

Mass Flowtube Models CFS10 and CFS20

Installation, Startup, Troubleshooting, and Maintenance



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Important Information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service, or maintain it. The following special messages may appear throughout this manual or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

DANGER

DANGER indicates a hazardous situation which, if not avoided, **will result in death or serious injury**.

WARNING

WARNING indicates a hazardous situation which, if not avoided, **could result in death or serious injury**.

CAUTION

CAUTION indicates a hazardous situation which, if not avoided, **could result in minor or moderate injury**.

NOTICE

NOTICE is used to address practices not related to physical injury.

Please Note

Electrical equipment should be installed, operated, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

1. Introduction

General Description

The Model CFS20 is a dual path mass flowtube that uses two *parallel*-connected, large-bore tubes. Fluid entering the flowtube is channeled through a rigid center body via two parallel loops back into the outlet side of the rigid center body.

The Model CFS10 is a single path mass flowtube that uses two *serial*-connected, large bore tube loops positioned side by side. Fluid entering the flowtube is channeled first through one loop, through a rigid center body, and then through the second loop.

Electromagnetic drivers bridge both loops at opposite extremities, equidistant from the center. Electromechanical sensors are used for Coriolis force measurement. Each sensor bridges both loops and is positioned adjacent to a driver.

The CFT50 or CFT51 Mass Flow transmitter is wired to the flowtube and provides an alternating current to each driver. These currents are 180° out of phase so that as the drivers alternately expand and contract, the pairs of tube ends alternately move away from each other and then draw closer to each other. The result is that each tube effectively oscillates about its mid-point.

The movement of the tube acts on the flowing fluid within the tube, so that a Coriolis force is generated normal to the flow path. This Coriolis force acts upon the tubes and consequently the sensors to provide a signal whose amplitude with respect to the drive signal is proportional to the process fluid mass flow rate.

The density of the process fluid can also be measured because the natural driving frequency of the parallel flowtube is dependent upon the density of the fluid in the flowtube.

Temperature measurement is achieved by an internally positioned Resistance Temperature Detector (RTD).

Reference Documents

This instruction covers the installation and maintenance of the CFS10 and CFS20 Mass Flowtubes. Refer to the list below for other supporting documents.

Table 1. Reference Documents

Document No.	Document Description
DP 019-366	CFS10 Style B Flowtube Dimensions (1/8 inch)
DP 019-182	CFS10 Style B Flowtube Dimensions (1/4 through 2 inch)
DP 019-183	CFS20 Style B Flowtube Dimensions (1-1/2 and 3 inch)
DP 019-375	Dimensional Print for Digital Coriolis Mass Flow Transmitter Model CFT50
DP 019-376	Dimensional Print for Digital Coriolis Mass Flow Transmitter Model CFT51
MI 019-132	CFT50 Transmitter Installation, Startup, Configuration, and Maintenance
MI 019-133	CFT50 Safety Connection Diagrams (FM, CSA)
MI 019-140	Digital Coriolis Mass Flow Transmitter With HART and MODBUS Communication Protocols Model CFT51
MI 019-141	Digital Coriolis Mass Flow Transmitter Model CFT51 Safety Connection Diagrams (FM, CSA)
PL 008-704	CFT50 Transmitter Parts List
PL 008-733	CFS10 Style B Flowtubes, Sanitary/General, Parts List
PL 008-735	CFS20 Style B Flowtubes, Sanitary/General, Parts List
PL 008-752	Mass Flow and Density Meters Model CFT51 Digital Coriolis Mass Flow Transmitter with HART or Modbus Communication Protocol

Standard Specifications

Mass Flow Rate Range

The mass flow rate range is dependent on the flowtube size. Refer to Table 2 for the mass flow rate range for each flowtube size.

Table 2. Mass Flow Rate Ranges

Flowtube Model	Flowtube Size		Mass Flow Rate Ranges			
			Nominal Mass Flow Rate		Extended Upper Range (a)	
	mm	in	kg/min	lb/min	kg/min	lb/min
CFS10	3	1/8	0.03 to 3.2	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 400	9 to 900	485	1070
	80	3	18 to 1815	40 to 4000	2040	4500

a. The extended upper ranges shown above are based on a process fluid specific gravity of 0.8 and a temperature of 100°C (212°F). To find the extended upper range at other specific gravities and temperatures, contact Global Customer Support.

Process Fluid Density Ranges

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. Specific gravity of 1 corresponds to a fluid density of 1000 kg/m³ (62.4 lb/ft³).

Approximate Mass

Flowtube mass is dependent on the flowtube size and the end connections used.

Table 3. Approximate Flowtube Mass (a)

Nominal Flowtube Size		With ANSI Class 150 Flanged Ends		With Threaded or Sanitary Connections	
mm	in	kg	lb	kg	lb
3	1/8	Not Applicable		6.4	14
6	1/4	9.5	21	8.6	19
15	1/2	11.8	26	10.4	23
20	3/4	18.6	41	16.8	37
25	1	22.7	50	20.4	45
40	1-1/2	53.5	118	49.9	110
50	2	77.6	171	71.2	157
80	3	111	244	99.3	219

a. See Model Codes for other end connections available with each flowtube size.

Flowtube Internal Fluid Volume

Flowtube internal fluid volume is dependent on the flowtube size and the end connections used.

Table 4. Flowtube Internal Volume

Flowtube Model	Nominal Flowtube Size		Internal Fluid Volume With Flanged/Threaded Ends		Internal Fluid Volume With Sanitary Ends	
	mm	in	cm ³	in ³	cm ³	in ³
CFS10	3	1/8	18	1.1	Not available	Not available
	6	1/4	67	4	74	5
	15	1/2	321	20	352	21
	20	3/4	1,013	62	1,111	68
	25	1	1,591	97	1,630	99
	40	1-1/2	4,638	283	4,818	294
	50	2	7,934	484	8,227	502
CFS20	40	1-1/2	2,621	160	Not available	Not available
	80	3	10,015	611	9,632	588

Flowtube Coil Resistances

Table 5. Flowtube Nominal Coil Resistances (a)

Flowtube Model	Flowtube Line Size	Driver Resistance	Sensor Resistance
CFS10	3 mm (1/8 in)	12	200
	6 mm (1/4 in)	30	50
	15 mm (1/2 in)	12	12
	20 mm (3/4 in)	12	12
	25 mm (1 in)	25	12
	40 mm (1-1/2 in)	40	12
	50 mm (2 in)	40	12
CFS20	40 mm (1-1/2 in)	25	12
	80 mm (3 in)	40	12

a. At room temperature.

Maximum Process Pressure

Maximum process pressure is dependent on the process temperature, flowtube size, and end connections used. The following tables specify the maximum process pressure for the type of end connection or process temperature. Interpolation is required for process temperatures between those listed. Use the lesser of the pressures determined from these tables.

Table 6. Flowtube Process Temperature/Pressure Limits (Flanged End Connections) (a)

End Connection Type	Process Temp.	MWP (b)	
		316/316L ss	Nickel Alloy (c)
ANSI; Class 150 Flange	100°F	275 psig	290 psig
	200°F	240 psig	260 psig
	300°F	215 psig	230 psig
	356°F	204 psig	213 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	535 psig	713 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	1067 psig	1421 psig
EN 1092; PN 10/16 Flange	RT (d)	16 barg	16 barg
	100°C	16 barg	16 barg
	150°C	14.5 barg	14.5 barg
	180°C	13.8 barg	13.8 barg

Table 6. Flowtube Process Temperature/Pressure Limits (Flanged End Connections) (a) (Continued)

End Connection Type	Process Temp.	MWP (b)	
		316/316L ss	Nickel Alloy (c)
EN 1092; PN 25/40 Flange	RT (d)	40 barg	40 barg
	100°C	40 barg	40 barg
	150°C	36.3 barg	36.3 barg
	180°C	34.7 barg	34.7 barg
EN 1092; PN 100 Flange	RT (d)	100 barg	100 barg
	100°C	100 barg	100 barg
	150°C	90.9 barg	90.9 barg
	180°C	86.9 barg	86.9 barg
ANSI B2.1; Threaded (NPT)	MWP limited by threaded end connection limits per Table 7.		
Quick Disconnect Sanitary Coupling or DIN 11851 Coupling (e)	Maximum working pressure is 10 barg at 25°C (145 psig at 77°F). (f)		

- a. Linear interpolation is acceptable.
- b. See Model Codes for flowtube configurations available with 316 ss, 316L ss, and nickel alloy (equivalent to Hastelloy® C-22) end connections.
- c. Equivalent to Hastelloy C-22. Hastelloy is a registered trademark of Haynes International, Inc.
- d. RT = Reference Temperature = -10 to +100°C.
- e. End connections using DIN 11851 must be used with compliant 3-A sanitary gaskets for sanitary 3-A applications.
- f. If higher MWPs are required, contact Global Customer Support.

Table 7. Flowtube Process Temperature/Pressure Limits (Threaded End Connections) (a)

Nominal Flowtube Size		Process Temperature		Maximum Working Pressure (MWP)			
				316/316L ss		Nickel Alloy (b)	
mm	in	°C	°F	barg (c)	psig	barg (c)	psig
3 and 6	1/8 and 1/4	40	100	179	2600	217	3150
		100	200	155	2243	217	3150
		150	300	140	2026	213	3050
		180	356	133	1932	207	3010
15 and 20	1/2 and 3/4	40	100	100	1440	103	1500
		100	200	85	1240	103	1500
		150	300	78	1120	100	1455
		180	356	75	1080	98	1435

- a. Linear interpolation is acceptable.
- b. Nickel alloy (equivalent to Hastelloy® C-22) not available with 20 mm (3/4 inch) flowtube.
- c. To obtain MPa value, divide bar value by 10. To obtain kPa value, multiply bar value by 100.

Ambient Temperature Limits

–40 and +85°C (–40 and +185°F)

Process Fluid Temperature Range

See Table 9 and Table 11.

Mechanical Vibration

10 m/s² (1 'g') at 5 to 40 and 100 to 200 Hz.

Product Safety Specifications

The flowtubes have been designed to meet the electrical safety description listed in the tables in this section. For detailed information or status of testing laboratory approval/certifications, contact Global Customer Support. Refer to Table 8 for flowtube Electrical Safety Specifications when used with a CFT50, and to Table 10 for flowtube Electrical Safety Specifications when used with a CFT51.

Wiring restrictions required to maintain flowtube electrical safety specifications are provided in “Wiring” on page 29. Refer to appropriate transmitter instruction for transmitter electrical safety specification information.

Table 8. Electrical Safety Specification (Applies to Flowtubes Used with CFT50 Only)

Testing Laboratory, Type of Protection, and Area Classification	Application Conditions (a)	Electrical Safety Design Code
ATEX intrinsically safe, II 2 G; EEx ib II B; Zone 1	Connected to CFT50-*****M or Q Mass Flow Transmitter	MMM
ATEX nonsparking, II 3 G; EEx nA II; Zone 2	Connected to CFT50-*****T Mass Flow Transmitter	LLL
CSA nonincendive for use in Class I, Division 2, Groups A, B, C, and D, hazardous locations	Connected to Model CFT50-*****L, P, or S Mass Flow Transmitter per MI 019-133/MI 019-141	CNN
FM intrinsically safe apparatus for Class I, Division 1, Groups C and D, hazardous locations	Connected to Model CFT50-*****K or N Mass Flow Transmitter per MI 019-133/MI 019-141	FBB
FM nonincendive for use in Class I, Division 2, Groups A, B, C, and D, locations	Connected to Model CFT50-*****K, N, or R Mass Flow Transmitter per MI 019-133/MI 019-141	FNN
Agency approvals or certifications are not required		ZZZ

a. Temperature Class is a function of process temperature. See Table 9.

Table 9. Process Temperature Range for Electrical Safety Design Codes When Used with CFT50

Flowtube Model	Flowtube Size		Ambient Temperature		Temp. Class	Process Temperature Range	
	mm	in	°C	°F		°C	°F
Process Temperature Range for Intrinsically Safe Electrical Safety Design Codes (MMM and FBB)							
CFS10	3 through 20	0.125 through 0.750	-20 to +60°	-4 to +140°	T2	-200 to +180°	-328 to +356°
					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°
	25 through 50	1.00 through 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°
					T5	-55 to +60°	-67 to +140°
					T6	-55 to +45°	-67 to +113°
CFS20	40 and 80	1.50 and 3.00	-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°
					T5	-55 to +60°	-67 to +140°
					T6	-55 to +45°	-67 to +113°
Process Temperature Range for Electrical Safety Design Codes for Zone 2 or Division 2 (LLL, CNN, FNN)							
CFS10 and CFS20	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 ZZZ (Agency Approvals Not Required)							
CFS10 and CFS20	All Flowtube Sizes		-40 to +180°	-40 to +356°	N/A	-40 to +180°	-40 to +356°

Table 10. Electrical Safety Specification (Applies to Flowtubes Used with CFT51 Only)

Testing Laboratory, Type of Protection, and Area Classification	Application Conditions (a)	Electrical Safety Design Code
CSA/CSAus Division 1/Zone 0 Intrinsically Safe	Connected to CFT51 Electrical Safety Code CDA or CNA	CAA
CSA/CSAus Division 2/Zone 2 Non-Incendive	Connected to CFT51 Electrical Safety Code CDN or CNN	CCN
FM Division 1/Zone 0 Intrinsically Safe	Connected to CFT51 Electrical Safety Code FDA or FNA	FAA
FM Division 2/Zone 2 Non-Incendive	Connected to CFT51 Electrical Safety Code FDN or FNN	FFN
ATEX Intrinsic safe Ex ia/ic	Connected to CFT51 Electrical Safety Code ADA or ANA	AAA
ATEX Non Sparking Zone 2 Ex nA	Connected to CFT51 Electrical Safety Code ADN or ANN	ANN
IECEx Intrinsic safe Ex ia/ic	Connected to CFT51 Electrical Safety Code EDA or ENA	EAA
IECEx Non Sparking Zone 2 Ex nA	Connected to CFT51 Electrical Safety Code EDN or ENN	ENN
EAC Intrinsic Safe Ex ia/ic	Connected to CFT51 Electrical Safety Code RDA or RNA	RAA
EAC Non Sparking Zone 2 Ex nA	Connected to CFT51 Electrical Safety Code RDN or RNN	RNN
INMETRO Intrinsic Safe Ex ia/ic	Connected to CFT51 Electrical Safety Code BDA or BNA	BAA
INMETRO Non Sparking Zone 2 Ex nA	Connected to CFT51 Electrical Safety Code BDN or BNN	BNN
KOSHA Non Sparking Zone 2 Ex nA	Connected to CFT51 Electrical Safety Code KNN	KNN
Agency approvals or certifications not required		YYY

a. Temperature Class is a function of process temperature. See Table 11.

Table 11. Process Temperature Range for Electrical Safety Design Codes When Used with CFT51

Flowtube Model	Flowtube Size		Ambient Temperature		Temp. Class	Process Temperature Range	
	mm	in	°C	°F		°C	°F
Process Temperature Range for Intrinsically Safe Electrical Safety Design Codes (CAA, FAA, AAA, EAA, RAA, BAA)							
CFS10	3 through 20	0.125 through 0.750	-40 to +60°	-40 to +140°	T4	-200 to +180°	-328 to +356°
	25 through 50	1.00 through 2.00				-55 to +180°	-67 to +356°
CFS20	40 and 80	1.50 and 3.00				-55 to +180°	-67 to +356°
Process Temperature Range for Electrical Safety Design Codes for Zone 2 or Division 2 (CCN, FFN, ANN, ENN, RNN, BNN, KNN)							
CFS10 and CFS20	All Flowtube Sizes		-40 to +60°	-40 to +140°	T4	-40 to +180°	-40 to +356°
Process Temperature Range for Electrical Safety Design Code YYY (Agency Approvals Not Required)							
CFS10 and CFS20	All Flowtube Sizes		-40 to +180°	-40 to +356°	N/A	-40 to +180°	-40 to +356°

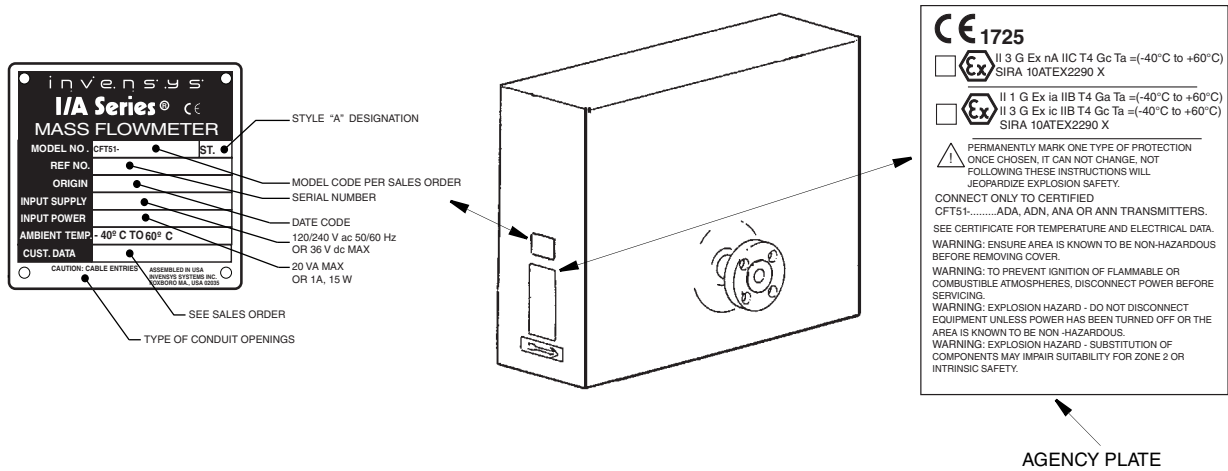
— NOTE

Protect the equipment from the temperature of the process such that the ambient temperature does not exceed 60°C (140°F).

2. Installation

Flowtube Identification

Figure 1. Data Plate Location and Flowtube Identification



NOTE

The MVV coefficient is applicable only for systems used with the CFT51.

NOTICE

Before installing your flowtube, copy the following information from the flowtube data plate (see Figure 1): MODEL, SENSOR IDENT, DENSC 1, DENSC 2, DENSC 3, DENSC 4, DENSC 5 (if provided), DENSC 6 (if provided), FLOW C1, FLOW C2, FLOW C3, FLOW C4 (not used with CFT50 or CFT51), NOM CAPACITY, TP COR S (if provided), and TP COR O (if provided). This information is required when programming the transmitter.

Density and flow coefficients use an exponential format for the CFT50, CFT10/15, but the density and flow coefficients for the CFT51 use a decimal format.

Moving the Flowtube

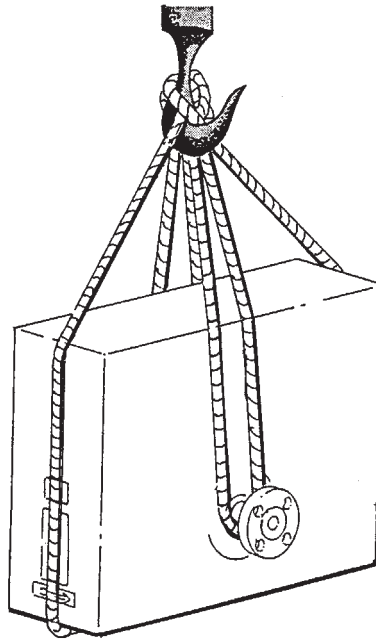
Care must be exercised when moving the flowtube to avoid personal injury and prevent damage to the flowtube and integral cable extending from flowtube. Refer to the following recommendations for proper handling and support of the flowtube.

- ◆ Before removing flowtube from shipping container, move the flowtube as close to the installation location as possible.
- ◆ Smaller flowtubes can be removed from the shipping container and installed between the upstream and downstream pipe connections by hand lifting and carrying. However, to avoid personal injury and/or damage to the flowtube, larger flowtubes must be lifted and restrained as shown in Figure 2. Note that in addition to using the upstream and downstream connections, the flowtube must also be restrained at both sides to prevent rotation as the flowtube is lifted.

▲ CAUTION

Do not lift or support the flowtube by its junction box or cable.

Figure 2. Support Required when Moving a Flowtube



Mounting Considerations

- ◆ The flowtube and cable should be mounted no closer than 3 m (10 ft) from any motor, speed controller, large transformer, or power contactor.
- ◆ Standard practice is to mount the flowtube on a horizontal pipe as shown in Figures 3, 4, and 6. For self-draining, or if the process fluid contains gas bubbles, the flowtube should be mounted on a vertical pipe as shown in Figures 5 and 6.

NOTE

Performance and operation are not affected by the orientation of the flowtube, except that when vertical mounting is used, flow must be upward through the flowtube.

- ◆ When required by the process application, the flowtube can be heat traced or insulated with a lightweight material.

▲ WARNING
If the process fluid is a gas at ambient conditions, but is in the liquid state due to line pressure, the flowtube must be enclosed in a containment unit. In the event of a break in the flowtube, increasing pressure inside the flowtube case can cause the case to burst. Failure to comply with this warning could result in severe injury or death.

▲ CAUTION
The flowtube case must not be pierced. The interior is filled with an inert gas pressurized at 70 kPa (10.15 psia).

Mounting Procedure

The flowtube can be mounted horizontally or vertically as shown in Figures 3 through 6. When mounted vertically (as in self-draining applications), the direction of flow must be upward to minimize the incidence of trapped air. All of the following steps apply to both horizontal and vertical mounting.

NOTE

For 3-A sanitary compliance, flowtube **MUST** be installed vertically.

1. Determine the face-to-face distance between the flowtube end connections. Refer to “Reference Documents” on page 12 for Dimensional Prints.
2. Fabricate the end connections to the pipe.
3. Provide upstream and downstream flowline supports. Supports can extend from floor, ceiling, or wall, as convenient, but should not be firmly secured to the pipeline at this time. Refer to Figure 7 for types of recommended pipeline supports. Note that “rest type” supports should not be used for flowtube sanitary connection types N and P.
 - ◆ Each support must contact flowline as close to the junction of pipe and flowtube enclosure as practically possible. For flowtubes with flanged end connections (Figure 3 and Figure 5), the distance between each support and the junction must not exceed 38 cm (15 inches).
 - ◆ For sanitary flowtube end connections N and P, and if flowtube size is 15 mm (1/2 in) or greater, additional supports must be positioned between the flowtube enclosure and the junction of flowtube and pipeline.
 - ◆ All supports must provide a minimum of 25 mm (1 in) of axial length of surface contact.
 - ◆ A filter is recommended on the smaller line sizes to minimize problems with dirt particles introduced during installation.
4. Move the flowtube into position between the flowline end connections. Arrow on the flowtube must be pointing in the direction of flow.
5. Align the flowtube and flowline end connections. Secure the flowtube to the flowline. Various end connections are described on page 25 through page 28.

Figure 3. Flowtube Mounting with Flanged End Connections - Horizontal Pipeline

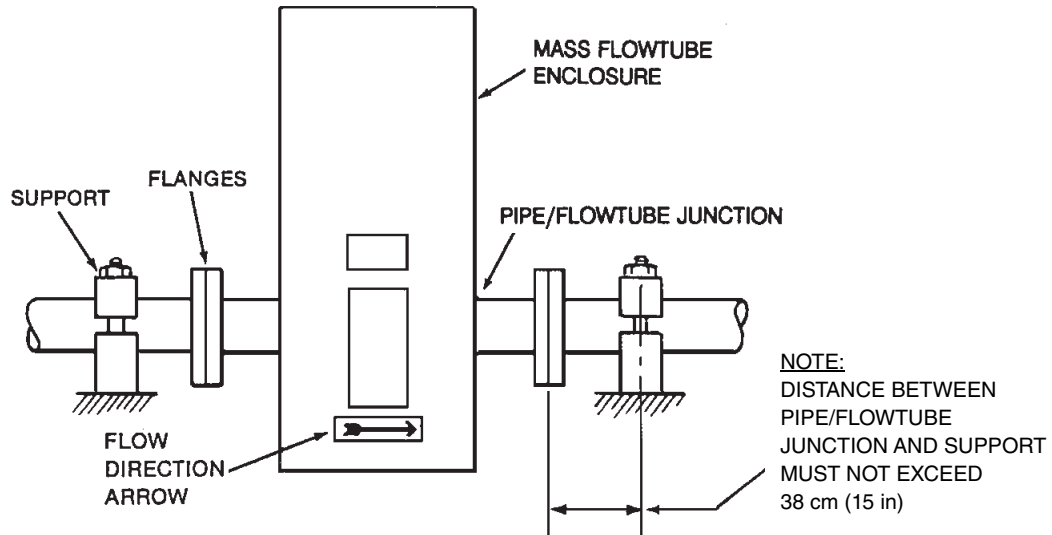
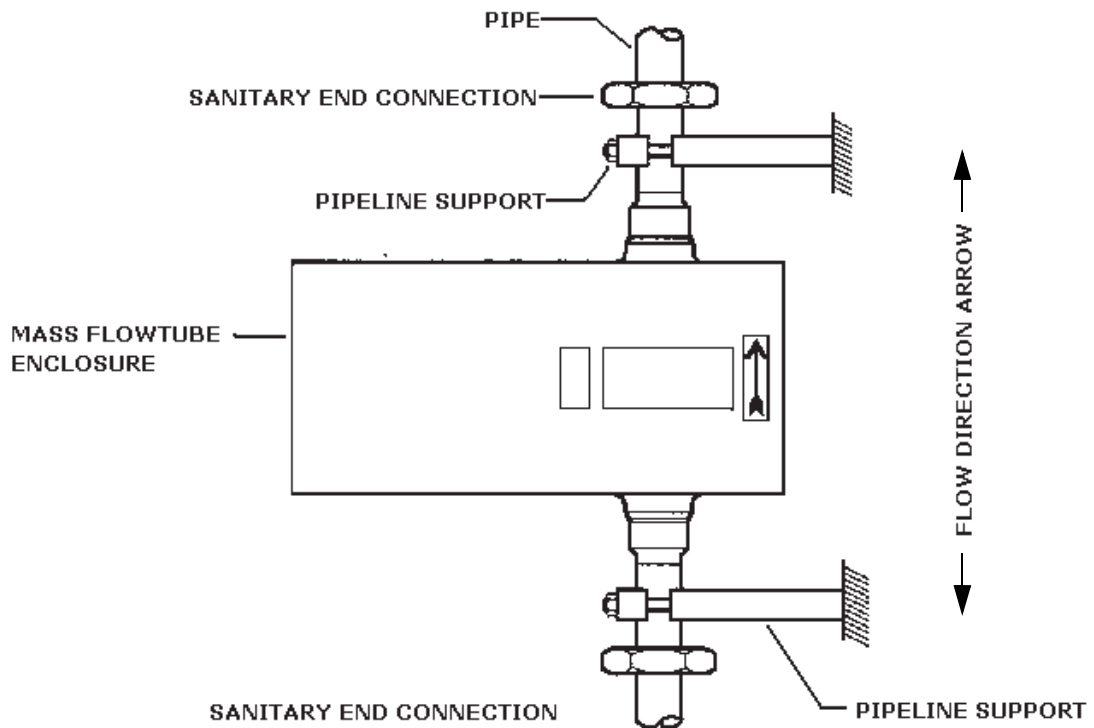


Figure 4. Flowtube Mounting with Threaded or Sanitary End Connections - Vertical Pipeline



For 3-A sanitary compliance, flowtube **MUST** be installed vertically.

When installing a sanitary flowtube in a vertical pipeline, ensure that the pipeline supports are also between the enclosure and end connection, as shown Figure 4.

— NOTE —

Horizontal pipeline mounting is not recommended when self-draining is required, or when gas bubbles are present.

Figure 5. Flowtube Mounting with Flanged End Connections - Vertical Pipeline

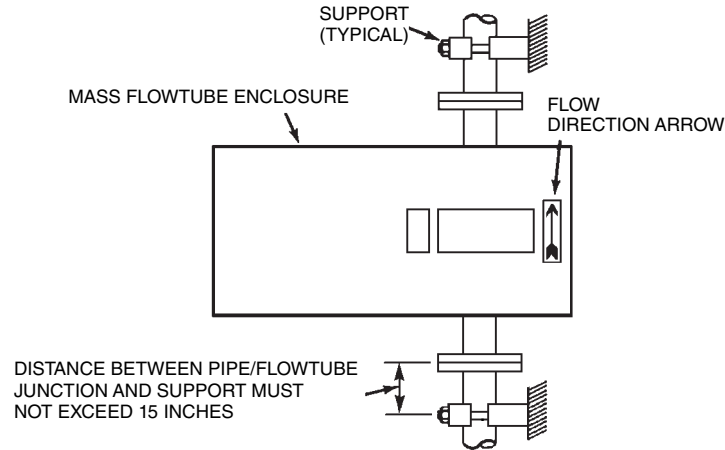
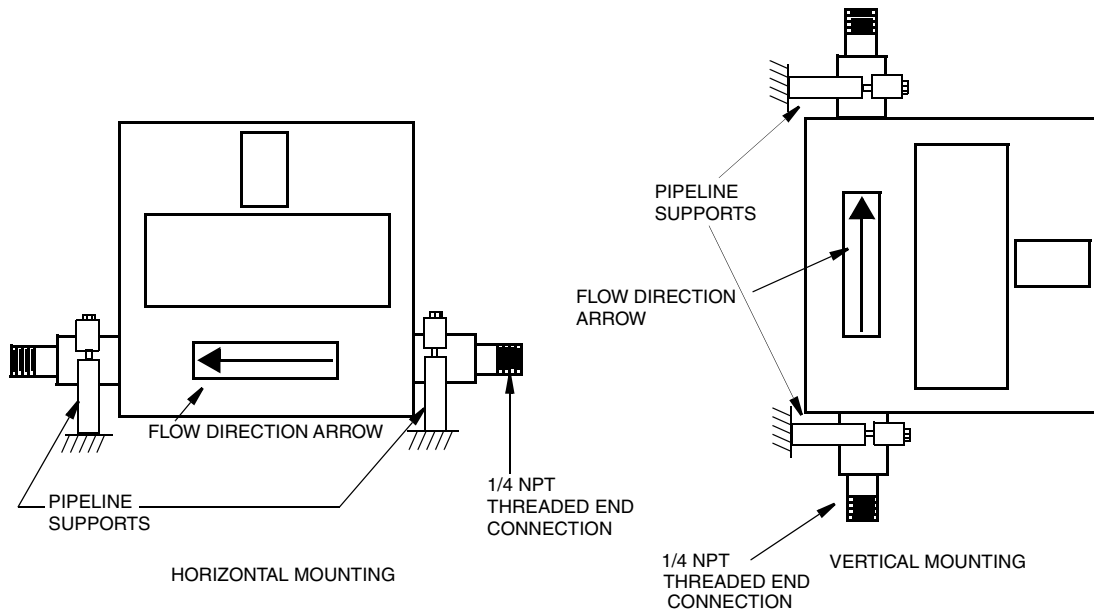
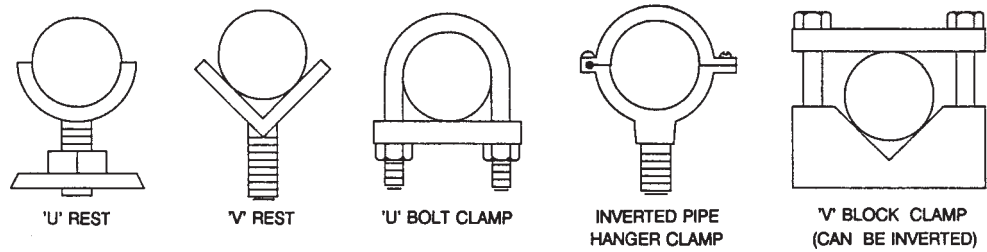


Figure 6. 3 mm (1/8-inch) Flowtube Mounting



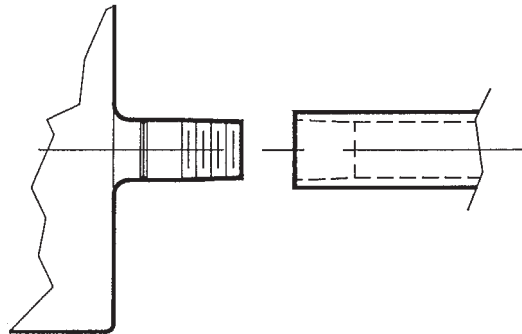
⚠ CAUTION

Flowtube CFS10-02 (1/8-inch) must be mounted with pipeline supports inside of threaded ends, as shown in Figure 6.

Figure 7. Recommended Pipeline Supports

Code A and B, Threaded End Connections

1. Apply process compatible thread sealant to the threaded flowtube end connection.
2. Secure the threaded pipe adapter to the flowtube threaded end connection.
3. Secure the pipeline end of adapter to the pipeline.
4. Tighten the hardware to secure the flowline to the supports.

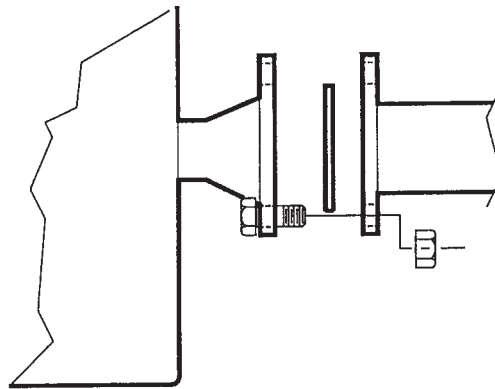
Figure 8. Code A and B, Threaded End Connections

Code C, D, E, F, and J, Flanged End Connections

Refer to current pipe flange and fitting standards for proper gasket dimensions.

1. Insert the lower mounting bolts (2 for 4-hole flanges, or 4 for 8-hole flanges).
2. Position the gasket between the flanges.
3. Insert the remaining mounting bolts.
4. Add the washers and nuts to all bolts and hand tighten only.
5. Secure the meter by tightening the nuts in uniform steps, working from nut to opposite nut.
6. Tighten the hardware to secure the pipeline to the supports.

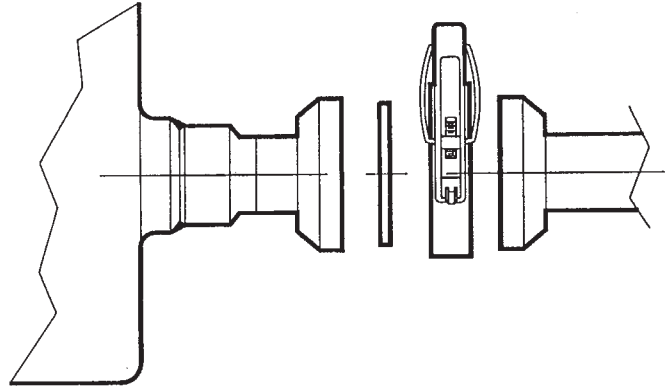
Figure 9. Code C, D, E, F, and J, Flanged End Connections



Code P, Quick Disconnect End Connection

1. Insert the seal into each flowtube end connection.
2. Make full face contact between the flowtube end connection and the pipeline end connection.

Figure 10. Code P, Quick Disconnect End Connection

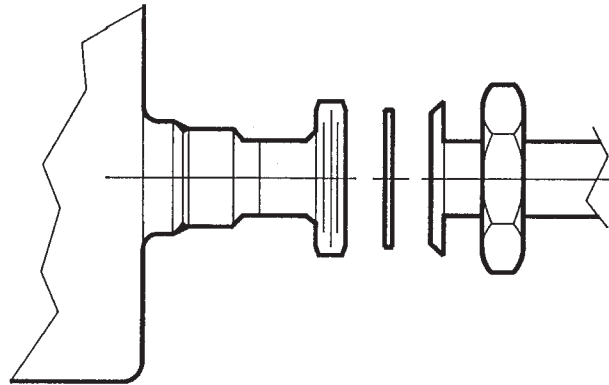


3. Position the clamp over the mating surfaces of the flowtube end connection and the pipeline end connection and press the clamp closed.
4. Tighten the hardware to secure the flowtube and pipeline to the supports.

Code N, DIN Coupling End Connection

1. Insert the seal into the groove in each flowtube end connection.
2. Bring the pipeline end connection into full contact with the flowtube end connection and tighten the nut on the pipeline end connection securely.
3. Tighten the hardware to secure the flowtube and flowline to the supports.

Figure 11. Code N, DIN Coupling End Connection



NOTE

End connections using DIN 11851 must be used with compliant 3-A sanitary gaskets for sanitary 3-A applications.

3. Wiring

The installation and wiring of the flowtube must conform to local code requirements. If the flowtube is classified intrinsically safe (refer to model number), it also must conform to national standards for installation of intrinsically safe equipment in potentially hazardous areas.

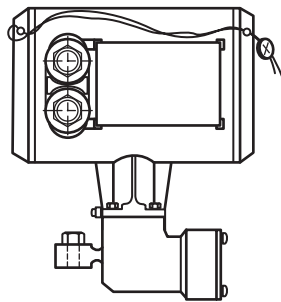
⚠ DANGER

If the flowtube is classified intrinsically safe, connect the ground (potential equalizing) terminals on the flowtube (refer to dimensional prints listed in Table 1) and the transmitter (see MI 019-132, MI 019-133, MI 019-140, and MI 019-141) to the building signal ground reference point with a dedicated wire of 12 AWG or larger. The total resistance of the ground path must not exceed one ohm. Note that this is in addition to the transmitter ac power ground. The intrinsic safety of the flowtube and interconnecting wiring is dependent on making this connection.

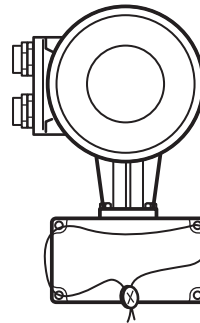
Cover Locks

The following diagram illustrates the lock and seal mechanisms provided as part of the CFT50 Custody Transfer NTEP (-T) and Tamperproof Sealing (-S) model code selections. For instructions on locking the CFT50, refer to MI 019-132 (HART) or MI 019-134 (Modbus).

Figure 12. CFT50 Cover Locks



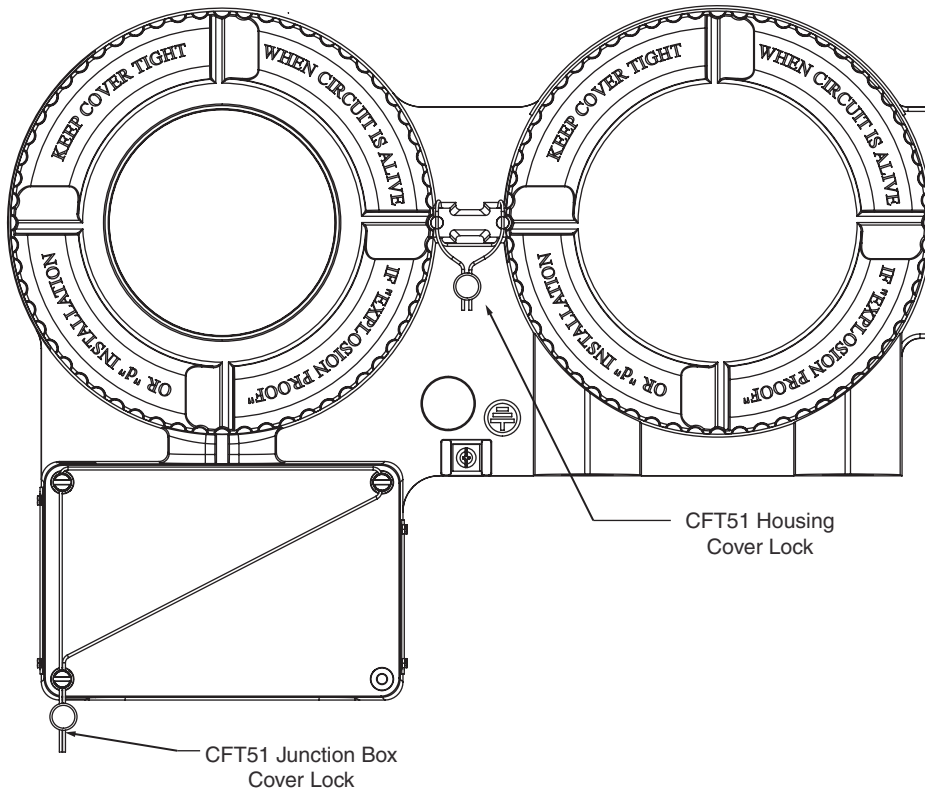
CFT50
Housing Cover Lock



CFT50
Junction Box Cover Lock

The following diagram illustrates the lock and seal mechanisms provided as part of the CFT51 Tamperproof Sealing (-S), Weights and Measures Custody Transfer/NTEP (-T), and Weights and Measures Industry Canada Approval (-D) model code selections. For instructions on locking the CFT51, refer to MI 019-140 (HART or Modbus).

Figure 13. CFT51 Cover Locks

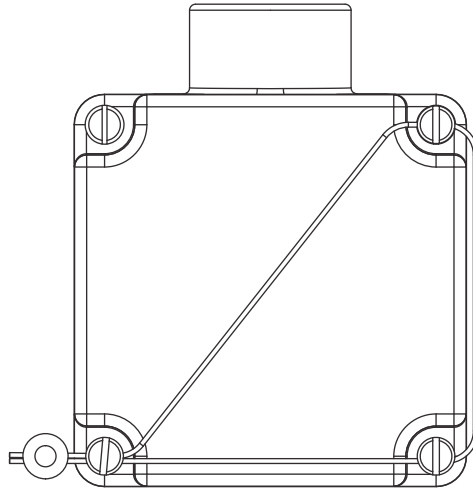


The following diagram illustrates the lock and seal mechanisms provided as part of the CFS Tamperproof Sealing (-S), Weights and Measures Custody Transfer/NTEP (-T), and Weights and Measures Industry Canada Approval (-D) model code selections. To lock the covers on the flowtube junction box, slide the seal wire through the holes in the three elongated cover screws and crimp the seal.

— **NOTE** —

The CFS Custody Transfer/NTEP (-T) selection must be combined with the CFT50 or CFT51 transmitter Option -T; the CFS Weights and Measures Industry Canada Approval (-D) selection must be combined with the CFT51 transmitter Option -D.

Figure 14. Flowtube Junction Box Cover Locks



Junction Box

An electrical junction box meeting NEMA 4X and IP66/67 requirements is mounted on each flowtube. It is fitted with a 3/4 NPT female cable entrance. Contained within the junction box are a pair of 6-position feedthrough type screw terminal blocks (properly spaced for intrinsic safety) which are prewired to the flowtube. Signal cable is not supplied with the flowtube, but PVC insulated (Foxboro Model KFS1) and FEP insulated (Foxboro Model KFS2) cable in specific lengths from 6 to 300 m (20 to 1000 ft) is available. One end of the cable is prepared for direct connection to the transmitter. The PVC cable can be used for most applications within an ambient temperature range of -20 to +80°C (-4 to +176°F). The FEP cable is suitable for ambient temperatures from -40 to +85°C (-40 to +185°F). If non-Foxboro cable is installed, the use of individually shielded 6 twisted pair signal cable of 22 AWG or larger (Belden #8778) is recommended. Total cable length from transmitter to flowtube must not exceed 300 m (1000 ft).

▲ CAUTION

Do not route signal cable close to power cables or equipment that can produce a large magnetic field.

If conduit is to be used, install a watertight conduit connector and drip loop at the junction box to prevent collection of condensate. If conduit is not used, a watertight cable grip is required. Teflon thread sealant on the connector threads is recommended to reduce the risk of galvanic corrosion.

If rigid conduit is used, the length extending from the conduit fitting must not exceed 0.3 m (12 in). This conduit must **not** be subjected to additional mechanical loading or attachment. If additional protection is required, flexible armored sheathing is recommended.

Junction Box Extension

The normal clearance between the rear of the junction box and the flowtube case is 0.5 inch (12.7 mm). To accommodate a steam jacket or case insulation, this distance can be increased to 4.00 inches (101.6 mm). A kit for this purpose is available (Part No. G0117HZ) consisting of a 3/4 NPT Schedule 40 stainless steel pipe coupling, 2-1/2 inch long nipple and thread sealant (see Figure 15).

▲ CAUTION

Junction box extension without the addition of a steam jacket or case insulation is not recommended.

To promote heat dissipation at elevated operating temperatures, maintain a space of at least 13 mm (0.5 inch) between the rear of the junction box and the case insulation or steam jacket.

Installing a Junction Box Extension

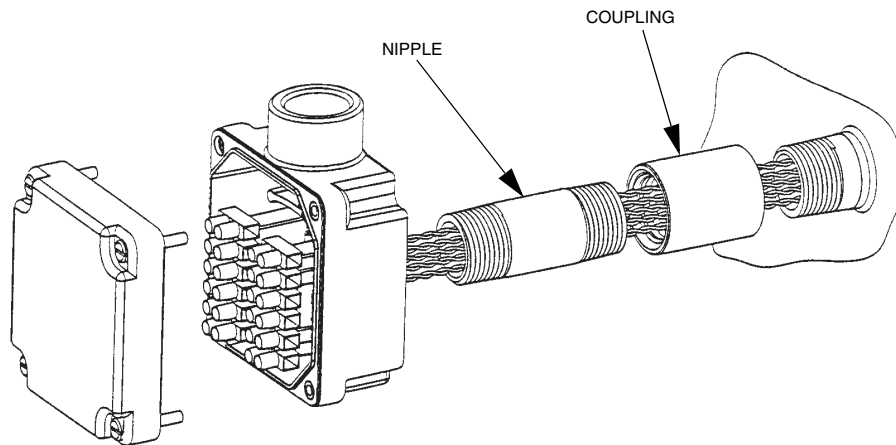
1. Remove the junction box cover.
2. Loosen the terminal block wiring screws and disconnect the flowtube wiring. Ensure that the wire pairs remain twisted to facilitate identification.
3. Unscrew and remove the junction box from the flowtube using a suitable tool (such as a length of pipe inserted in the conduit entrance). Remove all thread sealant residue.
4. Apply sealant to all male threads.
5. Insert the flowtube wiring through the coupling, nipple, and base of junction box and engage the threads.
6. Tighten the assembly, locating the conduit entrance as desired.
7. Reconnect the flowtube wiring to the appropriate terminals (see Figure 16) and tighten the screws.

⚠ CAUTION

No bare wire should be visible at the terminals. Ensure that the wire insulation has not prevented electrical contact.

8. Dress excess flowtube wire within the junction box as necessary.

Figure 15. Junction Box Extension



Signal Cable Preparation

If conduit is to be used, run the unprepared end of the cable through the conduit from the transmitter.

Flowtube End

1. Cut the flowtube end of the cable to length and strip back the jacket approximately 127 mm (4 in).
2. Separate the twisted pair conductors from their wrappers, shields, and drain wires. The wire pairs should remain twisted for ease of identification.
3. Trim the shields, wrappers, and drain wires back to the jacket interface.
4. Strip the ends of the conductors 6 mm (1/4 in).

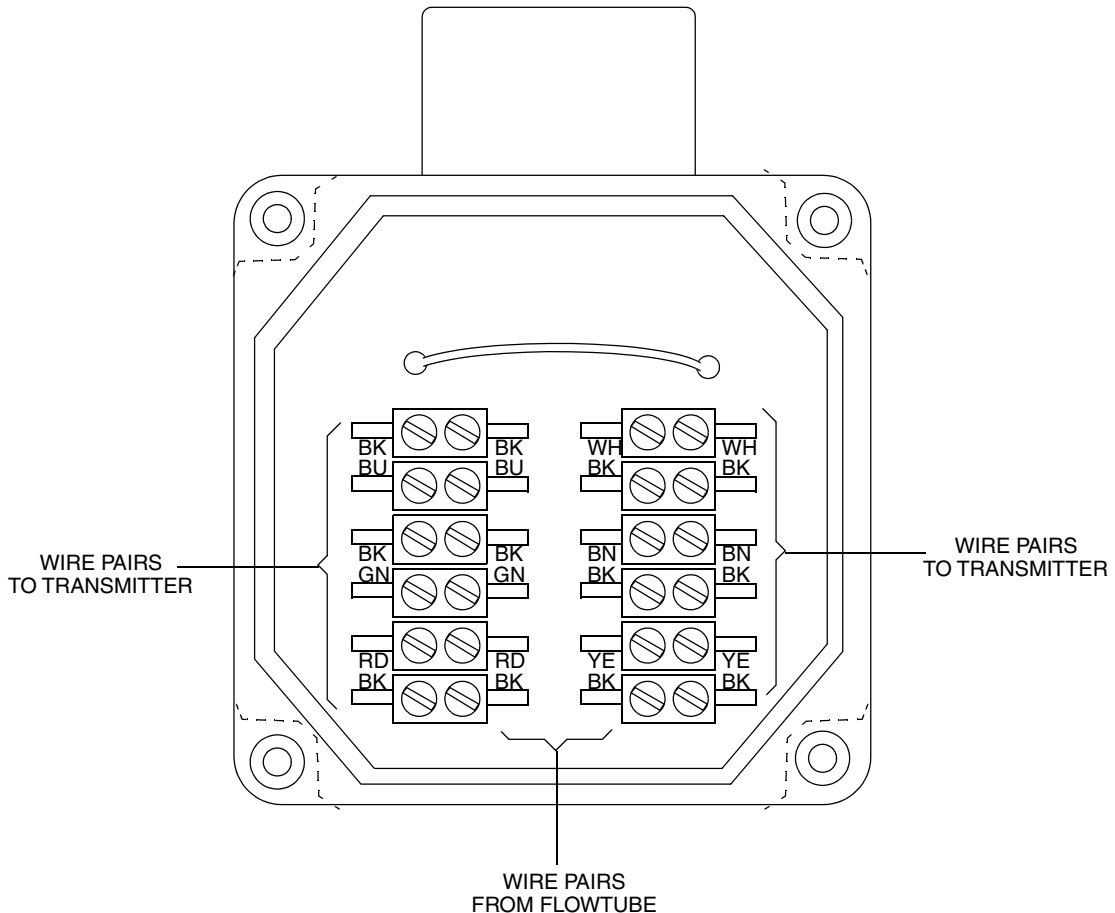
Transmitter End (Customer Supplied Cable)

Follow Steps 1, 2, and 4 above. Trim shields and wrappers back to the jacket interface. Tightly twist together (2 to 4 turns) the six individual twisted pair drain wires at a point close to the jacket interface. Trim all but one drain wire close to the twist. Solder the twisted wire area, creating a single drain wire. Appropriately insulate the drain wire and soldered connection to prevent shorting. Refer to MI 019-132 for CFT50 or MI 019-140 for CFT51 wiring instructions.

Flowtube Wiring

1. Remove the junction box cover and insert the prepared cable end through either a cable grip or conduit connector. Route the paired wires to the proper terminal block. To facilitate wire identification, ensure that the proper wire pairs remain twisted as the black wires are not common.
2. Insert the ends of the individual wires into the appropriate terminal block openings, carefully matching the wire color pairs of the cable to the wire color pairs of the flowtube (see Figure 16). Tighten the screws. No bare wire should be visible. Dress the wiring and secure the cover to the junction box. Refer to MI 019-132 and MI 019-133 for CFT50 or MI 019-140 for CFT51 wiring instructions.

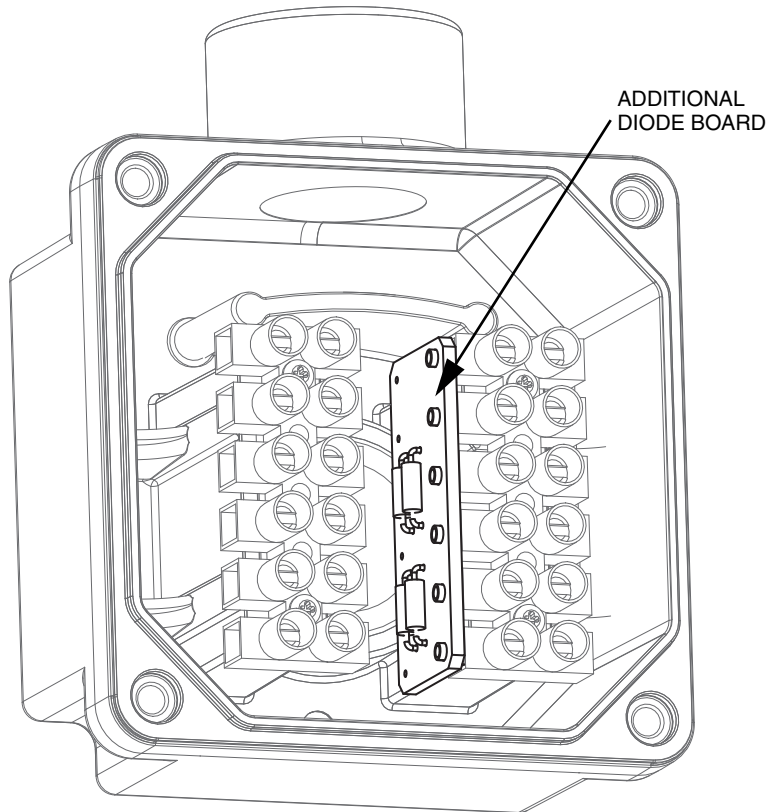
Figure 16. Terminal Box Wiring Color Orientation



NOTE

The inside of your junction box may differ slightly from that shown in Figure 16, with an additional diode board for flowtubes sized 1 to 3 inches certified as intrinsically safe. See Figure 17. The additional board does not affect wiring color orientation.

Figure 17. Junction Box with Additional Diode Board



4. Startup

Sizing Your Flowtube and Determining Pressure Loss

In most cases a flowtube is specified with a particular process application in mind. However, to apply a flowtube to another application, its sizing and pressure loss must be considered. The best way to do this is to use the FlowExpertPro™ software program at www.FlowExpertPro.com.

Filling the Flowtube

Filling of the flowtube requires a period of continual flushing to remove all air from the flowtube. Proceed as follows:

1. Slowly fill the flowtube, avoiding hydraulic shock to flowmeter and associated piping.
2. Flush at highest possible flow rate within operating range for a minimum of five minutes. Flushing rate must be above 2 ft/s.

Zeroing

1. Close valves to ensure zero flow.
2. Allow 30 seconds minimum for flow to settle at zero.

The flowtube is now ready for zeroing with the CFT50 or CFT51 Transmitter. For zeroing procedure from the CFT50 or CFT51 transmitter keypad or a HART Communicator, refer to MI 019-132 or MI 019-140 respectively.

If elapsed time between flushing and zeroing exceeds 10 minutes, the flowtube must be flushed again for five minutes and the zeroing procedure repeated.

— NOTE —

Flowtube must remain full with process fluid to maintain accurate, repeatable results. In applications where flowtube is frequently emptied or partially emptied and refilled, flowtube must be properly filled, avoiding hydraulic shock. **Rezeroing is not generally required.**

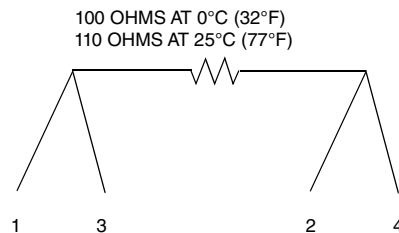
5. Troubleshooting

RTD Res Low or RTD Res High

The problem of RTD resistance being too low or too high can be caused by a wiring problem; either in the transmitter Resistance Temperature Detector (RTD) drive current circuits or the 4-wire IEC Pt 100 RTD in the flowtube. Perform the following tests to locate the problem.

1. Disconnect flowtube connection terminations 1 through 4 at the transmitter. Using an ohmmeter, confirm that continuity (a short circuit) exists between the flowtube wires normally connected to terminals 1 and 3 and then 2 and 4.
2. Using an ohmmeter, confirm that approximately 110Ω at 25°C (77°F) exists between the flowtube wires normally connected to terminals 1 (or 3) and 2 (or 4). The resistance is dependent on flowtube temperature at time of measurement. Nominal resistance is 100Ω at 0°C (32°F). See Figure 18.
3. Place 110Ω resistor across transmitter terminals 3 and 4. Voltage measured across the resistor should be 44 mV . If voltage reading is not correct, contact Global Customer Support. Transmitter replacement may be required.

Figure 18. Resistance between Flowtube Wires Connected to Transmitter Terminals 1, 2, 3, and 4



6. Maintenance

Sanitary End Connection Couplings

For flowtubes using 3-A sanitary service, temperature fluctuations within the process can cause couplings and seals to loosen. Process flowtube connections should be routinely checked.

Cleaning the Flowtube

The flowtube must be cleaned at intervals dictated by the properties of the process fluid or industry requirements. Avoid hydraulic shocks (fluid hammer) while cleaning because such shocks could damage the flowtube.

▲ WARNING

Be sure that power is disconnected from flowtube during the cleaning process.

If the flowtube is to be removed for cleaning, proceed as follows:

1. Open or close valves as required to isolate the flowtube from the process.
2. Drain the flowtube using appropriate venting procedures.

▲ CAUTION

A significant amount of liquid is retained in a horizontally mounted flowtube and it can flow out of the flowtube when it is moved.

3. Disconnect the flowtube from the pipe. Handle with care to avoid damage to the flowtube.
4. Flush as required.

▲ CAUTION

When cleaning a flowtube, be sure that the flow, pressure, and temperature ratings of flowtube are not exceeded.
--

5. Return the flowtube to operation.

Flowtube Repair

The flowtube is not field repairable. For troubleshooting and assistance, refer to the flow charts in “Troubleshooting” on page 39.

If problems arise, contact Global Customer Support. If the flowtube or transmitter issue cannot be solved via telephone interaction, the instrument must be returned to the factory for evaluation and repair.

Prior to shipping the instrument, a return authorization number must be issued. The service department representative can assist in providing this information. In addition, it is imperative that the internal structure of the flowtube be thoroughly cleaned and degreased prior to shipping. A letter (signed by a process engineer/manager) stating that cleaning was performed, as well as MSDS sheets stating the plant process fluid used, must accompany the returned flowtube.

Meter Verification

The CFT51 transmitter offers a meter verification feature which can be used to assess the meter’s performance over time.

Two modes of flow tube vibration, the Drive mode and Coriolis mode, are excited one after the other. The ratio of the resonant drive frequencies is measured and used to generate a Meter Verification Value (MVV). Over time, these ratios can be used to determine if a flow tube is experiencing excessive wear (erosion) or if it is picking up deposits internally due to sedimentation.

1. The factory determined MVV should be entered into the CFT51 transmitter before startup.
2. Go to Setup menu and press the Down arrow key to TUBECHK and press Enter.
3. Press the Down arrow key to DATUM and enter the MVV from the data plate or factory calibration sheet.

Once the meter has been installed in the process piping, the meter should be either completely full of the process fluid or be run empty and dry to ensure a stable singlephase medium. This is not a requirement for the meter operation, it is only required that the process be relatively stable during the whole verification procedure.

4. Press the Up arrow key and go to Run the CHECK function, to determine an in-situ MVV.
5. Once the process is complete, save the result as RATIO.

Changes in the MVV are an indication of changes in the flowtube. If the MVV change is greater than 1%, contact Global Customer Support.

— NOTE —

If the meter verification function fails to complete properly, the message “Check Failed” will be displayed on the front panel. Before repeating the meter verification procedure, check that the tube is connected and operating correctly and that the flow process is stable and single-phase.

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