriolis Mass Flow and Density Meter. The principle of Coriolis acceleration is used which allows true mass flow rate measurements of fluids to be made directly, without the need for external temperature, pressure, or specific gravity measurements.

FEATURES

- Precision system achieved using DSP transmitter
- High system accuracy of $\pm 0.10\%$ of flow rate plus flowtube zero instability for liquids; and $\pm 0.50\%$ of flowrate plus flowtube zero instability for gases.
- Density accuracy of ± 0.0005 g/cc, or better.
- Wide rangeability in excess of 100:1 without sacrificing performance
- Available with 3A authorization
- The CFS10 single path design ideal for shear sensitive fluids, and in applications requiring positive cleaning; available in 3 to 50 mm (1/8 to 2 in) sizes. The CFS20 is a dual path design and is available in 40 and 80 mm (1 1/2 and 3 in) sizes.
- Welded 304 ss stainless steel enclosure. Hermetically sealed with 70 kPa (10.15 psia) internal pressure.
- Thick-wall Hastelloy® C-22 construction available
- Weights and Measures Custody Transfer Option, per NIST Handbook 44.
- Tamperproof Sealing Option of terminal block cover provided with Options -T and -S.
- Patented anti-phase double driver system allows close sensor proximity to inhibit signal distortion, and provides low power consumption per driver
- Low stress levels maximize mechanical reliability
- Easy installation because of short end-to-end distance
- Will drain when mounted in vertical orientation with an upward flow
- Uses tubes essentially of same nominal I.D. as connecting pipe, and with increased wall thickness
- Designed for FM, CSA, and ATEX hazardous area locations. Applicable agency plate also includes the CE mark.

INTRODUCTION

The I/A Series Coriolis Mass Flow and Density Meters measure fluid mass flow rate directly, not inferentially as volumetric flowmeters do. With direct measurement of mass, the inaccuracies of multiple process measurements associated with volumetric flow devices are eliminated.

This flowmeter is a new and advanced generation of mass flow devices using Coriolis principles. It incorporates significant improvements in transmitter and flowtube design, including digital signal processing (DSP), computer modeling, remote communications, automated manufacturing processes, construction and testing that all add up to an ideal product for today and tomorrow's "real world" process fluid flow applications.

MODEL CFT50 DSP TRANSMITTER

The CFS10 and CFS20 Mass Flowtubes are used with the Model CFT50 Digital Coriolis Mass Flow Transmitter to form a mass flow and density meter. The transmitter uses DSP techniques to improve flowmeter performance and to minimize the shortcomings experienced by existing Coriolis flowmeters, such as measurement of two-phase flow, partial empty tube conditions, and batching from empty. Refer to PSS 1-2B7 A for further data and specifications relating to the Model CFT50.

APPLICATION VERSATILITY

This brand of Coriolis flowmeter is insensitive to varying process conditions. In addition to accurately measuring liquid, it can also be used in applications with entrained air, non-Newtonian fluids, viscous and abrasive fluids, slurries, and liquefied gases.

MANY FLOWTUBE CONFIGURATIONS OFFERED

Flowtube Model	Flowtube Size	End Connections(a)
CFS10 (Single Path Sensor)	3 mm (1/8 in)	T only
	6 mm (1/4 in)	T, F, or S
	15 mm (1/2 in)	T, F, or S
	20 mm (3/4 in)	T, F, or S
	25 mm (1 in)	F or S
	40 mm (1 1/2 in)	F or S
	50 mm (2 in)	F or S
CFS20 (Dual Path Sensor)	40 mm (1 1/2 in)	F only
	80 mm (3 in)	F or S

(a) T = Threaded

F = Flanged (ANSI or DIN)

S = Sanitary (DIN coupling or quick disconnect ferrule)

REAL WORLD CONDITIONS

Exemplified by:

- High accuracy at realistic nominal velocities means reduced erosion
- Immunity to external pipe vibrations
- Low pressure loss
- Low velocities mean lower pumping costs
- High accuracy over a wide range of fluid densities
- Immune to entrained air
 - Continues to measure during two phase flow
 - No zero drifting with CFT50 DSP transmitter
 - Tubes can be blown dry with NO false indications of flow

HIGH FLOWTUBE RELIABILITY

Assured because of:

- Advanced CAE technology with computer modeling
- Rigid center flowtube body
- Automated orbital welding and brazing
- Low stressed welds and brazed joints
- All welds performed by qualified welders
- Annealed process-wetted welds
- Thick walled tubes
- Tubes in torsion (not bending) with low stress throughout, particularly at welds and brazed joints
- Realistic velocities
- Hydrostatically tested at 1.5 times the rated maximum pressure
- Meets NACE requirements

DESIGNED FOR SANITARY SERVICE

Prepared for sanitary applications, 3A Authorization Number 224.

Ideally suited for general Food and Drug Industry applications. Process-wetted parts are 316L stainless steel. Flowtube internal surface is micropolished to 20 RA/15 RA, free from internal crevices, and allows for in-line cleaning using various combinations of cleaning solutions at temperatures dependent upon limitation of the end connection seals. Refer to Model Codes for the numerous sanitary configurations available.

CUSTODY TRANSFER OPTION

Optional Selection -T provides for Weights and Measures Custody Transfer per NIST Handbook 44. (An NTEP approved label is also applied to the flowtube.) This option incorporates the Tamperproof Sealing option below, and must be combined with the CFT50 Transmitter Custody Transfer Option.

TAMPERPROOF SEALING OPTION

Tamperproof Sealing of the terminal box cover is provided by selecting option -S.

OPERATING CONDITIONS (Flowtube Only)

Influence	Reference Operating Conditions	Normal Operating Condition Limits	Transportation and Storage Limits
Process Temperature	Water at 23 ±6°C (73 ±13°F)	–200 and +180°C(a),(e) (–328 and +356°F)(a),(e)	Not Applicable
Process Pressure	Water at 100 to 500 kPa (15 to 75 psi)	Refer to Tables 3 and 2	Not Applicable
Ambient Temperature	23 ±2°C (73 ±3°F)	–40 and +85°C(b),(d) (–40 and +185°F)(b),(d)	–40 and +85°C (–40 and +185°F)
Ambient Pressure	100 kPa (14.7 psia)	70 and 108 kPa (10.1 and 15.7 psia)	70 and 108 kPa (10.1 and 15.7 psia)
Relative Humidity	50 ±10%	5 and 100%(c)	0 and 100% Noncondensing

(a) The –200°C (–328°F) operating limit temperature is achievable when the Cryogenic Service option is selected. See Model Code and Optional Features sections.

(b) Where lagging or heat tracing of flowtube is involved, the case temperature may exceed these limits.

(c) 100% relative humidity value includes condensation.

(d) PVC insulated cable is suitable for ambient temperatures from –20 to +80°C (–4 to +176°F).

FEP insulated cable is suitable for ambient temperatures from –40 to +85°C (–40 to +185°F).

(e) PVC or FEP insulated cable can be used for this process temperature range. See Note (d).

SYSTEM PERFORMANCE SPECIFICATIONS⁽¹⁾

(Under Reference Operating Conditions unless Otherwise Specified)

Accuracy - Mass Flow Rate (Liquids)
(Includes Linearity, Hysteresis, and Repeatability)

±0.10% + Zero Instability (see Table 1)

Accuracy in % of rate is therefore,

$$\text{Accuracy} = \pm 0.10\% + \left(\frac{\text{Zero Instability}}{\text{Mass Flow Rate}} \times 100 \right) \%$$

For example, for a 3/4 in Flowtube, the measured Mass Flow Rate value of a liquid is 50 lb/min; then from Table 1, Zero Instability for a 3/4-in Flowtube is 0.010 lb/min; and therefore the accuracy in % of Rate, using the liquid equation, is:

$$\pm 0.10\% + \left(\frac{0.010 \text{ lb/min}}{50 \text{ lb/min}} \times 100 \right) \% = \pm 0.12\%$$

and therefore the accuracy of the measured liquid is ±0.12% of the measured mass flow rate value of 50 lb/min, or

$$\pm 0.12\% (50 \text{ lb/min}) = \pm 0.06 \text{ lb/min}$$

Accuracy - Mass Flow Rate (Gases)
(Includes Linearity, Hysteresis, and Repeatability)

±0.50% + Zero Instability (see Table 1)

Accuracy in % of rate is therefore,

$$\text{Accuracy} = \pm 0.50\% + \left(\frac{\text{Zero Instability}}{\text{Mass Flow Rate}} \times 100 \right) \%$$

Table 1. Zero Instability (a)

Flowtube Model	Flowtube Size	Zero Instability	
		kg/min	lb/min
CFS10	3 mm (1/8 in)	0.000016	0.00035
	6 mm (1/4 in)	0.00045	0.001
	15 mm (1/2 in)	0.00204	0.0045
	20 mm (3/4 in)	0.00454	0.010
	25 mm (1 in)	0.00907	0.020
	40 mm (1 1/2 in)	0.0204	0.045
	50 mm (2 in)	0.0340	0.075
CFS20	40 mm (1 1/2 in)	0.0204	0.045
	80 mm (3 in)	0.0907	0.200

(a) In the accuracy equation, Zero Instability and Mass Flow Rate units must be the same.

Accuracy - Process Temperature

±1°C (±1.8°F) for temperatures between –60 and +100°C (–76 and +212°F). Or ±3°C (±5.4°F) for temperatures from –130 to –60°C (–202 to –76°F) and from 100 to 180°C (212 to 356°F).

Accuracy - Density

Flowtube Size		Accuracy - Density (a)(b)
mm	in	
3 to 80	1/8 to 3	±0.0005 g/cc

(a) Density Accuracy is at Reference Operating Conditions.

(b) May require in situ calibration for maximum accuracy.

(1) Also refer to PSS 1-2B7 A for Model CFT50 Digital Coriolis Mass Flow Transmitter specifications.

FUNCTIONAL SPECIFICATIONS

Mass Flow Rate Ranges

Flowtube Model	Nominal Flowtube Size		Mass Flow Rate Ranges			
			Nominal		Extended Upper Range(a)	
	mm	in	kg/min	lb/min	kg/min	lb/min
CFS10	3	1/8	0.03 to 3	0.07 to 7	7	15
	6	1/4	0.09 to 9	0.2 to 20	22	48
	15	1/2	0.4 to 40	0.9 to 90	73	160
	20	3/4	0.9 to 90	2 to 200	119	261
	25	1	1.8 to 180	4 to 400	244	536
	40	1 1/2	4 to 400	9 to 900	607	1335
	50	2	7 to 700	15 to 1500	1023	2250
CFS20	40	1 1/2	4 to 40	9 to 900	485	1070
	80	3	18 to 1800	40 to 4000	2040	4500

(a) Extended upper range is based on a fluid specific gravity of 0.8 at a temperature of 100°C (212°F).

To find the extended upper range at other specific gravities and temperatures, contact Invensys.

Process Temperature/Pressure Limits

Process temperature/pressure limits are limited by either the **maximum flowtube values** or the **maximum end connection values**, whichever are less. Refer to Table 2 and Table 3.

Table 2. End Connection Process Temperature/Pressure Limits (a)

End Connection Type	Process Temp.	MWP (b)	
		316/316L ss	Hast. C-22
ANSI® Class 150 Flange	100°F	275 psig	290 psig
	200°F	240 psig	260 psig
	300°F	215 psig	230 psig
	356°F	208 psig	217 psig
ANSI Class 300 Flange	100°F	720 psig	750 psig
	200°F	620 psig	750 psig
	300°F	560 psig	730 psig
	356°F	540 psig	719 psig
ANSI Class 600 Flange	100°F	1440 psig	1500 psig
	200°F	1240 psig	1500 psig
	300°F	1120 psig	1455 psig
	356°F	1080 psig	1435 psig
BS 4504 (DIN) PN 10/16 PN 25/40 Flange	40°C	40.0 bar(c)	41.7 bar(c)
	100°C	34.2 bar(c)	37.1 bar(c)
	150°C	30.8 bar(c)	32.9 bar(c)
	180°C	29.3 bar(c)	30.6 bar(c)
Flange to Mate with BS 4504 (DIN), PN 100/2	40°C	96 bar (c)	103 bar (c)
	100°C	82 bar (c)	103 bar (c)
	150°C	75 bar (c)	100 bar (c)
	180°C	72 bar (c)	98 bar (c)
Threaded, NPT, ANSI B2.1	MWP limited by threaded end connection limits per Table 3.		
Sanitary (Tri-Clamp® Ferrule and DIN 11851) (d)	Maximum working pressure is 10 bar at 25°C (145 psig at 77°F).		

(a) Linear interpolation is acceptable.

(b) See Model Codes for flowtube configurations available with 316 ss, 316L ss, and Hastelloy C-22 end connections.

(c) To obtain MPa values, divide bar value by 10.
To obtain kPa values, multiply bar value by 100.

(d) If higher MWPs are required, contact Invensys Foxboro.

Table 3.

Flowtube Process Temperature/Pressure Limits Threaded End Connections (a)

Nominal Flowtube Size		Process Temperature		Maximum Working Pressure (MWP)			
				316/316L ss		Hastelloy C-22	
mm	in	°C	°F	bar (b)	psig	bar (b)	psig
3	1/8	40	100	207	3000	217	3150
and	and	100	200	174	2530	217	3150
6	1/4	150	300	156	2270	213	3050
		180	356	148	2144	207	3010
15	1/2	40	100	100	1440	103	1500
and	and	100	200	85	1240	103	1500
20	3/4	150	300	78	1120	100	1455
		180	356	75	1080	98	1435

(a) Linear interpolation is acceptable.

(b) To obtain MPa value, divide bar value by 10.

To obtain kPa value, multiply bar value by 100.

Pressure Loss - FlowExpertPro.com

To determine pressure loss or sizing for your application, merely have your process information available and visit the Invensys Foxboro web site at FlowExpertPro.com.

Process Density

Process fluid density ranges from 200 to 3000 kg/m³ (12.5 to 187 lb/ft³); or a specific gravity range of 0.2 to 3. Note that a specific gravity of 1 corresponds to a fluid density of 1000 kg/m³ (62.4 lb/ft³).

PHYSICAL SPECIFICATIONS

Flowtube to Transmitter Interface

The flowtube has a terminal for the local earth (ground) connection. For signal connections, the flowtube is provided with an integrally mounted electrical junction box that meets NEMA Type 4X and IEC IP54 requirements and contains a pair of 6-position feedthrough type terminal blocks. The terminal blocks are connected to the flowtube through a hermetic seal with properly spaced intrinsically safe wiring. An internally threaded 3/4 NPT conduit fitting at the top of the junction box is provided for signal cabling.

Tamperproof sealing of the junction box cover is provided when selecting either Custody Transfer Option -T or Tamperproof Sealing Option -S. When selecting Option -T, an NTEP approved label is applied to the flowtube. Additionally, with Option -T, the customer must also select the CFT50 Transmitter Custody Transfer Option -T. See Figure 1.

Interconnecting cable to the transmitter is not provided with the tube. However, FEP or PVC jacketed cable can be ordered separately for this purpose. Refer to the Cable Model Code for specifications and ordering instructions.

NOTES

1. If conduit is used (required with cryogenic option), a watertight conduit connector and conduit drip loop is required at the junction box to prevent collection of condensate. If conduit is not used, a watertight cable grip and cable drip loop is recommended.
2. Hastelloy and some sanitary tubes are supplied with 4.9 m (16 ft) of cable for direct connection to the transmitter, or to a remote junction box with an extension cable to the transmitter.

Junction Box Extension Kit for Steam Jacket or Flowtube Insulation

The normal clearance between the outside surface of the tube and junction box is a nominal 12.7 mm (1/2 in). In order to adequately accommodate a steam jacket or insulation enveloping the tube's outside surface, this clearance can be increased to 102 mm (4 in) by using the junction box extension kit shown in Figure 2. See applicable installation instructions and parts list for further details.

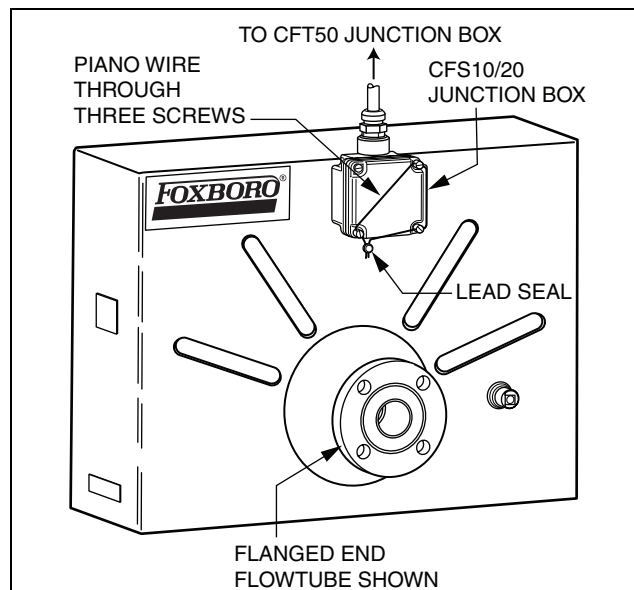


Figure 1. Tamperproof Sealing of Junction Box Cover provided with Option -S and Option -T.

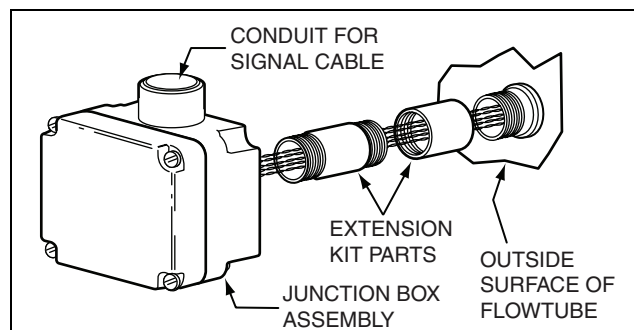


Figure 2. Junction Box Extension Kit

Flowtube Enclosure

AISI Type 304 stainless steel (304 ss) with a matte finish. Seams are welded and the enclosure is free from water and dust retaining cavities.

Ingress Protection

Hermetically sealed, welded flowtube enclosure provides ingress protection at internal pressure less than atmospheric pressure; 70 kPa (10.15 psia).

Flowtube Mounting

Designed for mounting to a horizontal or vertical pipe. There will be fluid draining when the flowtube is mounted vertically and there is an upward flow.

Dimensions

Refer to "DIMENSIONS-NOMINAL" section.

PHYSICAL SPECIFICATIONS (Cont.)**Approximate Mass
with ANSI Class 150 Flanges**

Nominal Flowtube Size		Approximate Mass	
mm	in	kg	lb
3	1/8	Not Applicable	
6	1/4	9.5	21
15	1/2	11.7	26
20	3/4	18.6	41
25	1	22.7	50
40	1 1/2	53.5	118
50	2	77.6	171
80	3	111	244

NOTE: See Model Codes for other flanges available with each flowtube size.

**Approximate Mass
with Threaded or Sanitary Connections**

Nominal Flowtube Size		Approximate Mass	
mm	in	kg	lb
3	1/8	6.4	14
6	1/4	8.6	19
15	1/2	10.4	23
20	3/4	16.8	37
25	1	20.4	45
40	1 1/2	49.9	110
50	2	71.2	157
80	3	99.3	219

NOTE: See Model Codes for end connections available with each flowtube size.

ELECTRICAL SAFETY SPECIFICATIONS

Testing Laboratory, Type of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
ATEX (KEMA) intrinsically safe, II 2 G, EEx ib, II B, Zone 1.	Connect to CFT50-.....M or CFT50-.....Q Mass Flow Transmitters. Temperature Class in accordance with process temperature listed in Table 4.	MMM
ATEX (KEMA) nonsparking, II 3 G, EEx nA II, Zone 2.	Connect to CFT50-.....T Mass Flow Transmitter. Temperature Class in accordance with process temperature listed in Table 4.	LLL
CSA for use in general purpose (ordinary) locations.	Connect to Model CFT50 Mass Flow Transmitter. Temperature Class in accordance with process temperature. Refer to Table 4.	CGZ
CSA nonincendive for use in Class I, Division 2, Groups A, B, C, and D, locations.	Connect to Model CFT50 Mass Flow Transmitter per MI 019-133. Temperature Class in accordance with process temperature. Refer to Table 4.	CNN
FM intrinsically safe apparatus for Class I, Division 1, Groups C and D.	Connect to Model CFT50 Mass Flow Transmitter per MI 019-133. Temperature Class is a function of process temperature. Refer to Table 4.	FBB
FM nonincendive for use in Class I, Division 2, Groups A, B, C, and D, locations.	Connect to Model CFT50 Mass Flow Transmitter per MI 019-133. Temperature Class is a function of process temperature. Refer to Table 4.	FNN
Agency approvals or certifications are not required.		ZZZ

NOTE

These flowtubes have been designed to meet the electrical safety descriptions listed in the table above. For detailed information or status of the Testing Laboratory approvals/certifications, contact Invensys.

Table 4.
Process Temperature Range in Accordance with
Flowtube Model, Size and Electrical Safety Design Code

Process Temperature Range for Electrical Safety Design Code MMM								
Flowtube Model	Flowtube Size		Ambient Temperature		Temp. Class	Process Temperature Range		
	mm	in	°C	°F		°C	°F	
CFS10	3 thru 20	0.125 thru 0.750	−20 to +60°	−4 to +140°	T2	−200 to +200°	−328 to +392°	
					T3	−200 to +160°	−328 to +320°	
					T4	−200 to +95°	−328 to +203°	
					T5	−200 to +60°	−328 to +140°	
					T6	−200 to +45°	−328 to +113°	
CFS10	25 thru 50	1.00 thru 2.00	−20 to +60°	−4 to +140°	T2	−55 to +165°	−67 to +329°	
					T3	−55 to +165°	−67 to +329°	
					T4	−55 to +95°	−67 to +203°	
CFS20	40 and 80	1.50 and 3.00			T5	−55 to +60°	−67 to +140°	
					T6	−55 to +45°	−67 to +113°	

Process Temperature Range for Electrical Safety Design Code LLL						
Flowtube Model	Flowtube Size	Ambient Temperature		Temp. Class	Process Temperature Range	
		°C	°F		°C	°F
CFS10 and CFS 20	All Flowtube Sizes	-40 to +85°	-40 to +185°	T3	-40 to +180°	-40 to +356°
		-40 to +85°	-40 to +185°	T4	-40 to +115°	-40 to +239°
		-40 to +80°	-40 to +176°	T5	-40 to +80°	-40 to +176°
		-40 to +65°	-40 to +149°	T6	-40 to +65°	-40 to +149°

Process Temperature Range for Electrical Safety Design Code FBB, FNN & CNN							
Flowtube Model	Flowtube Size		Ambient Temperature		Temp. Class	Process Temperature Range	
	mm	in	°C	°F		°C	°F
CFS10 and CFS20	6	0.25	-20 to +60°	-4 to +140°	T5	-135 to +195°	-211 to +383°
	15	0.50	-20 to +60°	-4 to +140°	T5	-200 to +195°	-328 to +383°
	20	0.75	-20 to +60°	-4 to +140°	T5	-200 to +195°	-328 to +383°
	25	1.00	-20 to +60°	-4 to +140°	T5	-50 to +195°	-58 to +383°
	40	1.50	-20 to +60°	-4 to +140°	T5	-50 to +195°	-58 to +383°
	50	2.00	-20 to +60°	-4 to +140°	T5	-50 to +175°	-58 to +347°
	80	3.00	-20 to +60°	-4 to +140°	T5	-50 to +175°	-58 to +347°

MODEL CODE**Model Code – CFS10 Series Mass Flowtubes (See next page for CFS10 Sanitary Flowtubes)****Description**

CFS10 = CFS10 Series Mass Flowtube (a)

Nominal Flowtube and Flange Size

- 02 = 3 mm (1/8 in); Threaded 1/4 NPT, ANSI B2.1 Connection
- 03 = 6 mm (1/4 in)
- 05 = 15 mm (1/2 in)
- 08 = 20 mm (3/4 in)
- 10 = 25 mm (1 in)
- 15 = 40 mm (1 1/2 in)
- 20 = 50 mm (2 in)

Flowtube Wetted Material

- S = AISI Type 316L Stainless Steel (316L ss)
- H = Hastelloy C-22
- C = AISI Type 316L ss prepared with Sanitary Finish
(Not with Flowtube Size Code -02)

End Connections

- A = Threaded, NPT, ANSI B2.1 (Not available with Flowtube Size Codes -10, -15, or -20)
- C = ANSI Class 150 Flange (Not Available with Flowtube Size Code -02) (b)
- D = ANSI Class 300 Flange (Not Available with Flowtube Size Code -02) (b)
- E = ANSI Class 600 Flange (Not Available with Flowtube Size Code -02) (b)
- F = PN 10/16, 25/40 Flange (Not Available with Flowtube Size Code -02) (b)
- J = PN 100 Flange, Mates with BS4504, Part 4, 1969, 100/2 Flange (b)
(Not Available with Flowtube Size Code -02)

Electrical Safety (See Electrical Safety Specifications Section)

- MMM = ATEX (KEMA), II 2 G, EEx ib, IIB
- LLL = ATEX (KEMA), II 3 G, EEx nA, II
- CGZ = CSA, General Purpose (Ordinary) Locations, No Certified Connectivity
- CNN = CSA, Nonincendive for use in Class I, Division 2, Groups A, B, C, and D
- FBB = FM, Intrinsically Safe, Class I, Division 1, Groups C and D
- FNN = FM, Nonincendive for Class I, Division 2, Groups A, B, C, and D
- ZZZ = No Electrical Certifications/Approvals

Optional Selections

- B = Bidirectional Flow Calibration (Standard Factory Calibration is one direction)
- E = Calibrated for use with a CFT50 Transmitter (Default Calibration) (c)
- F = Calibrated for use with a CFT10 or CFT15 Transmitter (c)
- G = Dual Calibrations, for use with a CFT10, CFT15, or CFT50 Transmitter (c)
- M = Foxboro Material Certification of Process Wetted Metal
Conforms to DIN 50049, Paragraph 3.1B)
- S = Tamperproof sealing for Terminal Block Cover (e)
- T = Weights and Measures Custody Transfer/NTEP; (f)
 - Includes Tamperproof Sealing Option -S
 - Must be combined with CFT50 Transmitter Option -T
 - Calibration Option -E must also be specified
- X = Radiography of Pressure Retaining Welds (d)

Examples: CFS10-05SCFBB-BX; CFS10-10SFCGZ-E

(a) IMPORTANT: The flowtube is not supplied with cable for transmitter interconnection. Standard cable can be ordered separately. See Cable Model Code for ordering information.

(b) Size Code -03, 6 mm (1/4 in) Flowtube, supplied with a 15 mm (1/2 in) flange connection.

(c) Specify one of either -E, -F, or -G Calibration Options only.

(d) Per ASME Section V Boiler/Pressure Vessel Code, Nondestructive.

(e) Option -S not available with Electrical Safety Codes MMM and LLL.

(f) Option -T not available with Electrical Safety Codes CNN, MMM, and LLL.

MODEL CODE**Model Code – CFS10 Series Sanitary Mass Flowtubes****Description**

CFS10 = CFS10 Series Sanitary Mass Flowtube (a)

Nominal Flowtube and End Connection Size

- 03 = 6 mm (1/4 in); Process Connection Size is 1/2 in
- 05 = 15 mm (1/2 in); Process Connection Size is 1 in
- 08 = 20 mm (3/4 in); Process Connection Size is 1 in
- 10 = 25 mm (1 in); Process Connection Size is 1 in
- 15 = 40 mm (1 1/2 in); Process Connection Size is 1 1/2 in
- 20 = 50 mm (2 in); Process Connection Size is 2 in

Flowtube Wetted Material

C = AISI Type 316L ss prepared for Sanitary Applications, 3A Authorization No. 224

End Connections (Supplied in AISI Type 316 Stainless Steel Only)

N = For Mating to DIN Coupling with External Thread, DIN 11851
(Not available with Flowtube Size Code -03)

P = For Mating to Tri-Clamp Quick-Disconnect Ferrule

Electrical Safety (See Electrical Safety Specifications Section)

- MMM = ATEX (KEMA), II 2 G, EEx ib, IIB
- LLL = ATEX (KEMA), II 3 G, EEx nA, II
- CGZ = CSA, General Purpose (Ordinary) Locations, No Certified Connectivity
- CNN = CSA, Nonincendive for use in Class I, Division 2, Hazardous Locations
- FBB = FM, Intrinsically Safe, Class I, Division 1, Groups C and D
- FNN = FM, Nonincendive for Class I, Division 2, Groups A, B, C, and D
- ZZZ = No Electrical Certifications/Approvals

Optional Selections

- B = Bidirectional Flow Calibration (Standard Factory Calibration is one direction)
- E = Calibrated for use with a CFT50 Transmitter (Default Calibration) (b)
- F = Calibrated for use with a CFT10 or CFT15 Transmitter (b)
- G = Dual Calibrations, for use with a CFT10, CFT15, or CFT50 Transmitter (b)
- M = Foxboro Material Certification of Process Wetted Metal
- S = Tamperproof sealing for Terminal Block Cover (c)
- T = Weights and Measures Custody Transfer/NTEP; (d)
 - Includes Tamperproof Sealing Option -S
 - Must be combined with CFT50 Transmitter Option -T
 - Calibration Option -E must also be specified

Examples: CFS10-05CPFBB-BM

(a) IMPORTANT: The flowtube is not supplied with cable for transmitter interconnection. Standard cable can be ordered separately. See Cable Model Code for ordering information.

(b) Specify one of either -E, -F, or -G Calibration Options only.

(c) Option -S not available with Electrical Safety Codes MMM and LLL.

(d) Option -T not available with Electrical Safety Codes CNN, MMM, and LLL.

MODEL CODE**Model Code – CFS20 Series Mass Flowtubes (Also see next page for CFS20 Sanitary Mass Flowtube)****Description**

CFS20 = CFS20 Series Mass Flowtubes (a)

Nominal Flowtube and Flange Size

-15 = 40 mm (1 1/2 in)

-30 = 80 mm (3 in)

Flowtube Wetted Material

S = AISI Type 316L Stainless Steel (316L ss); with Size Code -30 only

H = Hastelloy C; with Size Code -15 only

End Connections

C = ANSI Class 150 Flange

D = ANSI Class 300 Flange

E = ANSI Class 600 Flange

F = PN 40 Flange

J = PN 100 Flange, Mates with BS4504, Part 4, 1969, 100/2 Flange

Electrical Safety (See Electrical Safety Specifications Section)

MMM = ATEX (KEMA), II 2 G, EEx ib, IIB

LLL = ATEX (KEMA), II 3 G, EEx nA, II

CGZ = CSA, General Purpose (Ordinary) Locations, No Certified Connectivity

CNN = CSA, Nonincendive for use in Class I, Division 2, Hazardous Locations

FBB = FM, Intrinsically Safe, Class I, Division 1, Groups C and D

FNN = FM, Nonincendive for Class I, Division 2, Groups A, B, C, and D

ZZZ = No Electrical Certifications/Approvals

Optional Selections

-B = Bidirectional Flow Calibration (Standard Factory Calibration is one direction)

-E = Calibrated for use with a CFT50 Transmitter (Default Calibration) (b)

-F = Calibrated for use with a CFT10 or CFT15 Transmitter (b)

-G = Dual Calibrations, for use with a CFT10, CFT15, or CFT50 Transmitter (b)

-M = Foxboro Material Certification of Process Wetted Metal (c)

(Conforms to DIN 50049, Paragraph 3.1B)

-S = Tamperproof sealing for Terminal Block Cover (d)

-T = Weights and Measures Custody Transfer/NTEP; (e)

- Includes Tamperproof Sealing Option -S

- Must be combined with CFT50 Transmitter Option -T

- Calibration Option -E must also be specified

-X = Radiography of Pressure Retaining Welds (c)

(A copy of the Q.A. report is provided.)

EXAMPLE: CFS20-30SCFBB-BX; CFS20-15HCFBB-G

(a) IMPORTANT: The flowtube is not supplied with cable for transmitter interconnection. Standard cable can be ordered separately. See Cable Model Code for ordering information.

(b) Specify one of either -E, -F, or -G Calibration Options only.

(c) Per ASME Section V Boiler/Pressure Vessel Code, Nondestructive.

(d) Option -S not available with Electrical Safety Codes MMM and LLL.

(e) Option -T not available with Electrical Safety Codes CNN, MMM, and LLL.

MODEL CODE**Model Code – CFS20 Series Sanitary Mass Flowtubes****Description**

CFS20 = CFS20 Series Sanitary Mass Flowtubes (a)

Nominal Flowtube and End Connection Size

-30 = 80 mm (3 in), Process Connection Size is 3 in

Flowtube Wetted Material

C = AISI Type 316L ss prepared for Sanitary Applications, 3A Authorization No. 224

End Connections - supplied in AISI Type 316 stainless steel only

N = For Mating to DIN Coupling with External Thread, DIN 11851

P = For Mating to Tri-Clamp Quick-Disconnect Ferrule

Electrical Safety (See Electrical Safety Specifications Section)

MMM = ATEX (KEMA), II 2 G, EEx ib, IIB

LLL = ATEX (KEMA), II 3 G, EEx nA, II

CGZ = CSA, General Purpose (Ordinary) Locations, No Certified Connectivity

CNN = CSA, Nonincendive for use in Class I, Division 2, Hazardous Locations

FBB = FM, Intrinsically Safe, Class I, Division 1, Groups C and D

FNN = FM, Nonincendive for Class I, Division 2, Groups A, B, C, and D

ZZZ = No Electrical Certifications/Approvals

Optional Selections

-B = Bidirectional Flow Calibration (Standard Factory Calibration is one direction)

-E = Calibrated for use with a CFT50 Transmitter (Default Calibration) (b)

-F = Calibrated for use with a CFT10 or CFT15 Transmitter (b)

-G = Dual Calibrations, for use with a CFT10, CFT15, or CFT50 Transmitter (b)

-M = Foxboro Material Certification of Process Wetted Metal (c)
(Conforms to DIN 50049, Paragraph 3.1B)

-S = Tamperproof sealing for Terminal Block Cover (c)

-T = Weights and Measures Custody Transfer/NTEP; (d)

- Includes Tamperproof Sealing Option -S

- Must be combined with CFT50 Transmitter Option -T

- Calibration Option -E must also be specified

EXAMPLE: CFS20-30SCFBB-BX; CFS20-15SCFBB-G

(a) IMPORTANT: The flowtube is not supplied with cable for transmitter interconnection. Standard cable can be ordered separately.
See Cable Model Code for ordering instructions.

(b) Specify one of either -E, -F, or -G Calibration Options only.

(c) Option -S not available with Electrical Safety Codes MMM and LLL.

(d) Option -T not available with Electrical Safety Codes CNN, MMM, and LLL.

MODEL CODES (Cont.)**Model Code - Cable (Recommended by Invensys Foxboro)****Cable Insulation Material (a)**

KFS1 = IPVC-Insulated Cable, -20 to +80°C (-4 to +176°F) Ambient Temperature

KFS2 = FEP-Insulated Cable, -40 to +85°C (-40 to +185°F) Ambient Temperature

Cable Length - Feet or Metres

-F0020 = 20 feet

-F0100 = 100 feet

-F0200 = 200 feet

-F0500 = 500 feet

-F0750 = 750 feet

-F1000 = 1000 feet

-M006 = 6 metres

-M030 = 30 metres

-M060 = 60 metres

-M150 = 150 metres

-M225 = 225 metres

-M300 = 300 metres

Examples: KFS1-F0200 = 200 feet of PVC Cable; KFS2-M006 = 6 metres of FEP Cable

(a) See cable specifications below.

Cable Specifications

PVC Cable has 3 twisted pairs of PVC-insulated, 22 AWG stranded, tinned, copper wire. Each pair has an aluminum-polyester shield with drain wire. Cable has a chrome-PVC outer jacket with ambient temperature limits of -20 to +80°C (-4 to +176°F). One end of cable is dressed and ready for connection to transmitter. Voltage rating is 30 V ac.

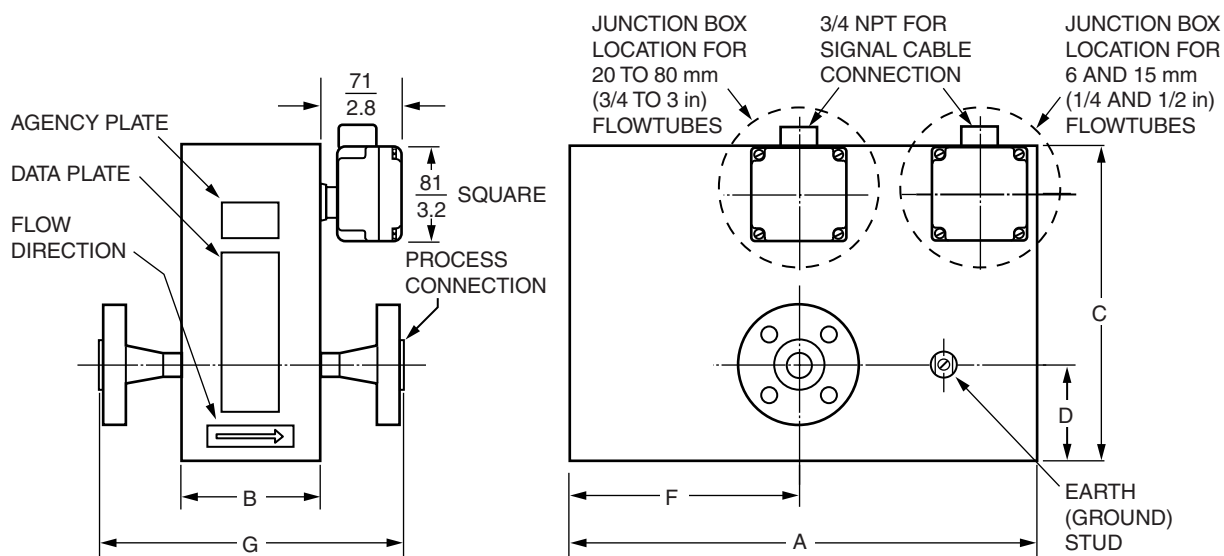
FEP Cable has 3 twisted pairs of FEP-insulated 22 AWG stranded, tinned, copper wire. Each pair has an aluminum-polyester shield with drain wire. Cable has an FEP outer jacket with ambient temperature limits of -40 to +85°C (-40 to +185°F). One end of cable is dressed and ready for connection to transmitter. Voltage rating is 30 V ac.

Flowtube Size vs. End Connection Configuration Table

Flowtube Model	Flowtube Size Code	Available with End Connection Codes:							
		Threaded	Flanged					Sanitary	
		A	C	D	E	F	J	N	P
CFS10	02	YES	NO	NO	NO	NO	NO	NO	NO
	03	YES	YES	YES	YES	YES	YES	NO	YES
	05	YES	YES	YES	YES	YES	YES	YES	YES
	08	YES	YES	YES	YES	YES	YES	YES	YES
	10	NO	YES	YES	YES	YES	YES	YES	YES
	15	NO	YES	YES	YES	YES	YES	YES	YES
CFS20	20	NO	YES	YES	YES	YES	YES	YES	YES
	15	NO	YES (a)	YES (a)	YES (a)	YES (a)	YES (a)	NO	NO
	30	NO	YES (b)	YES (b)	YES (b)	YES (b)	YES (b)	YES	YES

(a) Model CFS20 Size Code 15 (flanged) only available with Hastelloy C-22 wetted material.

(b) Model CFS20 Size Code 30 (flanged) only available with 316L ss wetted material.

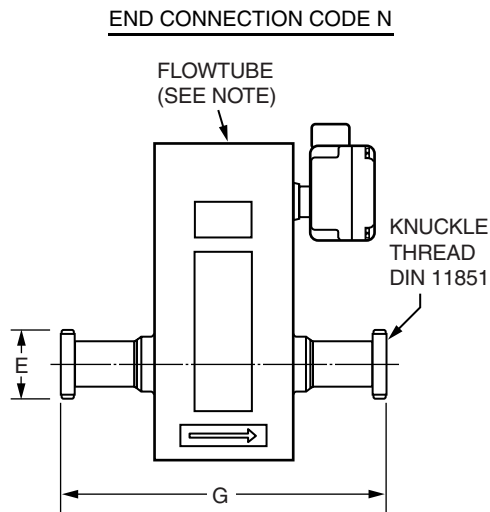
DIMENSIONS—NOMINAL**CFS10 AND CFS20 FLANGED END FLOWTUBES**
6 to 80 mm (1/4 to 3 in) Sizes**mm**
in**Dimensions A, B, C, D, and F – Flanged End Flowtubes**

Flowtube Model	Flowtube Size	Dimensions - Nominal				
		Dim. A	Dim. B	Dim. C	Dim. D	Dim. F
CFS10	6 mm (1/4 in)	411 16.2	160 6.3	231 9.1	30 1.2	206 8.1
	15 mm (1/2 in)	417 16.4	122 4.8	277 10.9	84 3.3	208 8.2
	20 mm (3/4 in)	518 20.4	163 6.4	391 15.4	12.2 4.8	259 10.2
	25 mm (1 in)	518 20.4	163 6.4	391 15.4	12.2 4.8	259 10.2
	40 mm (1 1/2 in)	704 27.7	241 9.5	457 18.0	130 5.1	353 13.9
	50 mm (2 in)	808 31.8	282 11.1	516 20.3	150 5.9	404 15.9
CFS20	40 mm (1 1/2 in)	518 20.4	163 6.4	391 15.4	12.2 4.8	259 10.2
	80 mm (3 in)	808 31.8	282 11.1	516 20.3	150 5.9	404 15.9

Dimension G – Flanged End Flowtubes

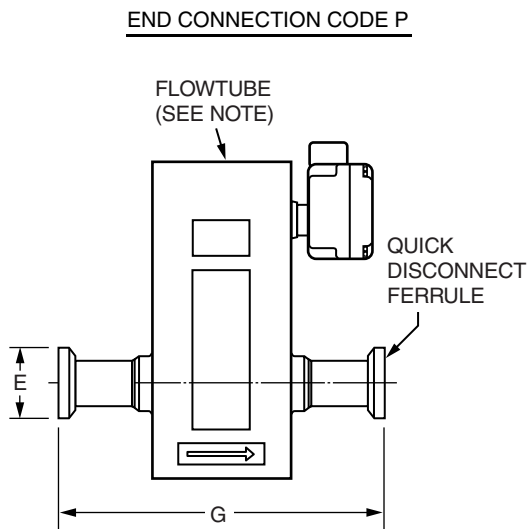
Flowtube Model	Flowtube Size	Dimension G with the Following Flange Types				
		ANSI Cl. 150	ANSI Cl. 300	ANSI Cl. 600	PN 40	PN 100
CFS10	6 mm (1/4 in)	264 10.4	264 10.4	264 10.4	264 10.4	264 10.4
	15 mm (1/2 in)	239 9.4	249 9.8	262 10.3	262 10.3	264 10.4
	20 mm (3/4 in)	290 11.4	300 11.8	312 12.3	305 12.0	312 12.3
	25 mm (1 in)	292 11.5	305 12.0	317 12.5	300 11.8	317 12.5
	40 mm (1 1/2 in)	391 15.5	406 16.0	411 16.2	406 16.0	411 16.2
	50 mm (2 in)	434 17.1	447 17.6	467 18.4	436 17.2	444 17.5
CFS20	40 mm (1 1/2 in)	356 14.0	368 14.5	370 14.6	368 14.5	370 14.6
	80 mm (3 in)	508 20.0	525 20.7	546 21.5	525 20.7	571 22.5

DIMENSIONS—NOMINAL (Cont.)

$$\frac{\text{mm}}{\text{in}}$$
CFS10 AND CFS20 SANITARY END FLOWTUBES
 6 to 80 mm (1/4 to 3 in) Sizes

Dimensions E and G - Sanitary End Flowtubes
End Connection Code N (a)

Flowtube Model	Flowtube Size	Dimensions	
		Dim. E	Dim. G
CFS10	6 mm (1/4 in)	Not Applicable	Not Applicable
	15 mm (1/2 in)	$\frac{53}{2.1}$	$\frac{284}{11.2}$
	20 mm (3/4 in)	$\frac{53}{2.1}$	$\frac{290}{11.4}$
	25 mm (1 in)	$\frac{51}{2.0}$	$\frac{320}{12.6}$
	40 mm (1 1/2 in)	$\frac{66}{2.6}$	$\frac{427}{16.8}$
	50 mm (2 in)	$\frac{79}{3.1}$	$\frac{457}{18.0}$
CFS20	80 mm (3 in)	$\frac{109}{4.3}$	$\frac{498}{19.6}$

(a) Code N is a DIN coupling with external thread, DIN 11851.


Dimensions E and G - Sanitary End Flowtubes
End Connection Code P (a)

Flowtube Model	Flowtube Size	Dimensions	
		Dim. E	Dim. G
CFS10	6 mm (1/4 in)	$\frac{24.9}{0.98}$	$\frac{274}{10.8}$
	15 mm (1/2 in)	$\frac{50.3}{1.98}$	$\frac{249}{9.8}$
	20 mm (3/4 in)	$\frac{50.3}{1.98}$	$\frac{290}{11.4}$
	25 mm (1 in)	$\frac{50.3}{1.98}$	$\frac{287}{11.3}$
	40 mm (1 1/2 in)	$\frac{50.3}{1.98}$	$\frac{386}{15.2}$
	50 mm (2 in)	$\frac{63.5}{2.50}$	$\frac{414}{16.3}$
CFS20	80 mm (3 in)	$\frac{90.9}{3.58}$	$\frac{4.32}{17.0}$

(a) Code P mates with a quick disconnect ferrule

- 1/4 in size mates with 1/2-inch ferrule
- 1/2 to 1 1/2 in sizes mate with 1-inch ferrule
- 2 in size mates with 2-inch ferrule
- 3-in size mates with 3-inch ferrule.

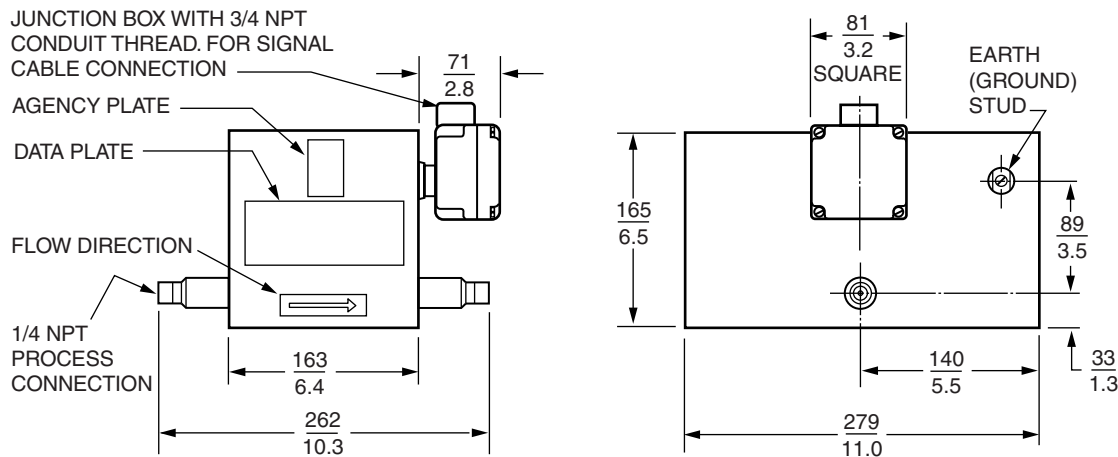
NOTE

For flowtube dimensions other than those indicated above, refer to Dimensions - Nominal section for flanged end flowtubes. Also, see next page for threaded end flowtubes.

DIMENSIONS—NOMINAL (Cont.)

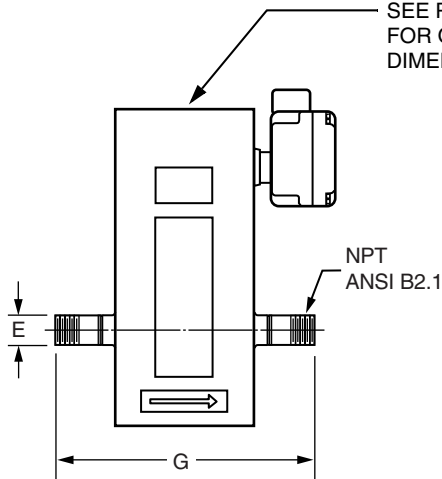
**mm
in**

**CFS10 THREADED END FLOWTUBE
3 mm (1/8 in) Size**



**CFS10 THREADED END FLOWTUBES
6, 15, and 20 mm (1/4, 1/2, and 3/4 in) Sizes**

SEE PREVIOUS PAGES
FOR OTHER FLOWTUBE
DIMENSIONS



Dimensions E and G - Threaded End Flowtubes

Flowtube Model	Flowtube Size	Dimensions	
		Dim. E	Dim. G
CFS10	6 mm (1/4 in)	1/4 NPT	224 / 8.8
	15 mm (1/2 in)	1/2 NPT	211 / 8.3
	20 mm (3/4 in)	3/4 NPT	259 / 10.2

ORDERING INSTRUCTIONS

1. Model Number – Flowtube
2. Model Number – Cable, if required
3. Model Number of CFT50 Transmitter, if required; see PSS 1-2B7 A.
4. Flow Data (rate, pressure, temperature, etc.)
5. Junction Box Extension Kit (contact Invensys, if required)
6. User Tag Data

OTHER M&I PRODUCTS

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:

www.foxboro.com/instrumentation