Instruction

MI 019-120
June 2011

I/A Series® Mass Flowtubes Models CFS10 and CFS20

Installation, Startup, Troubleshooting and Maintenance

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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
Dimensional Prints	
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 019-365	CFS10 Style B Flowtube Dimensions (1/8 inch)
DP 019-366	CFS10 Style B Flowtube Dimensions (1/8 inch)
DP 019-120	Dimensional Print for Single Measurement Configuration

Table 1. Reference Documents (Continued)

Document No.	Document Description
Instructions	
MI 019-132	CFT50 Transmitter Installation, Startup, Configuration, and Maintenance
MI 019-133	CFT50 Safety Connection Diagrams (FM, CSA)
MI 019-179	Instruction – Flow Products Safety Information (available only on website www.foxboro.com/instrumentation/tools/safety/flow)
MI 019-140	I/A Series® Digital Coriolis Mass Flow Transmitter With HART and MODBUS Communication Protocols Model CFT51
MI 019-141	I/A Series® Digital Coriolis Mass Flow Transmitter Model CFT51 Safety Connection Diagrams (FM, CSA)
Parts Lists	
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	I/A Series® 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 Range

Flowtube Model	Flowtube Size		Mass Flow Rate Ranges			
			Nominal Mass Flow Rate		Extended Upper Range (a)	
	in	mm	kg/min	lb/min	kg/min	lb/min
CFS10	1/8	3	0.03 to 3.2	0.07 to 7	7	15
	1/4	6	0.09 to 9	0.2 to 20	22	48
	1/2	15	0.4 to 40	0.9 to 90	73	160
	3/4	20	0.9 to 90	2 to 200	119	261
	1	25	1.8 to 180	4 to 400	244	536
	1-1/2	40	4 to 400	9 to 900	607	1335
	2	50	7 to 700	15 to 1500	1023	2250
CFS20	1-1/2	40	4 to 400	9 to 900	485	1070
	3	80	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 212°F (100°C). To find the extended upper range at other specific gravities and temperatures, contact Invensys .

Process Fluid Density Ranges

Process fluid density ranges of 200 to 3000 kg/m^3 (12.5 to 187 lb/ft^3), or specific gravity range of 0.2 to 3. Note that a specific gravity of 1 corresponds to a fluid density of 1000 kg/m^3 (62.4 lb/ft^3).

Approximate Mass

Flowtube mass is dependent on flowtube size and end connections used. Refer to Table 3.

Table 3. Approximate Flowtube Mass

Flowtube Model	Flowtube Size		With ANSI Class 150 Flanged Ends	With Threaded Ends	With Sanitary Ends
	mm	in			
CFS10	3	1/8	(a)	6.3 kg (13.9 lb)	(a)
	6	1/4	9.6 kg (21 lb)	8.8 kg (19.4 lb)	8.8 kg (19.4 lb)
	15	1/2	11.5 kg (25.5 lb)	10.4 kg (22.9 lb)	10.4 kg (22.9 lb)
	20	3/4	18.5 kg (40.5 lb)	16.7 kg (36.8 lb)	16.7 kg (36.8 lb)
	25	1	22.5 kg (49.5 lb)	(a)	20.3 kg (44.8 lb)
	40	1-1/2	53.4 kg (118 lb)	(a)	49.9 kg (110 lb)
	50	2	77.6 kg (171 lb)	(a)	71.2 kg (157 lb)
CFS20	40	1-1/2	24 kg (53 lb)	(a)	(a)
	80	3	111 kg (244 lb)	(a)	99.3 kg (219 lb)

(a) Not available.

Flowtube Internal Fluid Volume

Flowtube internal fluid volume is dependent on the flowtube size and the end connections used. Refer to Table 4.

Table 4. Flowtube Internal Volume

Flowtube Model	Nominal Flowtube Size		Flowtube Internal Fluid Volume			
			With Flanged/Threaded Ends		With Sanitary Ends	
	mm	in	cm^3	in^3	cm^3	in^3
CFS10	3	1/8	18	1.1	(a)	(a)
	6	1/4	67	4	74	5
	15	1/2	321	20	352	21
	20	3/4	1013	62	1111	68
	25	1	1591	97	1630	99
	40	1-1/2	4638	283	4818	294
	50	2	7934	484	8227	502
CFS20	40	1-1/2	2621	160	(a)	(a)
	80	3	10,015	611	9632	588

(a) Not available.

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 either the type of end connection (Table 6) or process temperature (Table 7). Interpolation is required for process temperatures between those listed. Use the lesser of the pressures determined from these tables.

Table 6. End Connection Process Temperature/Pressure Limits (a)

End Connection Type	Process Temp.	MWP (b)	
		316/316L ss	Nickel Alloy
ANSI® Class 150 Flange	100°F 200°F 300°F 356°F	275 psig 240 psig 215 psig 208 psig	290 psig 260 psig 230 psig 217 psig
ANSI Class 300 Flange	100°F 200°F 300°F 356°F	720 psig 620 psig 560 psig 540 psig	750 psig 750 psig 730 psig 719 psig
ANSI Class 600 Flange	100°F 200°F 300°F 356°F	1440 psig 1240 psig 1120 psig 1080 psig	1500 psig 1500 psig 1455 psig 1435 psig
BS 4504 (DIN) PN 10/16 PN 25/40 Flange	40°C 100°C 150°C 180°C	40.0 bar(c) 34.2 bar(c) 30.8 bar(c) 29.3 bar(c)	41.7 bar(c) 37.1 bar(c) 32.9 bar(c) 30.6 bar(c)
Flange to Mate with BS 4504 (DIN), PN 100/2	40°C 100°C 150°C 180°C	96 bar(c) 82 bar(c) 75 bar(c) 72 bar(c)	103 bar(c) 103 bar(c) 100 bar(c) 98 bar(c)

Table 6. End Connection Process Temperature/Pressure Limits (a) (Continued)

End Connection Type	Process Temp.	MWP (b) 316/316L ss	MWP (b) Nickel Alloy
Threaded, NPT, ANSI B2.1	MWP limited by threaded end connection limits per Table 7.		
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 Nickel alloy (equivalent to Hastelloy-C® [a]) 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.

a. Hastelloy is a registered trade mark of Haynes International Inc.

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	
mm	in	°C	°F	bar (b)	psig	bar (b)	psig
3 and 6	1/8 and 1/4	40	100	207	3000	217	3150
		100	200	174	2530	217	3150
		150	300	156	2270	213	3050
		180	356	148	2144	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) 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 10.

Mechanical Vibration

10 m/s^2 (1 ‘g’) at 5 to 40 and 100 to 200 Hz.

Product Safety Specifications

Refer to Table 8 for flowtube Electrical Safety Specifications. Wiring restrictions required to maintain flowtube electrical safety specifications are provided in "Wiring" on page 19. Refer to appropriate transmitter instruction for transmitter electrical safety specification information.

Table 8. Electrical Safety Specification (Applies to tubes used with CFT50 only)

Testing Laboratory, Type of Protection, and Area Classification	Application Conditions [a]	Electrical Safety Design Code
ATEX (KEMA) intrinsically safe II 2 G, EEx ib, IIB, Zone 1.	Connected to CFT50-......M or Q Mass Flow Transmitter.	MMM
ATEX (KEMA) nonsparking II 3 G EEx nA II; Zone 2.	Connected to Model 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 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 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 hazardous locations.	Connected to 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 10.

Table 9. Electrical Safety Specification (Applies to tubes used with CFT51 only)

Testing Laboratory, Type of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
CSA/CSAus Division 1/Zone 0 Intrinsically Safe	Connected to CFT51 Electrical Safety Code CDA and CNA	CAA
CSA/CSAus Division 2/Zone 2 Non-Incendive	Connected to CFT51 Electrical Safety Code CDN and CNN	CCN
FM Division 1/Zone 0 Intrinsically Safe	Connected to CFT51 Electrical Safety Code FDA and FNA	FAA
FM Division 2/Zone 2 Non-Incendive	Connected to CFT51 Electrical Safety Code FDA and FNN	FFN
ATEX Intrinsic safe Ex ia/ic	Connected to CFT51 Electrical Safety Code ADA and ANA	AAA
ATEX Non Sparking Zone 2 Ex nA	Connected to CFT51 Electrical Safety Code ADN and ANN	ANN

Table 9. Electrical Safety Specification (Applies to tubes used with CFT51 only)

Testing Laboratory, Type of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
IECEx Intrinsic safe Ex ia/ic	Connected to CFT51 Electrical Safety Code EDA and ENA	EAA
IECEx Non Sparking Zone 2 Ex nA	Connected to CFT51 Electrical Safety Code EDN and ENN	ENN
Agency approvals or certifications not required		ZZZ

— NOTE

These flowtubes have been designed to meet the electrical safety description listed in the table above. For detailed information or status of testing laboratory approval/certifications, contact Invensys.

Table 10. Process Temperature Range for Electrical Safety Design Codes MMM, LLL, FBB, CDA, CNA, FNA, FDA, ADA, ANA, EDA, ENA

Process Temperature Range for Electrical Safety Design Code

Flowtube Model	Flowtube Size mm	Flowtube Size in	Ambient Temperature °C	Ambient Temperature °F	Temp Class	Process Temperature Range °C	Process Temperature Range °F
CFS10	3 through 20	0.125 through 0.750	-40 to +60 (1)	-40 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 through 50	1.000 through 2.000	-40 to +60 (1)	-40 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	1.5 and 3.0	-40 to +60 (1)	-40 to +140	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 mm	Flowtube Size in	Ambient Temperature °C	Ambient Temperature °F	Temp Class	Process Temperature Range °C	Process Temperature Range °F
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 FDN, FNN, CDN, CNN, ADN, ANN, ENN, EDN

Flowtube Model	Flowtube Size mm	Flowtube Size in	Ambient Temperature °C	Ambient Temperature °F	Temp Class	Process Temperature Range °C	Process Temperature Range °F
CFS10 and CFS20	6	0.250	-40 to + 60 (1)	-40 to +140	T5	-135 to +195	-211 to +383
	15	0.500				-200 to +195	-328 to +383
	20	0.750				-200 to +195	-328 to +383
	25	1.000				-50 to +195	-58 to +383
	40	1.500				-50 to +195	-58 to +383
	50	2.000				-50 to +175	-58 to +347
	80	3.000				-50 to +175	-58 to +347

(1) Ambient low temperature limit increases to -20°C/-4°F when using the CFT50 transmitter.

2. Installation

Flowtube Identification

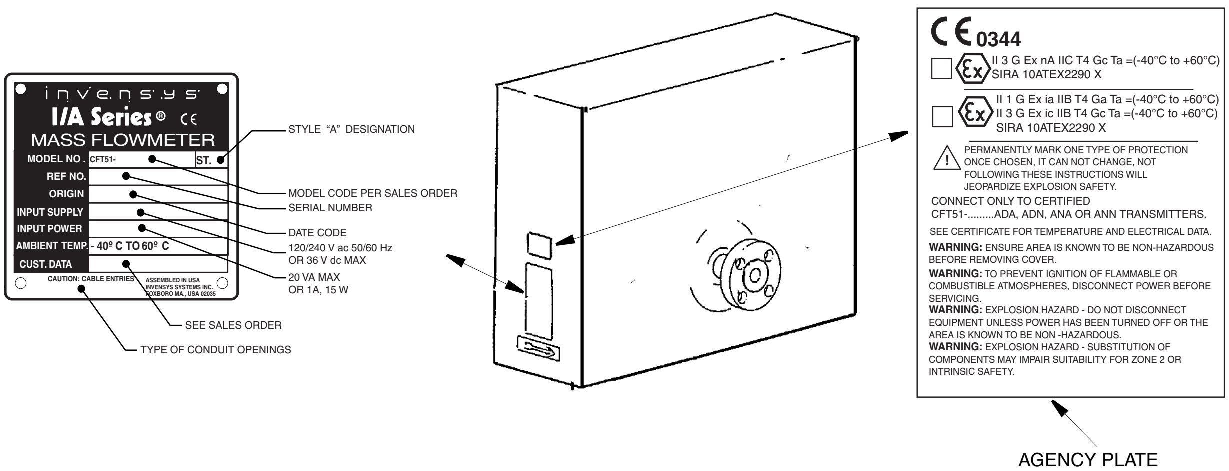

Figure 1. Data Plate Location and Flowtube Identification

— NOTE

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

— ! CAUTION

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.

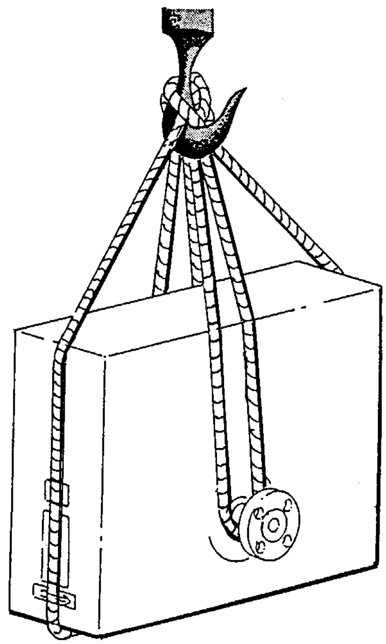

Figure 2. Support Required when Moving a Flowtube

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.

CAUTION

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

DANGER

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.

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 1 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.

NOTE

1. 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).
2. 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.
3. All supports must provide a minimum of 25 mm (1 in) of axial length of surface contact.
4. 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 16 through page 18.

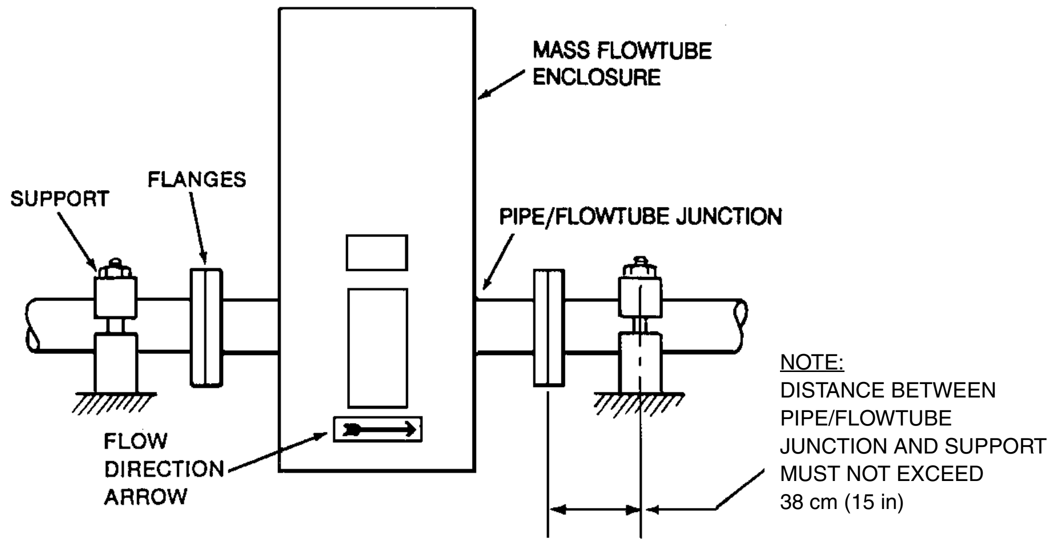

Figure 3. Flowtube Mounting with Flanged End Connections - Horizontal Pipeline

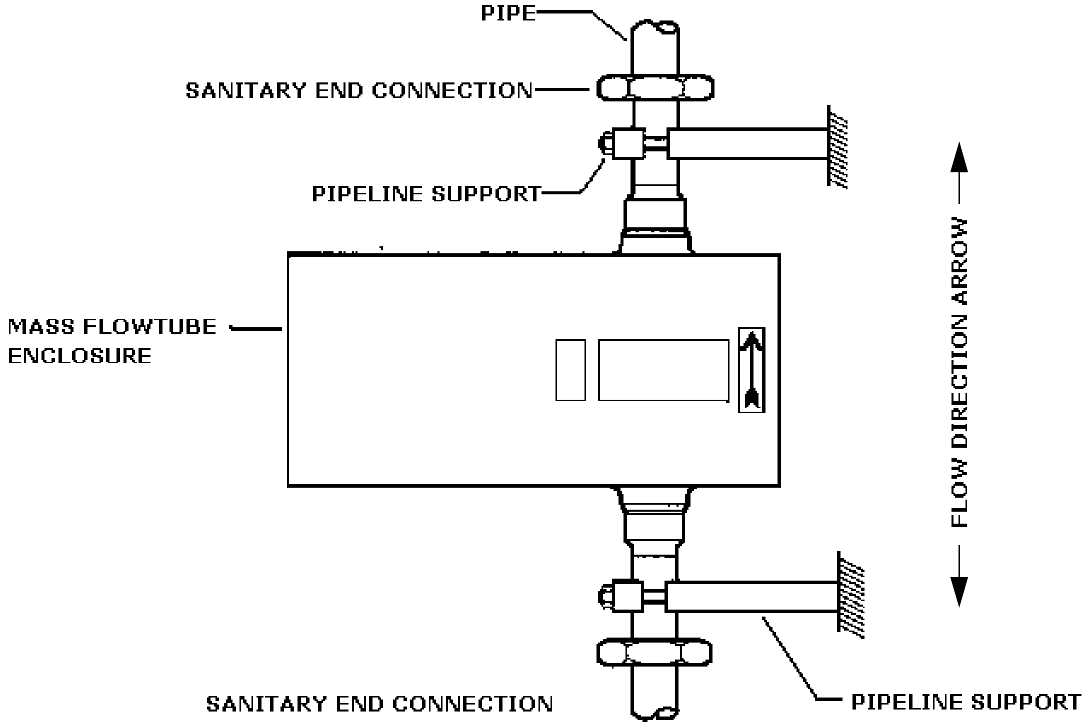

Figure 4. Flowtube Mounting with Threaded or Sanitary End Connections - Vertical Pipeline

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.

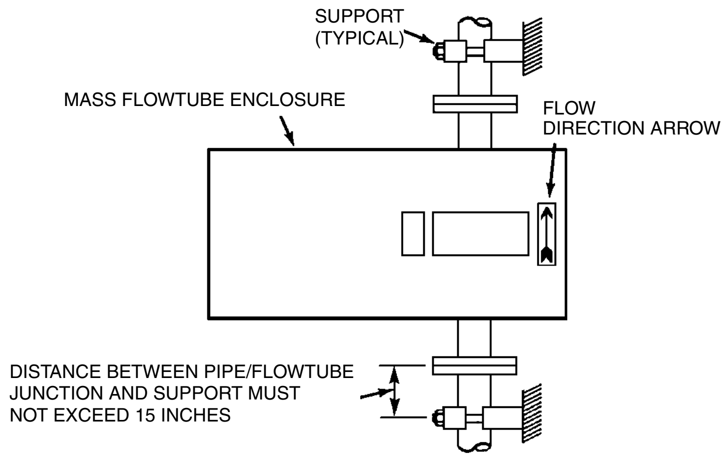

Figure 5. Flowtube Mounting with Flanged End Connections - Vertical Pipeline

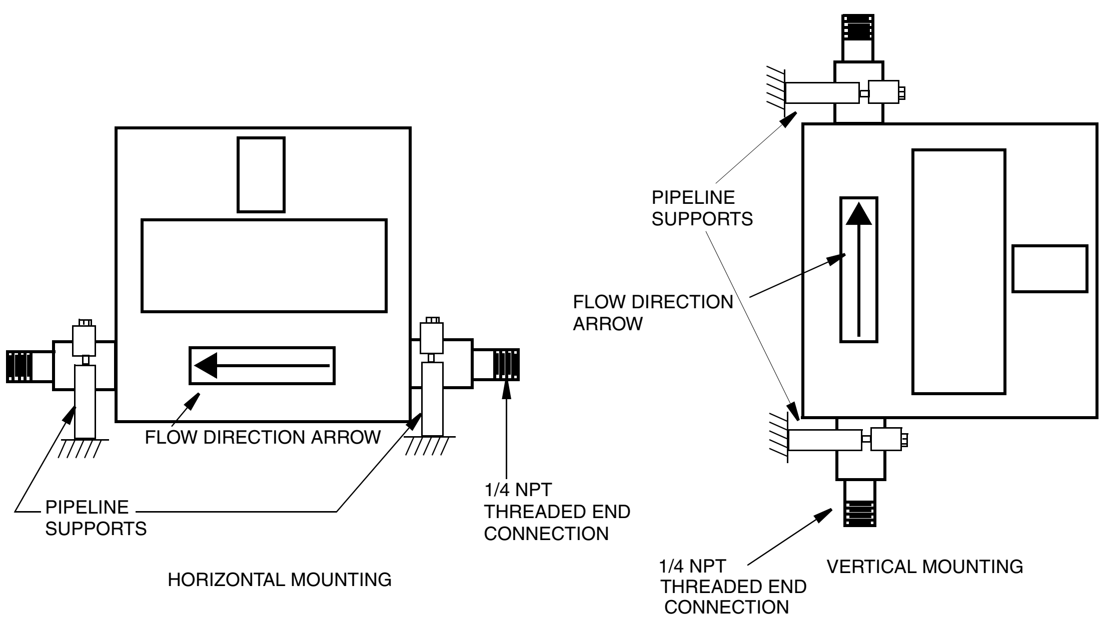

Figure 6. 3 mm (1/8-inch) Flowtube Mounting

— ! CAUTION

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

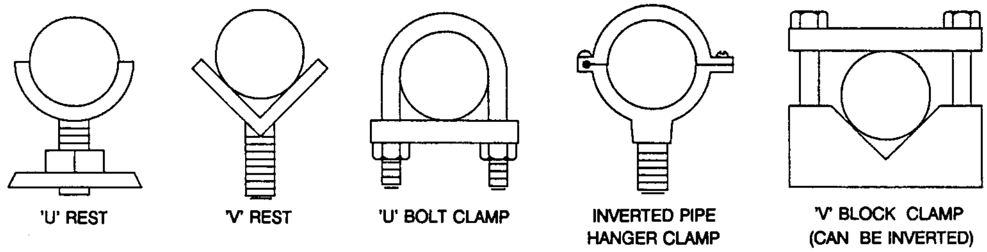

Figure 7. Recommended Pipeline Supports

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.

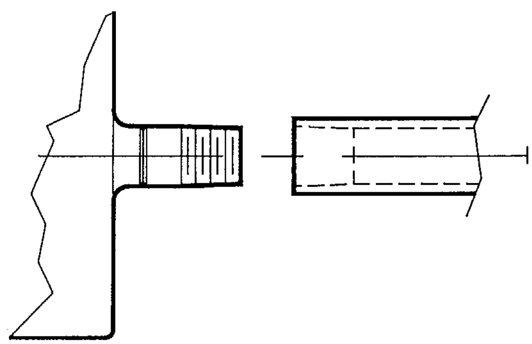

Figure 8. Code A and B, Threaded End Connections

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.

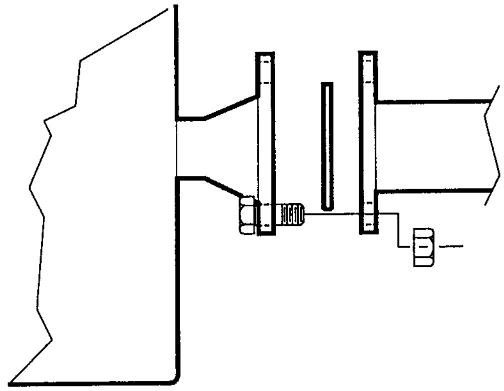

Figure 9. Code C, D, E, F, and J, Flanged End Connections

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.

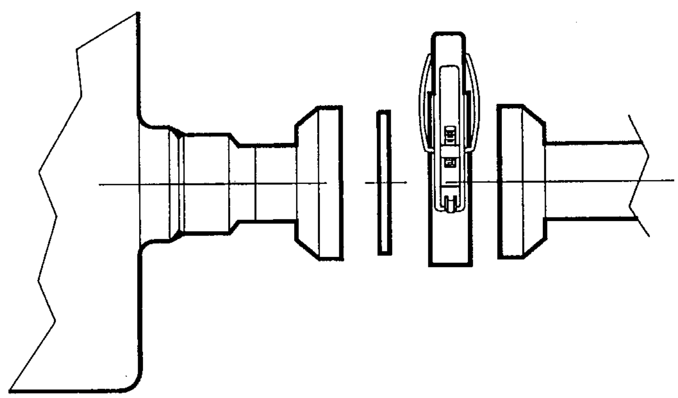

Figure 10. Code P, Quick Disconnect End Connection

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.

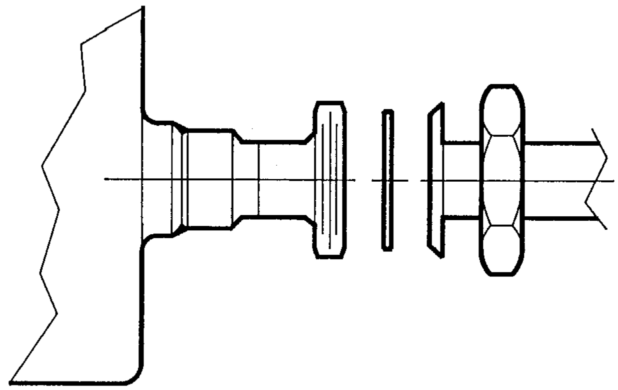

Figure 11. Code N, DIN Coupling End Connection

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).

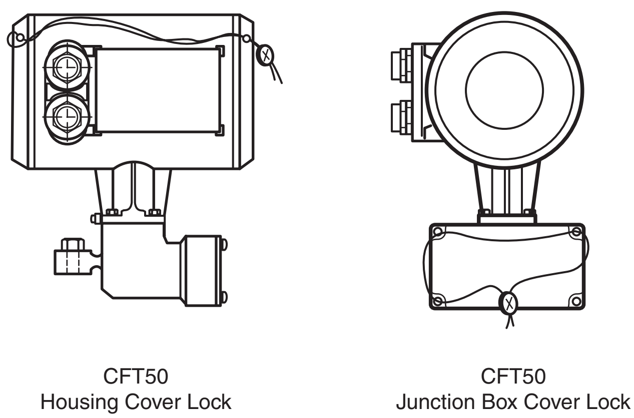

Figure 12. CFT50 Cover Locks

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

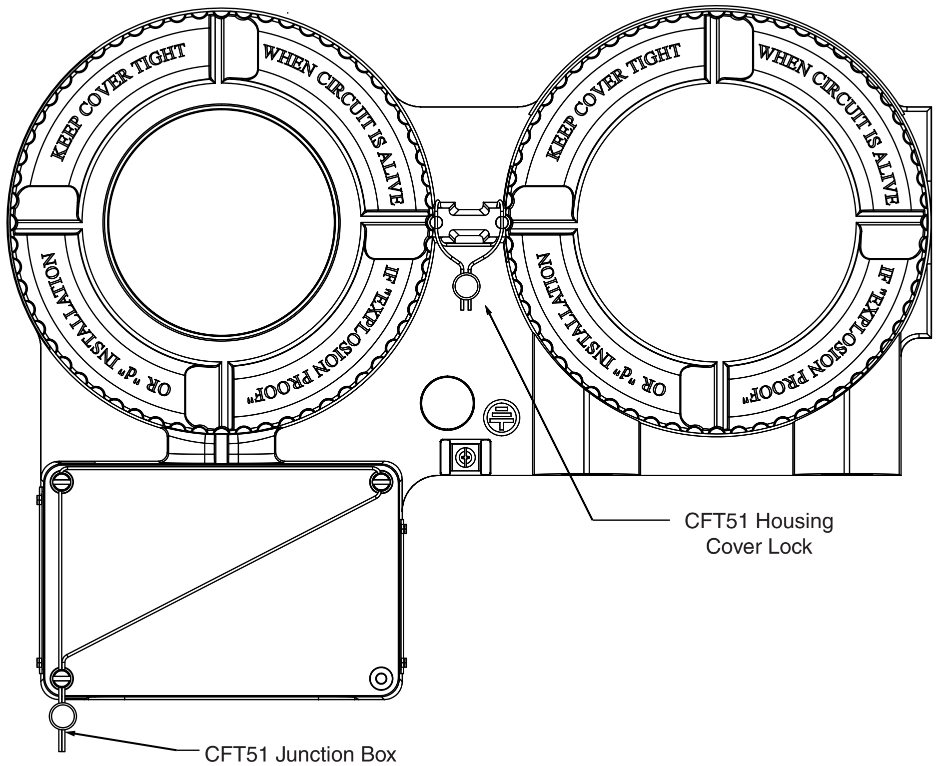

Figure 13. CFT51 Cover Locks

The following diagram illustrates the lock and seal mechanisms provided as part of the CFS Custody Transfer NTEP (-T) and Tamperproof Sealing (-S) 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.

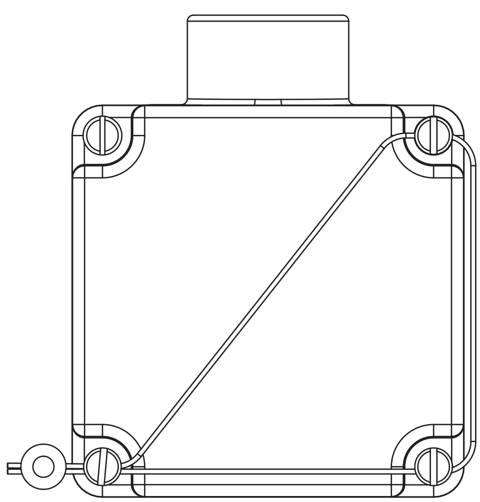

Figure 14. Flowtube Junction Box Cover Locks

Junction Box

An electrical junction box meeting NEMA 4X and IP54 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 (Model KFS1) and FEP insulated (Model KFS2) cable in specific lengths from 6 to 300 m (20 to 1000 ft) is available from Invensys. 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 cable other than that supplied by Invensys is installed, the use of individually shielded 6 twisted pair signal cable of 22 AWG or larger (Belden #8778) is recommended. The 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

Invensys does **not** recommend junction box extension without the addition of a steam jacket or case insulation.

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.

The procedure for installing a junction box extension follows:

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.

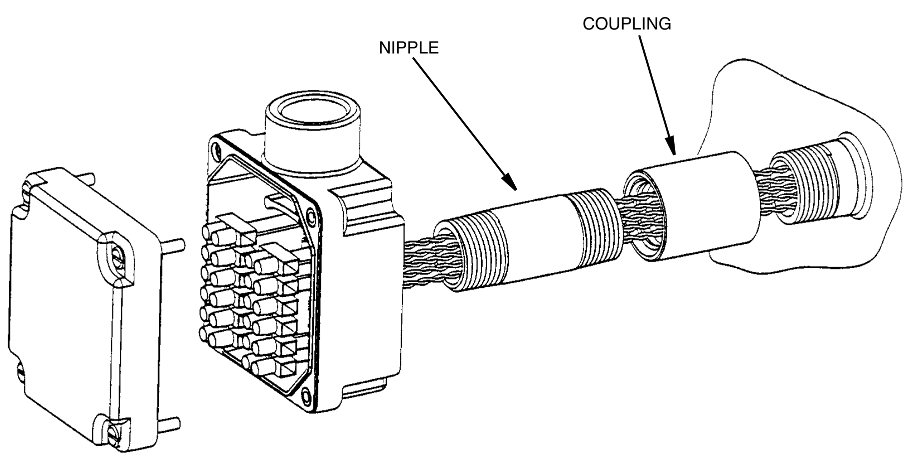

Figure 15. Junction Box Extension

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.

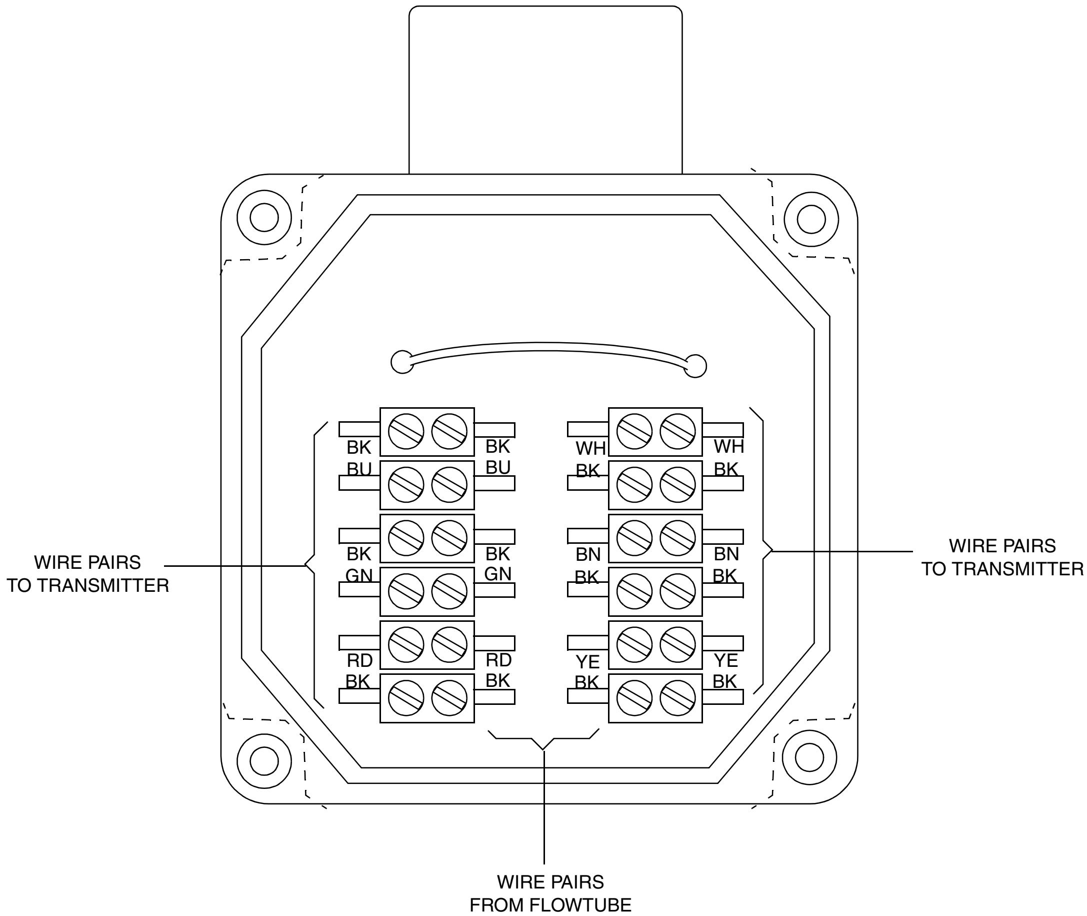

Figure 16. Terminal Box Wiring Color Orientation

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 FlowExpert Pro™ software program on the Invensys web site at 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.

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 110 Ω 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 100 Ω at 0 °C (32 °F). See Figure 17.
3. Place 110 Ω resistor across transmitter terminals 3 and 4. Voltage measured across the resistor should be 44 mV. If voltage reading is not correct, contact Invensys. Transmitter replacement may be required.

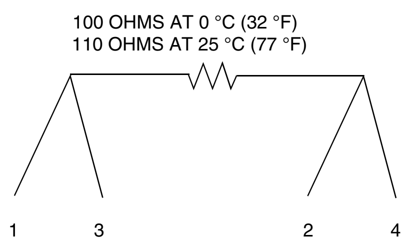

Figure 17. Resistance between Flowtube Wires Connected to Transmitter Terminals 1, 2, 3, and 4

6. Maintenance

Sanitary End Connection Couplings

For flowtubes using 3A 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 27.

If problems arise, contact Invensys. 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 %, please contact Invensys.

— 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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