Instruction

MI 021-413
November 2010

9100A Series Magnetic Flowtubes

Ebonite, DN 25-2000 (1-78 inch) Sizes

9200A Series Magnetic Flowtubes

Neoprene, EPDM, Linatex, Ebonite, Polyurethane, ptfe, EN1092 15-2000 mm (1/2-78 inch) JIS K10 and K12, or AS4087 50-1200 mm (2-48 inch) Sizes

Installation

FLANGED BODY FLOWTUBE
WITH REMOTE TRANSMITTER

invensys
Foxboro®

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1. Introduction

A 9100A or 9200A flanged magnetic flowtube combined with an IMT25 I/A Series Magnetic Flow Transmitter form easy-to-use, versatile magnetic flowmeter. The flowtube can be used with most common fluids, from ordinary conductive liquids to very difficult-to-handle conductive liquids. The 9100A series flowtubes, which are supplied with ebonite liners, are designed for use with conductive fluids in general purpose or water, waste, and district heating applications. The 9200A series flowtubes, which are supplied with liners and electrodes of several different materials, are designed for use with conductive fluids in the chemical and process industries. The transmitter converts the low level, high impedance signal from the flowtube to a standard scaled transmission signal (4 to 20 mA, digital, or pulse) that is proportional to flow rate.

General Description

The 9100A Series Flanged Magnetic Flowtubes are available with linings of ebonite in sizes of DN 25-2000 (1 to 78 in). The 9200A Series flowtubes are available with linings of neoprene, EPDM, Linatex rubber, Ebonite, or ptfe in sizes DN 15-2000 (1/2 to 78 in). Refer to Table 6 for recommended electrode materials and Table 7 for recommended liners for various process fluids. A flowtube and an IMT25 I/A Series Magnetic Flow Transmitter combine to form a magnetic flowmeter system. The transmitter is mounted in a remote location to a surface or pipe; the flowtube and transmitter are interconnected by a signal cable having a maximum length of 300 m (1000 ft).

The transmitters use a pulsed-dc technique to energize the flux-producing coils of the flowtube. As the process liquid passes through the magnetic field in the flowtube, low-level voltage pulses are developed across a pair of electrodes in accordance with Faraday's Law. The voltage level of these pulses is directly proportional to the average velocity of the liquid. The transmitters convert the voltage pulse to both a standard 4 to 20 mA and/or pulse output signal. The 4 to 20 mA signal is used with a suitable receiver to indicate, record, and/or control a variable. The proportional pulse output can be used for totalization of flow and can be configured for either a high-rate or low-rate pulse. With an I/A Series Transmitter, such as the IMT25, a digital output signal is also provided for flowmeters serving as a primary device in the I/A Series system. Details of the output signals are given in the applicable transmitter instruction.

This instruction relates to the installation of the flowtube portion of a magnetic flowmeter system. For installation, wiring, operation, configuration, and maintenance details relating to the complete flowmeter system, refer to the applicable IMT25 transmitter documents.

Reference Documents

Table 1. Reference Documents

Document	Description
MI 021-387	IMT25-..D and IMT25-..T Series Transmitters, Installation and Wiring
PL 008-748	Parts List — 9100A and 9200A Magnetic Flowtubes
DP 021-368	Dimensional Prints — 9100A and 9200A Magnetic Flowtubes
TI 27-71f	Magnetic Flowtube Materials Selection Guide
TI 027-072	Magnetic Flowmeter Liquid Conductivity Tables

Standard Specifications

Nominal Flowtubes Sizes

Table 2. Nominal Flowtube Sizes

9100A Series			9200A Series		
Flowmeter Size mm	Flowmeter Size inches	Base Model Code	Flowmeter Size mm	Flowmeter Size inches	Base Model Code
			15	1/2	920HA
25	1	9101A	25	1	9201A
40	1-1/2	911HA	40	1-1/2	921HA
50	2	9102A	50	2	9202A
65	2-1/2	912HA	65	2-1/2	922HA
80	3	9103A	80	3	9203A
100	4	9104A	100	4	9204A
125	5	9105A	125	5	9205A
150	6	9106A	150	6	9206A
200	8	9108A	200	8	9208A
250	10	9110A	250	10	9210A
300	12	9112A	300	12	9212A
350	14	9114A	350	14	9214A
400	16	9116A	400	16	9216A
450	18	9118A	450	18	9218A
500	20	9120A	500	20	9220A
600	24	9124A	600	24	9224A
700	28	9128A	700	28	9228A
	30	9130A		30	9230A
800	32	9132A	800	32	9232A
900	36	9136A	900	36	9236A
1000	40	9140A	1000	40	9240A

Table 2. Nominal Flowtube Sizes (Continued)

9100A Series			9200A Series		
Flowmeter Size mm	**Flowmeter Size inches**	**Base Model Code**	**Flowmeter Size mm**	**Flowmeter Size inches**	**Base Model Code**
	42	9142A		42	9242A
	44	9144A	1100	44	9244A
1200	48	9148A	1200	48	9248A
1400	54	9154A	1400	54	9254A
	60	9160A		60	9260A
1600	66	9166A	1600	66	9266A
1800	72	9172A	1800	72	9272A
2000	78	9178A	2000	78	9278A

Flow Velocity

(Refer to Figure 1 and Figure 2.)

Minimum Velocity Flow Range

0 to 0.5 m/s (0 to 1.65 ft/s)

Maximum Velocity Flow Range

0 to 10 m/s (0 to 33 ft/s)

Recommended Operating Velocity

General Liquids: (0.9 to 4.6 m/s (3 to 15 ft/s)

Erosive Slurries: 0.9 to 1.8 m/s (3 to 6 ft/s)

Liquids that Coat Flowtube Surface: 1.8 to 4.6 m/s (6 to 15 ft/s)

Flow Rate

For the general relationships between volume flow rate, fluid velocity, and flowtube line size, refer to Figure 1 (9100A/9200A in metric units) and Figure 2 (9100A/9200A in U.S. customary units). Note that the shaded areas in the figures correspond with the recommended operating velocities listed previously; that is, 0.9, 1.8, and 4.6 m/s, or 3, 6, and 15 ft/s. Also see Table 3 for unit conversion factors. For maximum and minimum Upper Range Value (URV) limits for each flowtube size, refer to Table 4.

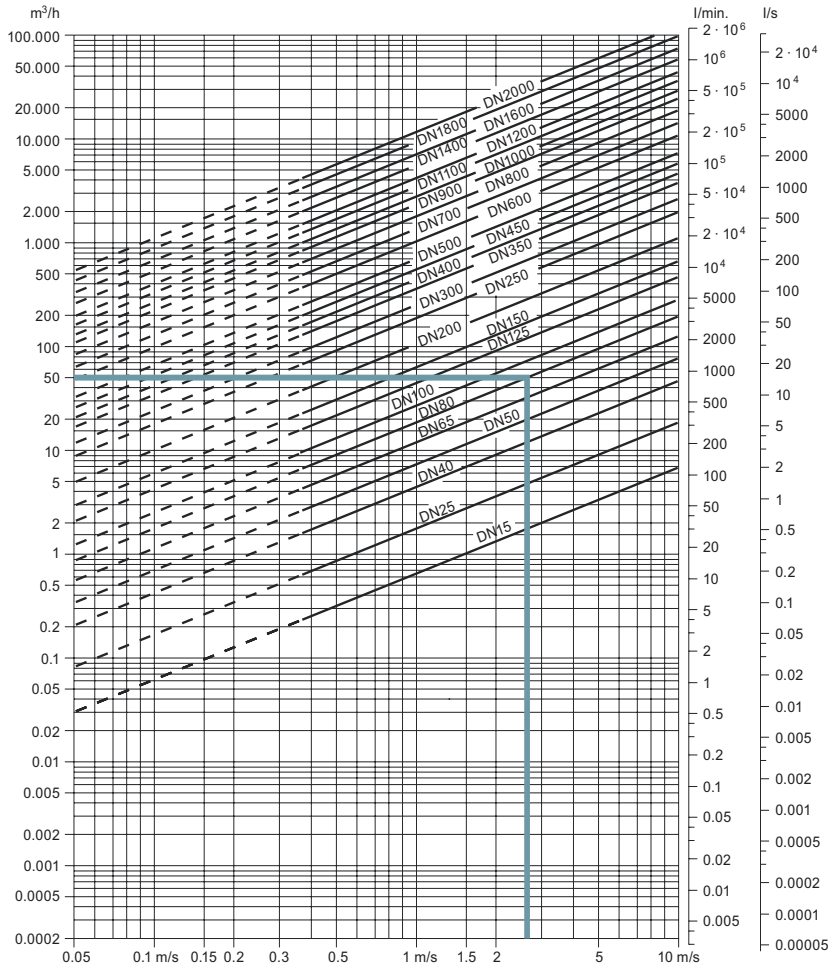
Table 3. Unit Conversion Factors

To Convert:	Multiply by:	To Obtain:
m^3/h	16.67	L/min
m^3/h	0.2778	L/s
m^3/h	4.403	U.S. gpm
L/min	0.06	m^3/h
L/s	3.60	m^3/h
U.S. gpm	0.8327	IMP gpm
U.S. gpm	8.021	ft^3/h
U.S. gpm	0.2271	m^3/h
IMP gpm	1.201	U.S. gpm
ft^3/h	0.1247	U.S. gpm

Flowtube Sizing Curves for 9100A/9200A flowtubes in Metric Units

Selection of sensor

Metric



Sizing table (DN15 … DN 2000)

The table shows the relationship between flow velocity v, flow quantity Q and sensor dimension DN.

Guidelines for selection of sensor

Min. measuring range: 0 to 0.25 m/s

Max. measuring range: 0 to 10 m/s

Normally the sensor size is selected so that the nominal flow velocity v lies within the measuring range 1 to 3 m/s.

Example:

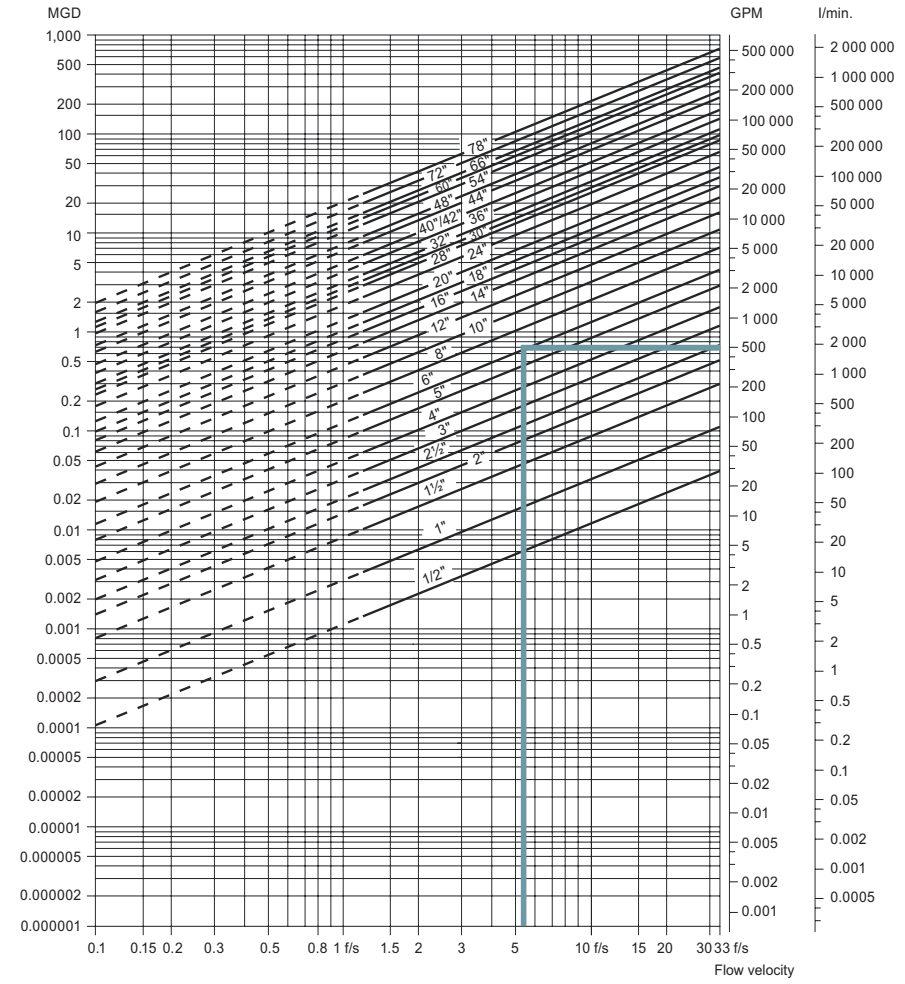
Flow quantity of 50 m^3/h and a sensor dimension of DN 80 gives a flow velocity of 2.7 m/s, which is within the recommended measuring range of 1 to 3 m/s.

Flow velocity calculation formula	Units
$v = 1273.24 \cdot Q / DN^2$ or	v : [m/s], Q : [l/s], DN : [mm]
$v = 353.68 \cdot Q / DN^2$	v : [m/s], Q : [m^3/h], DN : [mm]

Figure 1. Flowtube Sizing Curves for 9100A/9200A Flowtubes in Metric Units

Flowtube Sizing Curves for 9100A/9200A flowtubes in US Customary Units

Imperial



Sizing table ($^{1}/_{2}$ " … 78")

The table shows the relationship between flow velocity v, flow quantity Q and sensor dimension size.

Guidelines for selection of sensor

Min. measuring range: 0 to 0.8 ft/s

Max. measuring range: 0 to 33 ft/s

Normally the sensor size is selected so that the nominal flow velocity v lies within the measuring range 3 to 10 ft/s.

Example:

Flow quantity of 500 GPM and a sensor dimension of 6" gives a flow velocity of 5.6 ft/s, which is within the recommended measuring range of 3 to 10 ft/s.

Flow velocity calculation formula	Units
$v = 0.408 \cdot Q / (\text{Pipe I.D.})^2$ or	v : [ft/s], Q : [GPM], Pipe I.D. : [inch]
$v = 283.67 \cdot Q / (\text{Pipe I.D.})^2$	v : [ft/s], Q : [MGD], Pipe I.D. : [inch]

Figure 2. Flowtube Sizing Curves for 9100A/9200A Flowtubes in U.S. Customary Units

Table 4. 9100A Flowtubes — Minimum and Maximum URV Limits

Flowtube Size		Metric Units		U.S. Customary Units		
DN Flowmeter (mm)	Inch Flowmeter (in)	Minimum URV (m^3/h)	Maximum URV (m^3/h)	Minimum URV (U.S. gpm)	Maximum URV (U.S. gpm)	Nominal Calibration Factor (unitless)
15(a)	1/2					
25	1	0.80	16	35	70	25.0
40	1 1/2	2.1	42	9.0	180	8.8
50	2	2.9	58	12.5	250	5.20
65	2 1/2	5.0	100	22	440	3.05
80	3	7.1	142	31	625	2.20
100	4	12.0	250	55	1100	1.20
125	5	19.3	385	85	1700	0.75
150	6	27.7	554	122	2440	0.50
200	8	58.0	1160	255	5100	0.31
250	10	93.0	1860	410	8200	0.20
300	12	133	2660	585	11 700	0.12
350	14	165	3300	730	14 600	0.11
400	16	220	400	960	19 200	0.079
450	18	280	5600	1200	24 000	0.060
500	20	340	6800	1500	30 000	0.047
600	24	490	9800	2150	43 000	0.032
700	28	690	13 800	3000	60 000	0.0228
	30			3400	68 000	0.021
800	32	900	18 000	3900	78 000	0.016
900	36	1150	23 000	5000	100 000	0.0128
1000	40	1400	28 000	6200	124 000	
	42	1400	28 000	6200	124 000	0.0107
	44			7500	150 000	0.0091
1200	48	2050	41 000	9000	180 000	0.0075
1400	54	2800	56 000	12 000	240 000	
	60			14 000	280 000	0.004911
1600	66	4000	80 000	17 500	350 000	
1800	72	4800	96 000	21 000	420 000	0.0033
2000	78	5600	112 000	25 000	500 000	

(a) For 9200A only. Contact Invensys for 1/2 inch flowmeter sizes.

Process Fluid Conductivity and Signal Cable Length

The maximum allowable cable length is a function of the cable type, process fluid conductivity, and whether the cables are in the same or separate conduits. Standard system accuracy is maintained when the installations are made in accordance with Table 4.

Power Consumption

All flowmeter configurations are designed to consume less than 24 W at reference voltage and frequency, if used with an IMT25 transmitter.

Process Pressure and Temperature Limits

The maximum pressure limit of the flowtube is equal to the pressure limit of the flanges selected. The flowtube temperature limit depends on the liner material.

Model 9100A Flowtube Process Pressure-Temperature Limits

Refer to Figure 3 for Pressure-Temperature limits of Model 9100A Flowtubes. The shaded area beneath each flange curve represents the pressure limits for each flange type. The vertical dashed lines represent the temperature limits of the Ebonite liner. For example, looking at either the DIN or ANSI curve, Area E-F-C-D represents the process pressure-temperature limits of the flowtube with an EPDM liner and a PN 40 or ANSI Class 150 flange; and Area E-F-C-D represents the process pressure temperature limits of the flowtube with a Ebonite liner and either a PN 40 or ANSI Class 150 carbon steel flange. For the AWWA C207, Class D flanges used, the pressure rating is 150 psig within the temperature limits of the liner.

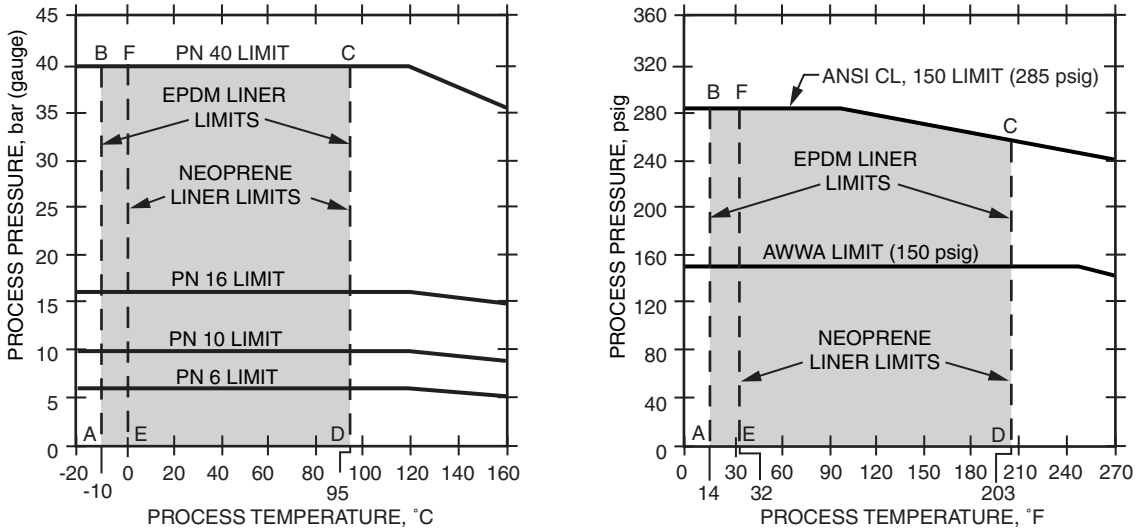


Figure 3. 9100A Flowtube — Process Pressure-Temperature Limits

Model 9200A Flowtube Process Pressure-Temperature Limits

Refer to Figure 4 for Pressure-Temperature limits of Model 9200A Flowtubes. The shaded area beneath each flange curve represents the pressure limits for each flange type. The vertical dashed lines represent the temperature limits of the various liners. The limits shown are independent of flowtube size.

For the AWWA C207 Class D flanges used, the pressure rating is 150 psig within the temperature limits of the liner. For the AS 2129 flanges used, the pressure rating is 14 bar throughout the process temperature limits.

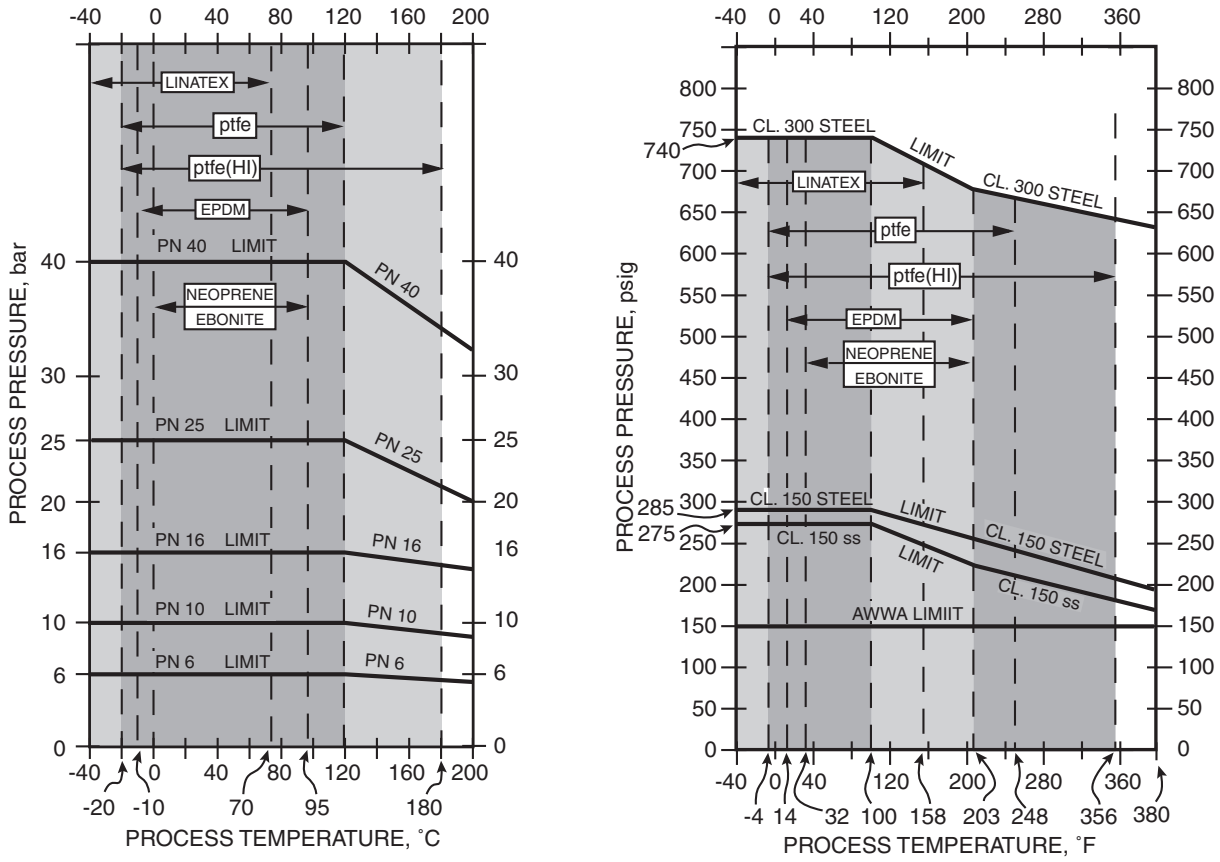


Figure 4. 9200A Flowtube — Process Pressure-Temperature Limits

Materials

Table 5. Materials

Item	9100A Flowtubes	9200A Flowtubes
Flowtube Material	AISI Type 304 ss	
Terminal Box Enclosure	Fiberglass reinforced polyamide, or aluminum, as specified	Fiberglass reinforced polyamide or aluminum are standard
Flowtube Liner	Ebonite	Neoprene, EPDM, ptfe, Ebonite, or Linatex, as specified
Electrodes	Hastelloy C276	AISI Type 316Ti ss, Hastelloy C-276, Titanium, Tantalum, or Platinum, as specified.
Flanges	Carbon Steel	Carbon Steel; ANSI Class 150, PN 6, PN 10, and PN 16 are also available with stainless steel

Electrode Material Application Guide

Table 6. Flowtube Electrode Material Selection Guide

Electrode Material(a)	Recommended Application(s)
316Ti ss	General purpose, water, and sewage
Hastelloy C-276	Has chemical resistant(a) qualities; sea water, slurries, foodstuffs
Titanium	Chlorine, chlorite, nitric (40%) and chromic (50%) acids; textile bleaching industry
Tantalum	Almost any acid solution
Platinum	An excellent electrode material that is unaffected by most process fluids.

(a) See TI 27-71f for recommended use of 316 ss, Hastelloy C, Titanium, Tantalum, and Platinum with about 150 process liquids.

Liner Material Application Guide

Table 7. Flowtube Liner Material Selection Guide

Flowtube Liner Material	Recommended Application(s)
ptfe (a)	Severe corrosion applications. Also for mildly abrasive fluids. 100°C (212°F) temperature limit.
EPDM	Potable and sea water, mildly abrasive fluids, and highly corrosive fluids.
Neoprene (a)	Mildly corrosive or abrasive fluids, and satisfactory with very abrasive fluids. Generally used for sewage and potable water applications.
Ebonite	Potable water and high pressure applications.
Linatex	Generally selected for abrasive fluids and mining slurries.

(a) See TI 27-71f for recommended use of ptfe and Neoprene with about 150 process liquids.

Approximate Mass

Table 8. Approximate Mass

Nominal Flowtube Size		Approximate Mass(a)	
DN	Inch	kg	lb
15	1/2	4	9
25	1	5	11
40	1 1/2	8	17
50	2	9	20
65	2 1/2	11	24
80	3	12	26
100	4	16	35
125	5	19	42
150	6	27	59
200	8	40	88
250	10	60	130
300	12	80	176
350	14	110	242
400	16	125	275
450	18	175	385
500	20	200	440
600	24	300	660
700	28	350	770
- - -	30	- - -	909
800	32	475	1045
900	36	560	1232
1000	40	700	1540
- - -	42	- - -	1600
- - -	44	- - -	2145
1200	48	1250	2750
1400	54	1753	3857
- - -	60	- - -	4503
1600	66	2341	5150
1800	72	3253	7157
2000	78	4060	8932

(a) Approximate Mass using metric flanges; includes terminal box. Pound (lb) weights are converted from the kg weights and are rounded upward to the next whole number.

Optional Selections and Accessories

Submersion Kit

The standard flowtube enclosure meets IEC IP67 and provides the environmental protection of NEMA Type 4X. Use of the submersion kit upgrades the protection to IEC IP68 and NEMA Type 6. Table 9 compares the standard protection, and improved protection using the optional submersion kit. Specify Part Number 085U0220 for the Submersion Kit.

Designation	Submersion Depth	Submersion Duration
IP67; NEMA 4X (Standard)	1.5 m Water (5 ft Water)	72 hours
IP68; NEMA 6 (Optional)	10 m Water (33 ft Water)	Continuous

Cable Glands

Cable glands provide a smooth, strain relieved entrance for cables entering the terminal box. Two cable glands are provided with the polyamide terminal box. They are available as an option with the aluminum terminal box.

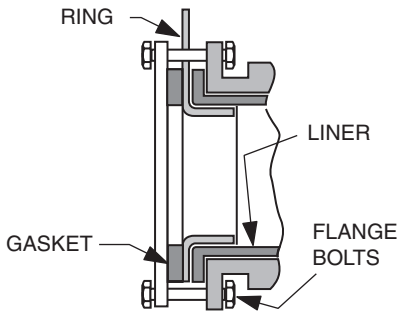
Liner Protection Rings

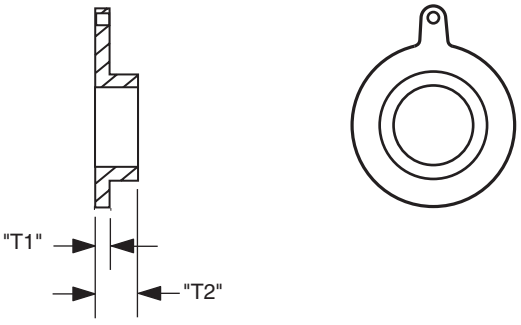
Liner protection rings, installed on the upstream end of the flowtube, protect the flowtube liner against high velocity and/or very abrasive fluids. A Type “C” 304 ss liner protection ring is available for Neoprene and EPDM lined flowtubes. See Table 9 for dimensions, approximate mass and configuration. A Type “E” 316 ss liner protection ring is available for 9200A ptfe lined flowtubes. See Table 10 for dimensions, approximate mass and configuration.

See PL 008-748 for liner protection ring part numbers.

Table 9. Type "C" Liner Protection Ring - Dimensions, Approximate Mass, and Configuration

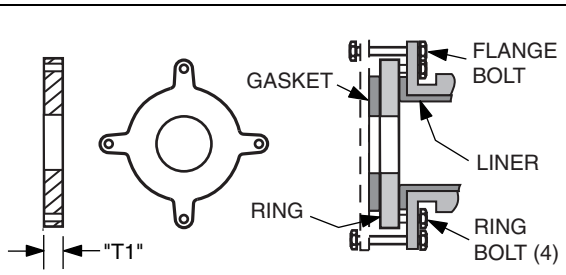
Flowtube Size		Type "C" Liner Protection Ring - 304 ss						
DN Flange Size	Inch Flange Size	Dim. "T1"		Dim. "T2"		Approx. Mass		Liner Protection Ring Configuration
		mm	in	mm	in	kg	lb	
15 mm[(a)]	1/2 in							
25 mm	1 in	1.2	0.047	15	0.59	0.03	0.07	
40 mm	1 12 in	1.2	0.047	15	0.59	0.08	0.18	
50 mm	2 in	1.2	0.047	15	0.59	0.12	0.26	
65 mm	2 12 in	1.2	0.047	15	0.59	0.16	0.35	
180 mm	3 in	1.2	0.047	15	0.59	0.20	0.44	
100 mm	4 in	1.2	0.047	15	0.59	0.25	0.55	
125 mm	5 in	1.2	0.047	15	0.59	0.29	0.64	
150 mm	6 in	1.2	0.047	15	0.59	0.33	0.73	
200 mm	8 in	1.2	0.047	15	0.59	0.37	0.81	
250 mm	10 in	1.2	0.047	15	0.59	0.4	0.88	
300 mm	12 in	1.6	0.063	20	0.79	0.6	1.3	
350 mm	14 in	1.6	0.063	20	0.79	1.0	2.2	
400 mm	16 in	1.6	0.063	20	0.79	1.4	3.1	
450 mm	18 in	1.6	0.063	20	0.79	1.8	4.0	
500 mm	20 in	1.6	0.063	20	0.79	2.2	4.8	
600 mm	24 in	1.6	0.063	20	0.79	2.6	5.7	
700 mm	28 in	2.0	0.079	25	0.98	3.0	6.6	
–	30 in	2.0	0.079	25	0.98	3.3	7.3	
800 mm	32 in	2.0	0.079	25	0.98	3.7	8.1	
900 mm	36 in	2.0	0.079	25	0.98	4.0	8.8	
1000 mm	40 in	2.0	0.079	25	0.98	4.4	9.7	
–	42 in	2.0	0.079	25	0.98	4.5	10.0	
–	44 in	2.0	0.079	25	0.98	4.7	10.3	
1200 mm	48 in	2.0	0.079	25	0.98	5.0	11.0	
1400 mm	54 in	3.0	0.12	40	1.6	9.0	20	
–	60 in	3.0	0.12	40	1.6	10.0	24	
1600 mm	66 in	3.0	0.12	40	1.6	12.5	28	
1800 mm	72 in	3.0	0.12	40	1.6	14.3	32	
2000 mm	78 in	3.0	0.12	40	1.6	16	35	





(a) For 15 mm Type C liner, contact Invensys.

Table 10. Type "E" Liner Protection Ring - Dimensions, Approximate Mass, and Configuration

Flowtube Size		Type "E" Earthing Ring - 316 ss				
SI (Metric)	U.S. Cust.	Dim. "T1"		Approx. Mass		Earthing Ring Configuration
		mm	in	kg	lb	
DN 200[a]	8 in	8	0.31	1.7	3.7	
DN 250	10 in	8	0.31	2.5	5.5	
DN 300	12 in	8	0.31	3.3	7.3	
DN 350	14 in	8	0.31	4.1	9.0	
DN 400	16 in	10	0.39	6.5	14.3	
DN 450	18 in	10	0.39	8.7	19.1	
DN 500	20 in	10	0.39	10.8	23.8	
DN 600[b]	24 in	10	0.39	13.0	28.6	

(a) For line sizes smaller than DN 200 contact Invensys.

(b) For line sizes larger than DN 600 contact Invensys.

Grounding Rings

Since most 9100A and 9200A flowtubes are supplied with grounding electrodes, grounding rings are not required for electrical protection. However, since 9200A flowtubes with ptfe liners do not have built-in grounding electrodes, the Type E 316 ss liner protection ring described above provides for process fluid grounding.

Operating Conditions

Table 11. Operating Conditions

Influence	Reference Operating Conditions	Normal Operating Condition Limits
Ambient Temperature	20 ±2°C (68 ±3°F)	-40 and +100°C (-40 and +212°F)
Process Temperature	20 ±2°C (68 ±3°F)	with ptfe Liner: -20 and +100°C (-4 and +248°F) with EPDM Liner: -10 and +95°C (14 and 203°F) with Neoprene Liner: 0 and 95°C (32 and 203°F) with Ebonite Liner: 0 and +95°C (32 and 203°F) with Linatex Rubber Liner: -40 and +70°C (-40 and +158°F)
Process Pressure [(a)]	3 bar (45 psig)	with ptfe Liner: 0 (no vacuum) and full flange rating with other Liners: Full vacuum and full flange rating
Vibration	Negligible	0 and 32 m/s^2 (0 and 3.2 "g") from 18 to 1000 Hz in all directions

(a) Maximum operating pressure decreases with increasing process temperature. See "Process Pressure and Temperature Limits" on page 8.

Electrical Safety Specifications

Table 12. Electrical Classification

Testing Laboratory, Types of Protection, and Area Classification	Application Conditions	Electrical Safety Design Code
FM/CSA nonincendive Class I, Division 2, Groups A, B, C, and D, hazardous locations	Temperature Class T4. Ta = 100°C For use on nonhazardous processes only.	N

NOTE

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

Flowtube Identification

The flowtube can be identified by data plates located on the flowtube. A typical data plates is shown in Figure 5. For detailed model code information, see PL 008-748.

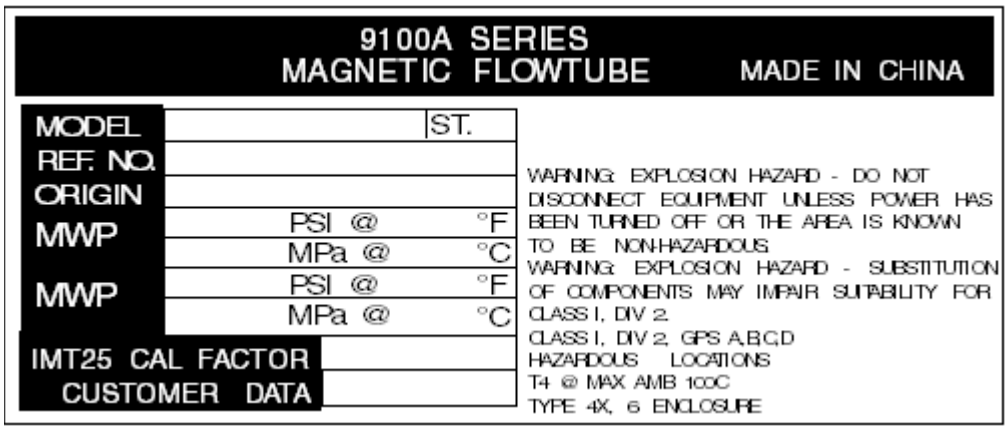


Figure 5. Typical Flowtube Data Plate

2. Installation

The following material provides information and procedures for installing the 9100A and 9200A Magnetic Flowtube. For dimensional information, refer to DP 021-368.

Unpacking and Handling Procedure

After removing flowmeter from its shipping carton, inspect it for visible damage. If any damage is observed, notify the carrier immediately and request an inspection report. Obtain a signed copy of the report from the carrier.

⚠ CAUTION

Avoid touching the electrodes with fingers or any material that can contaminate the electrodes. A deposit on the electrodes can cause a high-impedance boundary to form between the electrodes and conductive fluid. If the electrodes have been touched, clean them with isopropyl alcohol.

Installation Procedures

Overview of Installation Guidelines

When properly installed, these magnetic flowtubes are capable of providing high accuracy and durability while operating under real life conditions. To get maximum performance from the flowtube, select an appropriate location in the pipeline and avoid the factors that create pipe line stresses at the flowtube. These factors are highlighted below in general terms and covered specifically in the detailed installation instructions.

It is very important that:

- A location be selected that ensures a full flowtube under all operating conditions.
- The pipe line and flanges are aligned per the detailed instructions.
- Gaskets are centered on the ends of the tube.
- Flange bolts are tightened carefully to produce a uniform, well-centered load on the tube.
- Torque limits are not exceeded. (By following the installation instruction details, reliable joints can be made without exceeding these limits.)
- You allow approximately 5 pipe diameters of straight pipe upstream of the flowtube and 3 pipe diameters downstream.

Selecting a Location for the Flowtube

The flowtube can be installed in plastic or metal (magnetic or non-magnetic) piping. Usually, the flowtube tube can be placed at any convenient location in the pipeline, but to ensure good performance, the location should be reviewed relative to the factors listed below:

- It is essential for accuracy that the tube be completely full during operation. Horizontal, vertical, or sloping positions are acceptable, but some positions require special attention to be sure that the tube remains full. In addition to obvious problem locations such as down flowing vertical runs, consider areas where air pockets can form and where siphoning action or low pressure areas could create voids.
- The effects of upstream disturbances, such as valves and elbows, are difficult to predict, but in nearly all cases, standard accuracy is realized if there are at least 5 pipe diameters of straight pipe upstream of the flowtube. Downstream disturbances that are 3 or more pipe diameters from the center of the tube do not affect the measurement accuracy. The inside diameter of the piping should be the same as, or larger than, the nominal size of the flowtube. Flowtubes can be placed in larger nominal size pipelines by using tapered conical reducers. The small ends of the reducers can be directly coupled to the flowtube and have a maximum included angle of 16°.
- If the flowtube is to be used to measure a slurry flow, it is important for maintaining good accuracy to select a location where the velocities of the slurry components are nearly equal and high enough to ensure good mixing.

To ensure good service life:

- Avoid areas that can have large stresses, such as water hammer or severe shaking of the pipeline.
- Provide protection from freezing.
- With slurries, do not position the electrodes in such a way that a bend or other pipeline feature would cause large solid particles to strike the electrodes.
- The tube enclosure meets IEC IP67 and provides the environmental protection of NEMA Type 4X and has wide ambient temperature limits, but the tube should be protected from chemical spills and direct exposure to high temperature radiant heat sources.

Select a site with good accessibility for installation.

Mounting Positions

After a location is selected in the pipeline for the flowtube, the mounting position of the tube at that location still has to be determined. The choices are: (1) position of the conduit connections, (2) electrode position, and (3) convenience. Performance of the flowtube is not affected by the direction of the flow through the tube. This permits the tube to be installed in the direction that provides the best location for the wiring connections. **If the actual flow direction does not agree with the "direction-of-flow" arrow on the tube, just reverse the polarity of the coil drive wire connections. As an alternative, you can configure the IMT25 transmitter for reverse flow.**

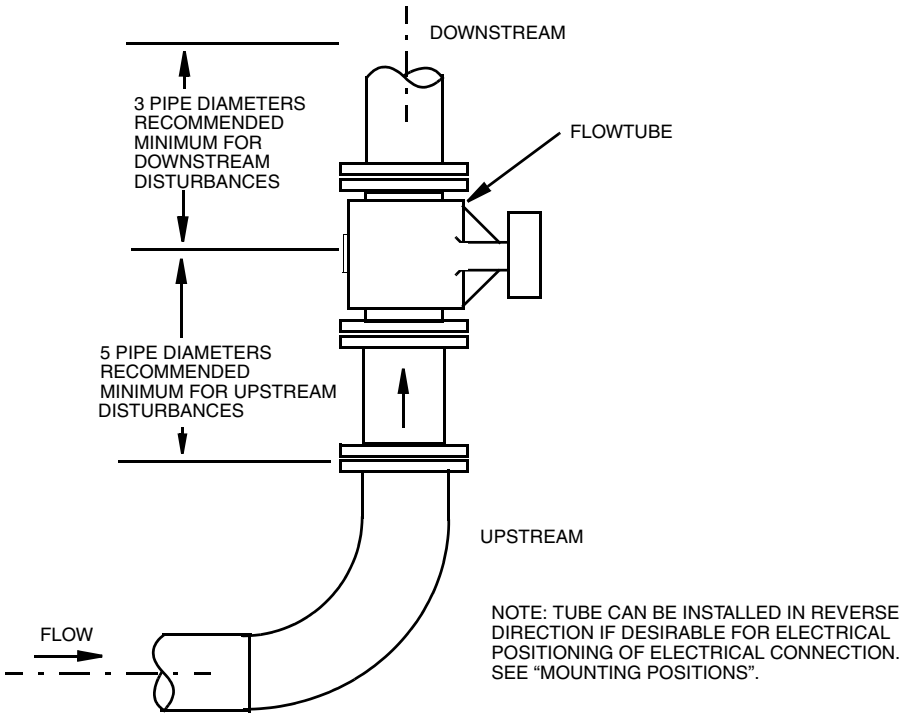


Figure 6. Flanged Body Flowtube Mounted Vertically, Remote Transmitter

If the flowtube is not mounted in a vertical position, it is best to turn it so that the electrodes are not near the top and bottom of the pipe. The purpose of this is to avoid the possibility of losing electrode-to-fluid contact, either because of bubbles (at top), or sediment (at bottom) of the flowtube.

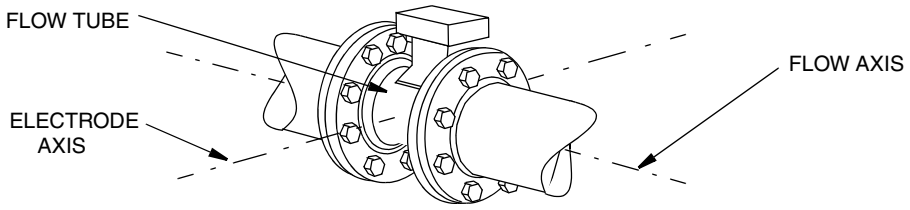


Figure 7. Flanged Body Flowtube Mounted Horizontally, Remote Transmitter

Pipeline Preparation

Flange Types and Materials

The pipe and flange material can be magnetic, nonmagnetic metal, or plastic without affecting the accuracy of the flowtube. To help control the stresses on the liner flanged ends, it is best to use a flange type that has a raised face I.D. equal to the pipeline I.D., such as a welding neck or socket welding flange. This assures full gasket contact for more even loading of the liner ends of the flowtube and permits higher bolting torques without over-compressing the gasket. Flange types that do not provide full surface contact with the gasket can be used, but with reduced bolt torques and careful attention to alignment.

Pipeline Support and Alignment

Adequately support the pipeline to carry its weight when full and to control pipeline motions such as can be caused by water hammer or other disturbances within the piping system.

In cases where temperature differences occur, make provisions to accommodate thermal expansions in a way that preserve the initial alignment of the piping at the flowtube.

It is important to align the pipeline flanges so that they make flat contact with the flowtube flanges. Bolt torque in excess of the maximum recommended values or misaligned flanges that cause an uneven flange clamping force can crush the liner. To prevent liner damage due to an uneven flange clamping force, align the flange well enough to allow full face contact to be made without exceeding 25% of the recommended maximum torque in any of the flange bolts. See Tables Table 13 and Table 14.

Flowtube Grounding

Since all 9100A and all 9200A flowtubes (except ptfe lined) are supplied with grounding electrodes, grounding rings or grounding jumper wires to the pipeline are not required for proper operation. For 9200A flowtubes with ptfe liners, grounding can be accomplished as follows:

- If the flowtube is installed in a metal (unlined) pipeline, install jumper wires from the threaded hole (M6) in the OD of the flowtube flanges to the upstream and downstream pipes.
- If the flowtube is installed in a nonconductive pipeline, such as lined metal or plastic, use Type “E” a 316 ss liner protection rings.

Installation Procedure Details

1. Review the guidelines on page 21 for selecting a location for the flowtube.
2. Prepare the pipeline for the tube, per “Pipeline Preparation” on page 23.
3. Review “Flowtube Grounding” on page 24.
4. Locate and remove all foreign objects from the piping. If possible, make up and install a section of pipe (spool piece) in the space provided for the flowtube and flush the pipeline.
5. If the flowtube has a ptfe liner and grounding rings are to be used, they should be bolted to the flowtube and the jumper wire connected before placing the tube into the pipeline.
   or
   If a liner protection ring is used, it should be placed on the upstream end of the flowtube before inserting the tube into the pipeline.
   In either case, it is not recommended to use a gasket between the grounding or liner protection ring and the flowtube. A gasket is needed between the ring and the mating flange and this gasket should have about the same hardness as the liner.
6. Place flowtube in the pipeline. Note, the tube can be installed with the “direction-of-flow” arrow reversed to the actual flow direction. This does not affect performance

and should be done if it places the electrical connections in a better position. (Refer to “Mounting Positions” on page 22.)

7. Initially tighten the bolts selectively to bring the flanges into full face contact. Full face contact should be achieved using less than 25% of the final recommended torque limit. See Table 13 and Table 14. If this cannot be done, the piping should be realigned. After full contact is achieved, tighten all the bolts at least finger tight. Then proceed to tighten the nuts, following a diametrically opposite pattern. Turn the first nut 1/6 of a turn, then move to the next nut and tighten it 1/6 of a turn. Continue this sequence until one nut on each bolt has made one complete turn, or until the maximum torque spec has been reached.

Table 13. Maximum Mounting-Nut Torques With ANSI and AWWA Flanges

Flange Size		ANSI Class 150		ANSI Class 300		AWWA Class D	
mm	**inch**	**ft•lb**	**N•m**	**ft•lb**	**N•m**	**ft•lb**	**N•m**
15	1/2	N/A	N/A	5	7	N/A	N/A
25	1	10	14	10	19		
40	1-1/2	15	20	13	18		
50	2	25	34	8	11		
65	2.5	30	41	12	16		
80	3	40	54	18	24		
100	4	30	41	25	34		
125	5	45	61	31	42		
150	6	55	75	26	35		
200	8	80	109	70	95		
250	10	80	109	95	129		
300	12	110	150	145	197		
350	14	145	197	130	177		
400	16	140	190	185	252		
450	18	225	306	200	272		
500	20	200	272	225	306		
600	24	300	408	375	510		
700	28					200	272
	30					200	272
800	32					250	340
900	36					250	340
1000	40					250	340
	42					250	340
1100	44					275	374
1200	48					275	374
1400	54					325	442
	60					350	476
1600	66					400	544
1800	72					400	544
2000	78					450	612

Table 14. Maximum Mounting-Nut Torques with EN1092 Flanges

Flowmeter Size		EN1092									
Flange Size		PN6		PN10		PN16		PN25		PN40	
mm	inch	N•m	ft•lb	N•m	ft•lb	N•m	ft•lb	N•m	ft•lb	N•m	ft•lb
15	1/2									10	7
25	1									20	15
40	1-1/2									34	25
50	2									41	30
65	2.5	10	7			61	45			34	25
80	3	25	18			41	30			42	31
100	4	25	18			48	35			72	53
125	5	25	18			61	45			114	84
150	6	25	18			82	60			144	106
200	8	68	50	109	80	82	60	122	90	163	120
250	10	54	40	88	65	122	90	184	135	245	180
300	12	88	65	102	75	163	120	190	140	258	190
350	14	136	100	136	100	190	140	292	215	388	285
400	16	116	85	184	135	245	180	394	290	544	400
450	18	129	95	218	160	245	180	381	280	476	350
500	20	122	90	190	140	340	250	442	325	510	375
600	24	170	125	245	180	476	350	578	425	816	600
700	28	163	120	245	180	306	225				
	30										
800	32	190	140	286	210	374	275				
900	36	218	160	286	210	374	275				
1000	40	204	150	340	250	510	375				
	42										
	44										
1200	48	258	190	408	300	680	500				
1400	54	340	250	476	350	748	550				
	60										
1600	66	340	250	646	475	884	650				
1800	72	374	275	680	500	884	650				
2000	78	476	350	748	550	884	650				

Table 15. Maximum Mounting-Nut Torques with JIS and EN1092 Flanges

Flowmeter Size		JIS B 2220:2004				EN1092			
Flange Size		K10		K20		PN63		PN100	
mm	inch	N•m	ft•lb	N•m	ft•lb	N•m	ft•lb	N•m	ft•lb
15	1/2	6	8	6	8				
25	1	12	16	12	16			25	18
40	1-1/2	15	20	25	20			52	38
50	2	20	27	10	13	45	33	83	61
65	2.5	27	36	13	18	32	23	60	44
80	3	16	21	21	28	41	30	76	56
100	4	19	26	27	37	68	50	118	87
125	5	32	43	44	59	102	75	177	130
150	6	56	76	30	40	153	112	159	117
200	8	34	46	45	62	189	139	294	216
250	10	53	72	83	113	276	203	472	348
300	12	41	56	71	96	293	216	541	399
350	14	53	72	108	147	413	304	800	590
400	16	85	115	129	175	588	431		
450	18	80	109	135	184				
500	20	93	127	155	211				
600	24	111	150	188	255				
700									
750									
800									
900									
1000									
1050									
1100									
1200									
1400									
1600									
1800									
2000									

Table 16. Maximum Mounting-Nut Torques with AS 4087 Flanges

Flowmeter Size		AS 4087					
Flange Size		PN16		PN21		PN35	
mm	inch	N•m	ft•lb	N•m	ft•lb	N•m	ft•lb
15	1/2						
25	1						
40	1-1/2						
50	2	21	15	33	24	33	24
65	2.5	22	16	22	16	22	16
80	3	32	24	28	21	28	21
100	4	50	37	35	26	35	26
125	5						
150	6	60	44	37	37	50	
200	8	55	41	57	28	37	
250	10	94	70	81	36	49	
300	12	72	53	77	32	43	
350	14	153	113	121	69	94	
400	16	172	127	116	77	105	
450	18	224	165	151	95	129	
500	20	198	146	155	104	141	
600	24	287	211	204	135	183	
700	28	228	168	182	153	207	
750	30						
800	32	426	314	304	224	286	211
900	36	416	307	371	274	287	212
1000	40	386	284	326	240	326	240
	42						
1100	44						
1200	48	443	327	471	347	471	347

System Wiring

For information on wiring your flowtube to an IMT25 Transmitter, refer to the Wiring section of the applicable transmitter installation document listed in Table 1.

Maintenance

System fault and maintenance information are described in the instruction book shipped with the applicable transmitter. For flowtube parts, refer to the applicable flowtube parts list in the "Reference Documents" section.

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