Model 4700S Sanitary Flowtube

Installation

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This book . . .

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GENERAL INSTRUCTIONS

Invensys Process Systems designs, manufactures, and tests its products to meet many national and international standards. However, for these products to operate within their normal specifications, you must properly install, use, and maintain these products. The following instructions must be adhered to and integrated with your safety program when installing, using, and maintaining Invensys Process Systems products.

- Read and save all instructions prior to installing, operating, and servicing the product.

- If you do not understand any of the instructions, contact your Invensys Process Systems representative for clarification.

- Follow all warnings, cautions, and instructions marked on and supplied with the product.

- Inform and educate your personnel in the proper installation, operation, and maintenance of the product.

- Install your equipment as specified in Invensys Process Systems site planning/installation instructions and per applicable local/national codes. Connect all products to the proper electrical and/or pressure sources.

- Handle, move, and install each product using the appropriate number of personnel and moving devices/equipment (dolly, forklift, crane, etc.). Failure to do so could cause serious personal injury.

- To ensure proper performance, use qualified personnel to install, operate, update, program, and maintain the product.

- When replacement parts are required, ensure that the qualified service technician uses replacement parts specified by Invensys Process Systems. Unauthorized substitutions may result in fire, electrical shock, other hazards, or improper equipment operation.

- Ensure that all equipment doors are closed and protective covers are in place, except when maintenance is being performed by qualified personnel, to prevent electrical shock and personal injury.

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1. Introduction

Product Description

The 4700S Series Sanitary Magnetic Flowtube, together with a 47 or 48 Series Magnetic Flow Transmitter form an easy-to-use, versatile Sanitary Magnetic Flowmeter. The flowmeter is a microprocessor-based magnetic flow system for use with most common conductive liquids used in sanitary process applications. The transmitter converts the low level, high impedance signal from the lined flowtube to a standard scaled transmission signal (4 to 20 mA, digital, or pulse) that is proportional to volumetric flow rate. Typical applications are found in the following industries.

- Water sector: Portable water, treatment of chemicals, waste water and sludge
- Food sector: Dairy products, beer, wine, soft-drinks and fruit juices
- Chemical sector: Detergents, pharmaceuticals, acids and alkalies
- Other sectors   HVAC, paper pulp and mining slurries

Flowmeters feature a unique PROM memory unit which stores flowtube calibration data and transmitter settings for the life of the product. At commissioning, the flowmeter commences measurement without any initial programming.

The factory settings matching the flowtube are stored in the SENSORPROM® unit. Also user-specified settings are downloaded to the SENSORPROM unit. If the transmitter is replaced, the new transmitter uploads all previous settings and resumes measurement without any need for reprogramming.

Reference Documents

In addition to this instruction, there is other documentation supporting the electromagnetic flowmeter, as listed below:

MI 021-322	Model 47 and 48 Transmitters - Installation
MI 021-326	Surface and Pipe Mounting Kit
MI 021-329	Supplemental Installation Instructions when used in PMO, HTST Flowmeter Applications.

Technical Data

Table 1. 4700S Flowtube Specifications

	Ceramic Lined	pfa Lined
Type	Sanitary Flowtube	
Nominal Size	DN 10, 15, 25, 40, 50, 65, 80, 100 (3/8, 1/2, 1, 1 1/2, 2, 2 1/2, 3, 4 inch)	
Process Connection	Direct Welding into Dairy Pipe, Clamp Fitting, Threaded Fitting	
Operating Pressure Vacuum	DN 10-65: 40 bar (580 psi) DN 80: 37.5 bar (540 psi) DN 100: 30 bar (435 psi) 1×10^{-6} bar (14.5 $\times10^{-6}$ psi)	20 bar (290 psi) 0.02 x 10^{-6} bar (0.29 x10^{-6} psi)

Ambient Temperature
    Remote Transmitter
    Integral Transmitter
	
	-40 to +100°C (-40 to +212°F)
	-20 to +50°C (-4 to +122°F)	

Process Temperature	-20 to +150°C (-4 to +302°F) Suitable for steam sterilization	-30 to +130°C (-22 to +266°F) Suitable for steam sterilization at 150°C (302°F)
Temperature Shock (Duration > 1 minute) (Duration > 1 minute), followed by 10 min rest)	DN 10, 15, 25: Max ΔT≤15°C/min (27°F) DN 40, 50, 65: Max ΔT≤10°C/min (18°F) DN 80, 100: Max ΔT≤5°C/min (9°F) DN 10, 15, 25: Max ΔT≤80°C/min (144°F) DN 40, 50, 65: Max ΔT≤70°C/min (126°F) DN 80, 100: Max ΔT≤60°C/min (108°F)	Max ±100°C (212°F) momentarily.

Flow Velocity
    Min. Meas. Range
    Max. Meas. Range
    Recommended
    Operating Velocity
	
	0 to 0.25 m/s (0 to 0.8 ft/s)
	0 to 10 m/s (0 to 33 ft/s)
	
	Approximately 1 to 3 m/s (3 to 10 ft/s) See Figure 2.	

Liner	Ceramic (Aluminum Oxide) Al_2O_3	Reinforced pfa (Teflon)
Electrodes	Platinum	DN 10-15: Hastelloy C276 DN 25-100: Hastelloy C22
Enclosure	AISI 316 stainless steel	

Terminal Box
    Standard
    Option
	
	Fiberglass reinforced polyamide
	AISI 316 stainless steel	

Cable Entries	M20 or 1/2 NPT	

Enclosure Rating
    Standard
    Option
	
	IP67 to EN 60529 (NEMA 4X) (1 m H2O for 30 minutes
	IP68 to EN 60529 (NEMA 6) (10 m H2O continuous	

Mechanical Load (vibration)	18-1000 Hz random, 3.17 G rms, in all directions for 2 hours per EN60068-2-36.	
Sanitary Approvals	3A	

Table 1. 4700S Flowtube Specifications

	Ceramic Lined	pfa Lined
Excitation Frequency		
With Model 47	3.12 Hz	
With Model 48	DN 10-65: 12.5 Hz; DN 80-100: 6.25 Hz	
Gasket		
Ceramic Flowtube	FPM/FKM (-26°C to +204°C) (-15°F to +400°F)	
pfa lined Flowtube	EPDM (-50 to +150°C) (-58 to +302°F)	
	NBR (-20 to +100°C)(-4 to +212°C)	
Nominal Cal. Factor		
DN 10 (3/8 in)	0.0624	
DN 15 (1/2 in)	0.1597	
DN 25 (1 in)	0.4536	
DN 40 (1 1/2 in)	1.2181	
DN 50 (2 in)	2.0739	
DN 65 (2 1/2 in)	3.4755	
DN 80 (3 in)	6.1000	
DN 100 (4 in)	8.8200	
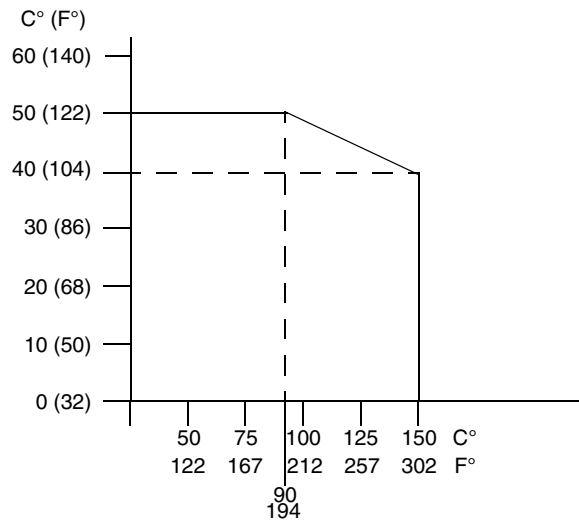
Figure 1. Ambient Temperature Limitation on Integrally Mounted Flowtubes
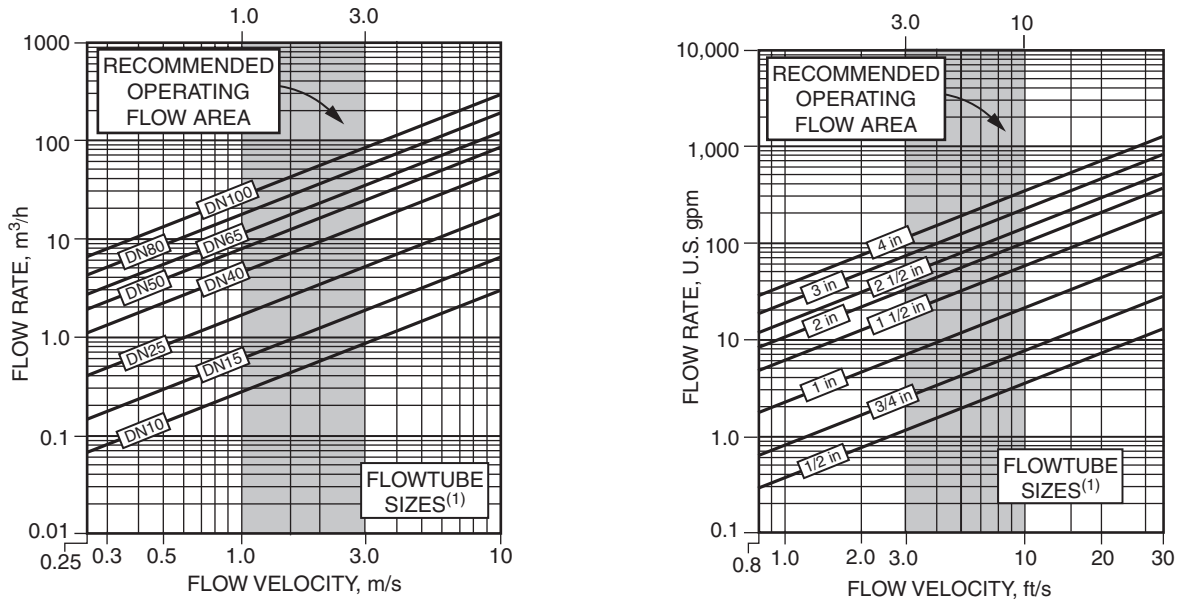
Figure 2. Flowtube Sizing Curves

Integral installation: Liquids with an electrical conductivity ≥ 5 µS/cm.
For a conductivity between 5 and 10 µS/cm, the repeatability may degrade to
±0.5% of actual flow.

Remote installation:
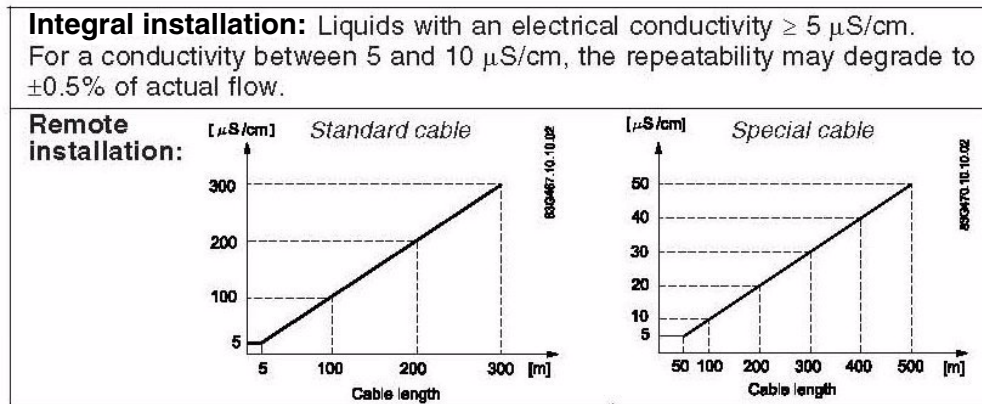
*Figure 3. Transmitter-Flowtube Cables and Conductivity of Medium*

─ **NOTE** ─
For detection of empty flowtube, the minimum conductivity must always be
≥ 20 µS/cm and the maximum length of electrode cable when remote mounted is
50 m. Special cable must be used.

Table 2. Minimum Acceptable Data for Cable

		Coil Cable	Electrode Cable
Basic Data	No. of Conductors	2	3
	Min Square Area	0.5 mm^2	0.2 mm^2
	Screen	Yes	Yes
	Max Capacitance	N.A.	350 pF/m
Maximum Cable Loop Resistance	Media Temperature <100°C <200°C	40 Ω 6 Ω	N.A. N.A.

Dimensions
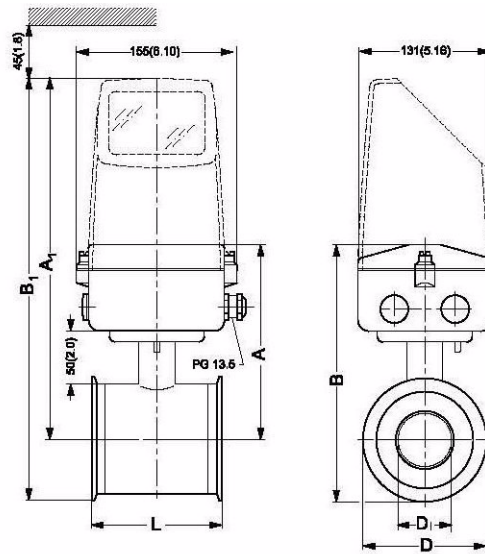
Size in Inches								
Flowtube	L	A	A_1	B	B_1	D	D_1	D_1
1/2	2.5	6.1	12.2	7.1	13.1	2.5	0.4	0.4
3/4	2.5	6.1	12.2	7.1	13.1	2.5	0.6	0.6
1	3.1	6.5	12.5	7.7	13.7	3.1	1.0	1.0
1 1/2	3.7	6.9	13.0	8.6	14.6	3.6	1.6	1.5
2	4.1	7.2	13.3	9.3	15.3	4.7	2.0	2.0
2 1/2	5.2	7.6	13.7	10.0	16.0	5.1	2.6	2.6
3	6.1	7.9	13.9	10.5	16.5	6.1	3.1	3.2
4	7.3	8.4	14.4	11.5	17.5	7.2	3.9	3.9
Size in Millimeters								
DN10	64	156	309	181	334	64	10	10
DN15	64	156	309	181	334	64	15	16
DN25	79	164	317	196	349	78	25	26
DN40	94	176	329	218	371	91	40	38
DN50	104	184	337	235	388	119	50	50
DN65	131	194	347	254	407	130	65	66
DN80	156	200	353	266	419	155	80	81
DN100	186	213	366	292	445	183	100	100

Figure 4. Flowmeter Dimensions
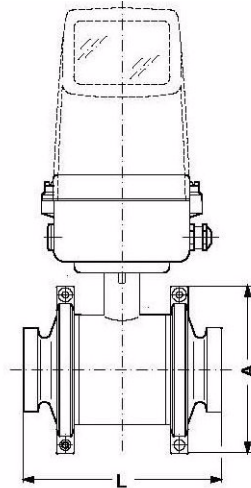
Flowtube Size	A (in)	L[a] (in)	Flowtube Size	A (mm)	L[a] (mm)
1/2 in	3.9	5.7	DN10	99	146
3/4 in	3.9	5.7	DN15	99	146
1 in	4.4	6.3	DN25	113	161
1 1/2 in	5.0	6.9	DN40	126	176
2 in	6.1	7.3	DN50	154	186
2 1/2 in	6.5	8.8	DN65	165	223
3 in	7.9	10.2	DN80	200	258
4 in	8.9	11.3	DN100	225	288
(a) The total built-in length L is independent of the adapter type used.					

Figure 5. Built in Length

Weight (Approximate)

Table 3. Approximate Weight

Flowtube Size		Weight[a]	
Inches	Metric	lb	kg
1/2	DN10	4.8	2.2
3/4	DN15	4.8	2.2
1	DN25	6.0	2.7
1 1/2	DN40	7.5	3.4
2	DN50	9.3	4.2
2 1/2	DN65	12.1	5.5
3 in	DN80	15.4	7.0
4 in	DN100	22.0	10.0
(a) With transmitter mounted on flowtube, add 1.8 lb (0.8 kg)			

2. Installation

⚠ **CAUTION**

Exposing the transmitter to direct sunlight may increase the operating temperature above its specified limit and decrease display visibility.

Installing the Flowtube
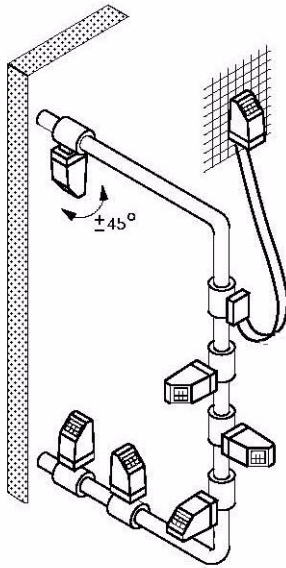
Reading and operating the flowmeter is possible under almost any installation conditions because the display can be oriented in relation to the flowtube.

Figure 6. Flowtube Orientation

To ensure optimum flow measurement attention should be paid to the following:
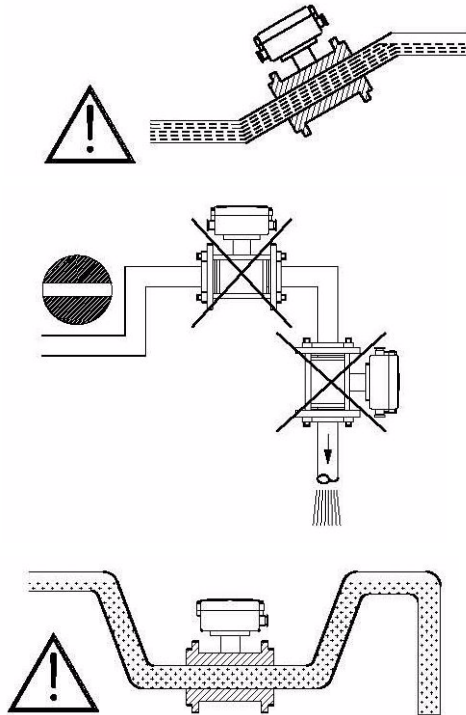
The flowtube must always be completely full with liquid.

Therefore avoid:

- Installation at the highest point in the pipe system
- Installation in vertical pipes with free outlet.

For partially filled pipes or pipes with downward flow and free outlet, the flowtube should be located in a U-tube.

Figure 7. Keep Flowtube Full of Liquid
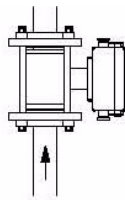
Recommended flow direction: upwards. This minimizes the effect on the measurement of any gas/air bubbles in the liquid.

Figure 8. Installation in Vertical Pipe

The flowtube must be mounted as shown in the upper figure. Do not mount the flowtube as shown in the lower figure. This positions the electrodes at the top where there is possibility for air bubbles and at the bottom where there is possibility for mud, sludge, sand, and so forth.

If using empty pipe detection, the flowtube can be tilted 45°, as shown in the upper figure.
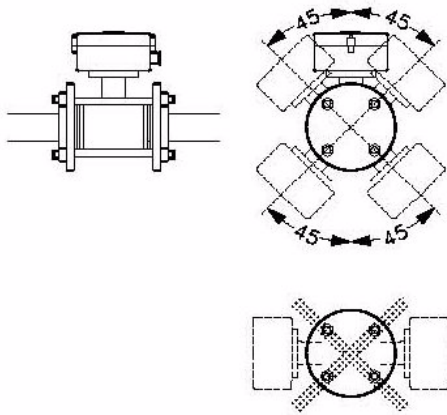
Figure 9. Installation in a Horizontal Pipe

Recommended installation is in a vertical or inclined pipe to minimize the wear and deposits in the flowtube.
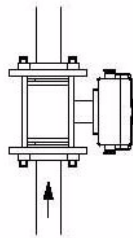
Figure 10. Measuring Abrasive Fluids and Liquids Containing Particles

To achieve accurate flow measurement, it is essential to have straight lengths of inlet and outlet pipes and a certain distance between pumps and valves.

It is also important to center the flowmeter in relation to pipe flanges and gaskets.
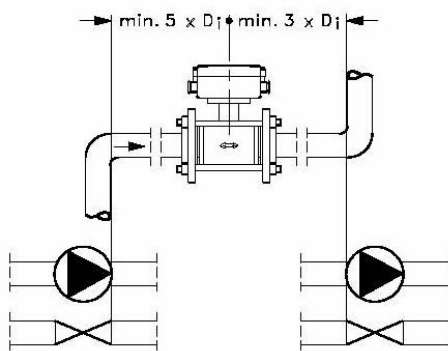
Figure 11. Inlet and Outlet Conditions

11
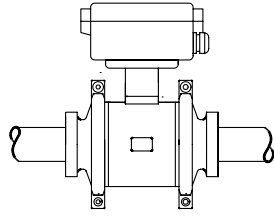
The flowtube must be installed between two adapters. Potential equalization with the liquid occurs automatically via these adapters and through the adjacent pipe.

Figure 12. Potential Equalization
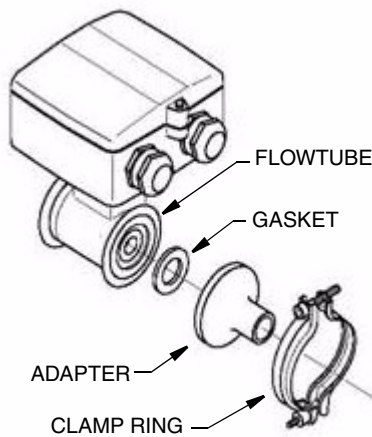
The flowtube has an integrated clamp connection and is designed for installation between two adapters, which are supplied separately. The adapters are available for a variety of standards according to: ISO, DIN, SS, SMS, BS and DS, for direct welding into dairy pipes or with clamp- or threaded fittings.

At assembly, the gasket is placed in the adapter. The adapter is then fastened with a clamp ring. The clamp ring must be located, closed and tightened in order to ensure complete metallic contact between flowtube and adapter facing.

To obtain optimum accuracy and hygienic conditions, it is important that the flowtube and the pipes are correctly aligned around their centerline, fittings must be perpendicular to the pipeline and upstream pipelines must be straight without curves.
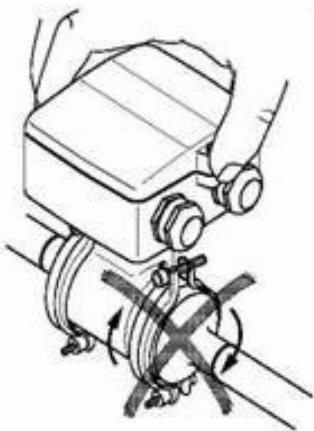
⚠ **CAUTION**

Turning the flowtube around the adapter center line after the clamp rings have been fastened damages the liner. The flowtube may therefore only be turned when the clamp rings have either been removed or completely loosened.

*Figure 13. Installing the Flowtube in the Line*
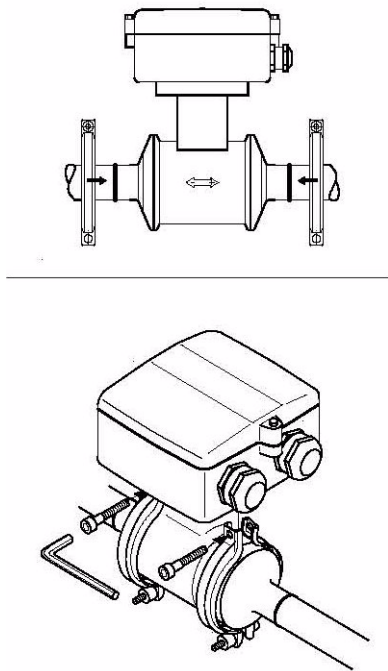
The two adapters are welded directly into the dairy pipes.

It is important to ensure a perpendicular welding to the pipeline in order to omit misalignment between flowtube and adapter facing.

Installation to be as follows:

1. Cut a piece of the pipeline equal to the built-in length "L" stated for the actual flowtube dimension.

2. Assemble the flowtube and the adapters with the clamp rings - leave the gaskets off.

3. Mount the flowtube and tag-weld the adapters to the pipe.

4. Remove clamp rings and dismount the flowtube.

5. The adapters are firmly welded to the pipe.

6. Reinstall the flowtube with gaskets and clamp rings.

*Figure 14. Installing Welding Type Adapter*
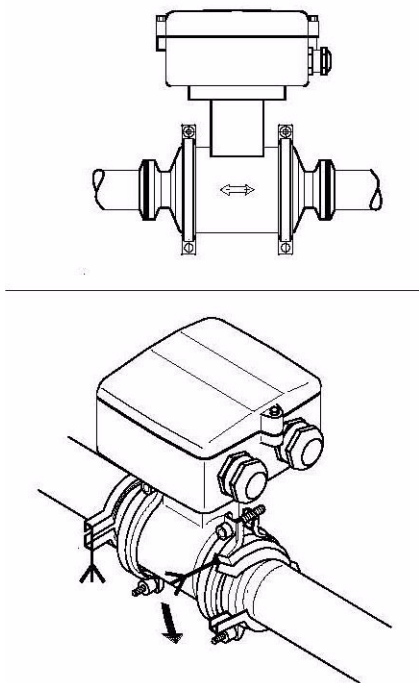
Flowtube, gaskets and adapters are assembled to one unit and then installed in the pipeline prepared with a suitable fitting. Standard gaskets for the actual clamp connection must be used. The clamp rings must be located, closed and tightened.

Figure 15. Installing Clamp Type Adapter
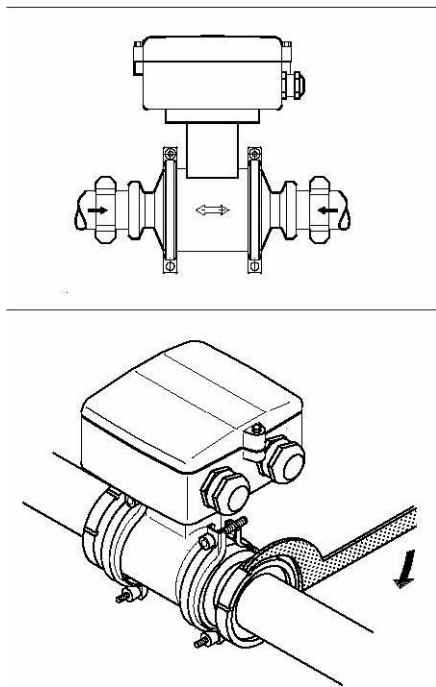
Flowtube, gaskets and adapters are assembled to one unit and then installed in the pipeline prepared with a suitable fitting.

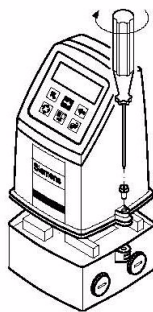Standard gaskets for the actual thread connection must be used.

Tightening must be performed with a suitable union spanner.

Figure 16. Installing Thread Type Adapter
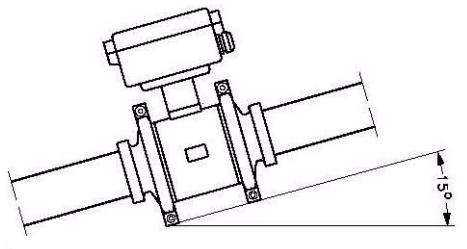
For applications where self-draining is required, the flowtube must be mounted with a minimum incline of 15° to the horizontal plane.

Figure 17. Self Draining

1. Mount the cover or the transmitter on the terminal box.

2. It is important that the screws are firmly tightened (4 N•m; 35 in•lb). Use a large screwdriver fitting into the screw slot.

Figure 18. Installation of Cover or Transmitter on Terminal Box
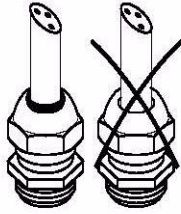
Tighten the cable glands and the cable entries to obtain optimum sealing. The cable entry gasket must obtain firm contact with the cable.

Figure 19. Cable Installation

SENSORPROM® Memory Unit

All 4700S Flowtubes feature a unique SENSORPROM memory unit, which stores flowtube calibration data and transmitter settings for the life of the product.

At commissioning, the flowmeter can be put into service without requiring any initializing, programming.

Factory settings for the flowtube are stored in the SENSORPROM unit. In addition, user-specified settings can be downloaded to the SENSORPROM unit. If the transmitter is replaced, the new transmitter uploads all previous settings and resumes measurement without any need for reprogramming.

As an alternative to using the SENSORPROM unit, you can enter the calibration factor manually through the local keypad of the transmitter. You can then operate the flowmeter without a SENSORPROM unit installed.

Installation with Integrally Mounted Transmitter

The SENSORPROM unit is factory installed in the terminal box of the flowtube. Connections to the transmitter are made when the connection plate is located in the junction box.
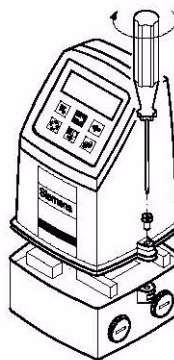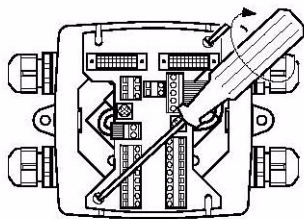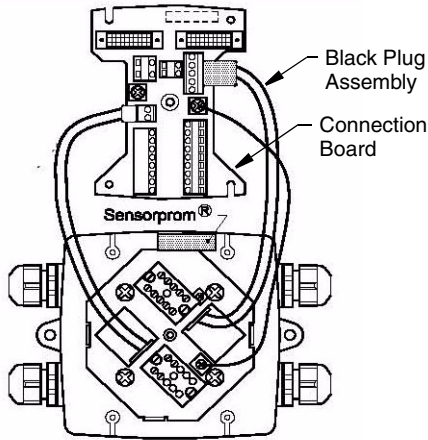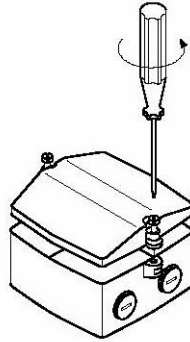
1. 1. Remove and discard the terminal box lid of the flowtube.

2. Fit the cable glands for the supply and output cables.

3. Remove the two black plug assemblies for coil and electrode cables in the terminal box and connect them to their corresponding terminal numbers on the connection board.

4. Connect an earth wire between PE on connection board and bottom of terminal box.

5. Connect the 2-pin connector and 3-pin connector as shown.

6. Mount the connection plate in the terminal box. The SENSORPROM unit connections are established automatically when the connection plate is mounted in the terminal box.

7. Check that your connection board lines up with the SENSORPROM unit. If not, move the SENSORPROM unit to the other side of the terminal box.

8. Fit the supply and output cables respectively and tighten the cable glands to obtain optimum sealing.

9. Refer to MI 021-322 for electrical connections.

10. Add HART module if applicable. See MI 021-322.

Figure 20. Installation on Flowtube

Installation with Remotely Mounted Transmitter

When the transmitter is remotely mounted, the SENSORPROM unit must be removed from the flowtube and installed on the connection plate in the transmitter junction box.

Wiring at the Flowtube
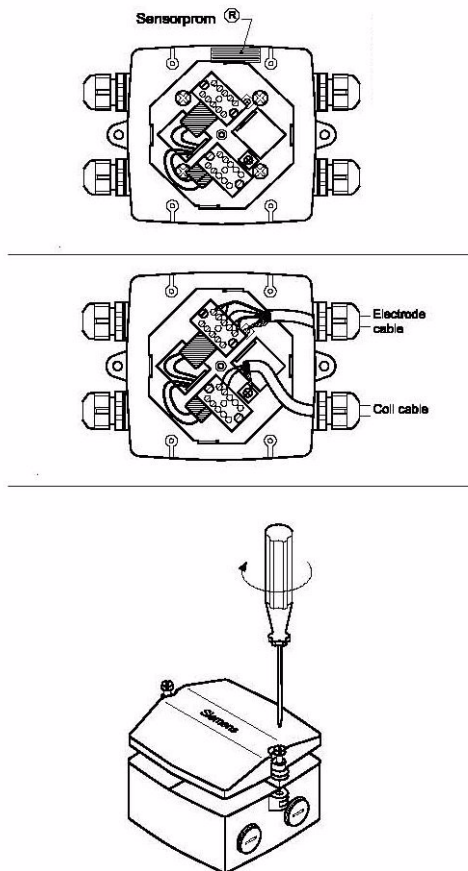
Remove the SENSORPROM unit from the flowtube and mount it on the connection plate in the transmitter.

Fit and connect the electrode and coil cables as shown in MI 021-322.

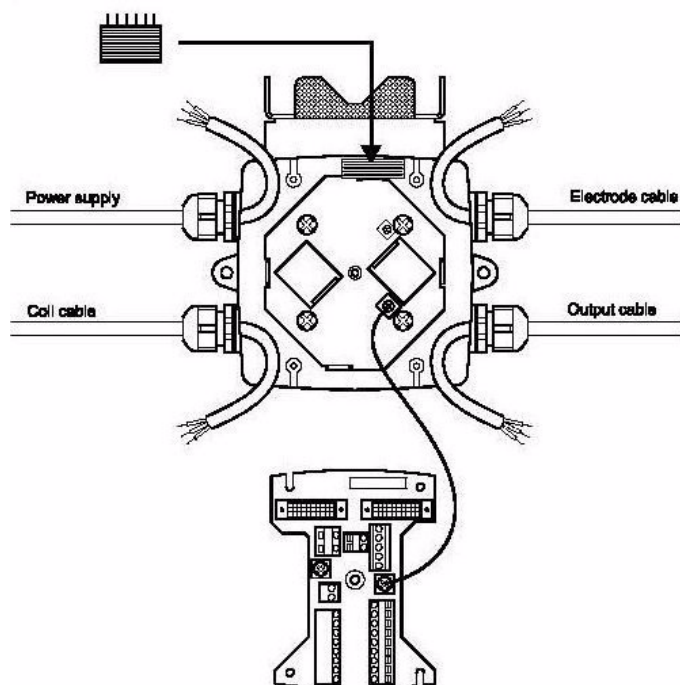The unscreened cable ends must be kept as short as possible.

The electrode cable and the coil cable must be kept separate to prevent interference.

Tighten the cable glands well to obtain optimum sealing.

⚠ **WARNING**

Mount the terminal box lid before applying power.

*Figure 21. Remote Installation - Wiring at the Flowtube*

Wiring at the Remote Transmitter

Mount the SENSORPROM memory unit (that you removed from the flowtube) into the remote terminal box as shown. The text on the SENSORPROM unit must face towards the mounting bracket.

Connect an earth wire between PE on connection board and bottom of terminal box.

Figure 22. Remote Installation - Wiring at the Remote Transmitter (1 of 2)
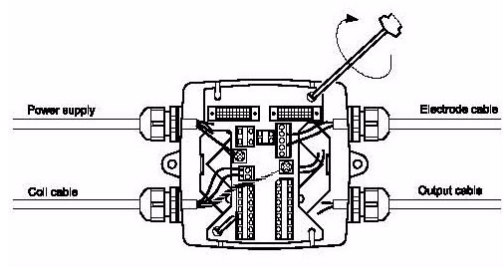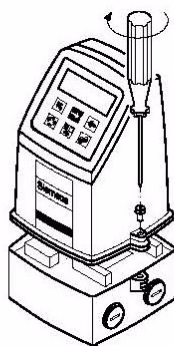

Mount the connection plate in the terminal box.

Fasten the connection plate with the two diagonally opposite screws.

Connect the coil, electrode, supply, and output cables respectively and tighten the cable glands to obtain optimum sealing. See MI 0121-322 for wiring connections.

Mount the transmitter on the remote terminal box.

⚠ **WARNING**
1. When remote mounted, power supply PE wire must be connected to PE terminal.
2. Coil cable shield must be connected to SHIELD terminal.
3. Use the supplied insulating tube to insulate the core shield

Figure 23. Remote Installation - Wiring at the Remote Transmitter (2 of 2)

3. Maintenance

The flowtube has an integrated clamp connection and is designed for installation between two adapters which are supplied separately. The gaskets between the flowtube and the adapters need to be replaced periodically.
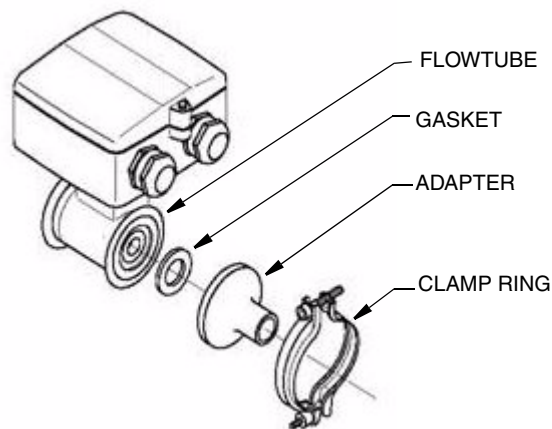

Figure 24. Gasket Location

> **— NOTE —**
> Gaskets used with ceramic lined flowtubes shipped between November 24, 2003 and March 1, 2008 should be changed to incorporate the FPM/FMK gaskets shown in Table 4.

FPM/FMK Gaskets for Ceramic Lined Flowtubes
   Rated -26 to +204°C (-15 to + 400°F)

EPDM Gaskets for pfa-lined Flowtubes
   Rated -50 to +150°C (-58 to +302°F)

NBR Gaskets for pfa-lined Flowtubes
   Rated -20 to +100°C (-4 to +212°F)

Table 4. Gasket Part Numbers

Nominal Flowtube Size		Part Number for the following Gasket Material[a]		
Metric	In	EPDM	NBR	FPM/FKM
DN 10	1/2	083G2206	083G2216	A5E00915707
DN 15	3/4	083G2207	083G2217	A5E00915764
DN 25	1	083G2209	083G2219	A5E00915771
DN 40	1 1/2	083G2211	083G2221	A5E00915773
DN 50	2	083G2212	083G2222	A5E00915775
DN 65	2 1/2	083G2213	083G2223	A5E00915780
DN 80	3	083G2214	083G2224	A5E00915782
DN 100	4	083G2215	083G2225	A5E00915784

(a) The gasket part numbers are for a lot of two gaskets.