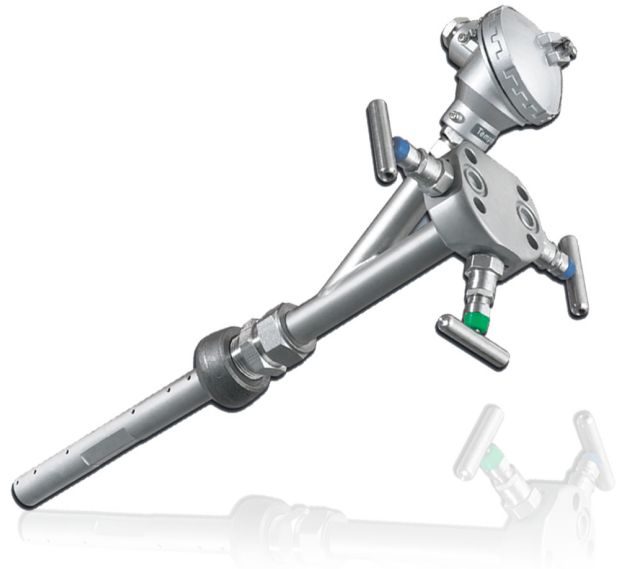


Torbar

Averaging pitot tubes

Economical flow metering solutions for gases, liquids and steam



Unique profile shape

- Offers high flow turndown

No drift in co-efficient

- Ensures long term stability

One-piece outer tube

- For pipes up to 5000 mm (197 in.) diameter
- Ensures optimum strength

Low permanent pressure loss

- Means low energy consumption & cost
- Reduced carbon footprint

Suitable for wide range of pipe sizes

- For circular, square or rectangular section ducts of 10 to 8000 mm (0.4 to 315 in.) diameter

Dual averaging

- For improved accuracy with asymmetric flow profiles

Hot-tap versions available

- Allows insertion into pressurized pipes

Optional Integral Transmitter

- For volumetric or mass flow metering

TORBAR

The TORBAR is a multiport self-averaging flow meter with a design based on the classical pitot tube concept of fluid flow measurement and with thousands having been installed into a large variety of industries world wide.

The TORBAR produces an averaged differential pressure (DP) signal proportional to the square of the flow rate.

The DP output is normally piped to a Differential Pressure transmitter in order to generate an electrical signal proportional to the flow rate. For certain applications, the DP transmitter can be directly mounted on to the TORBAR via an integral valve manifold.

Each TORBAR is designed to span the process pipe diameter and comprises four basic components:

- Outer impact tube – ONE PIECE CONSTRUCTION ¹
- Internal averaging tube ²
- Low pressure chamber
- Head with HP and LP impulse connections

The outer impact tube has a number of pressure sensing holes facing upstream which are positioned at equal annular points in accordance with a log-linear distribution. The 'total pressures' developed at each upstream hole by sum of the impact of the flowing medium and the static pressure are firstly averaged within the outer impact tube and then to a second order (and more accurately) averaged within the internal averaging tube. This pressure is represented at the head as the high pressure component of the DP output. The low pressure component is generated from a single sensing hole located on the downstream side of the outer impact tube, measuring static pressure. For bi-directional flow measurement, the TORBAR can be supplied with the same number of downstream ports as upstream.

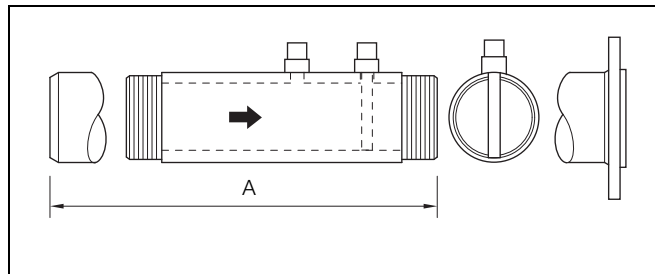
The TORBAR is an improvement on the round sensor design due to the unique profiled flats which are positioned around the downstream hole in order to define the separation point at which the flow lines separate as the fluid passes around the outer impact tube. This feature creates a stable pressure area at the downstream pressure sensing hole thereby maintaining a more constant flow coefficient at high velocities enabling a very wide range of flow measurement (turndown).

¹ due to manufacturing constraints, units longer than 5 metres will have 2-piece construction.

² due to manufacturing constraints, not available for models 121, 122, 123, 301, 311 or for any units coded to include the options NRTB or NRTT.

Permanently Installed Types

In-line fitting



In-line Fitting

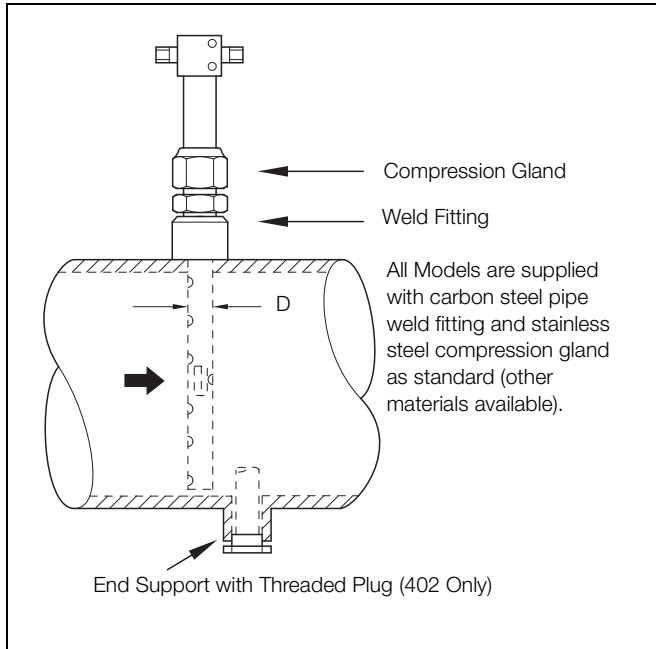
Basic Model	End Fittings	Fits Pipe Sizes mm (in.)
121	Butt Weld	13 to 50 (0.5 to 2)
122	Threaded	
123	Flanged	

All models are supplied with a pipe section in the same material as TORBAR probe

Pipe Size (Schedule 80)	'A' mm (in.)
1/2 in.	200 (8)
1 in.	225 (8.8)
1 1/2 in.	300 (12)
2 in.	400 (15.7)

Model	Maximum Pressure/Temperature
121	50 bar / 450 °C (725 psi / 840 °F)
122	50 bar / 450 °C (725 psi / 392 °F)
123	As flange rating to Class 900 ANSI

Threaded Fitting



Models 301, 401 and 402

All Models are supplied with carbon steel pipe weld fitting and stainless steel compression gland as standard. (Other materials available)

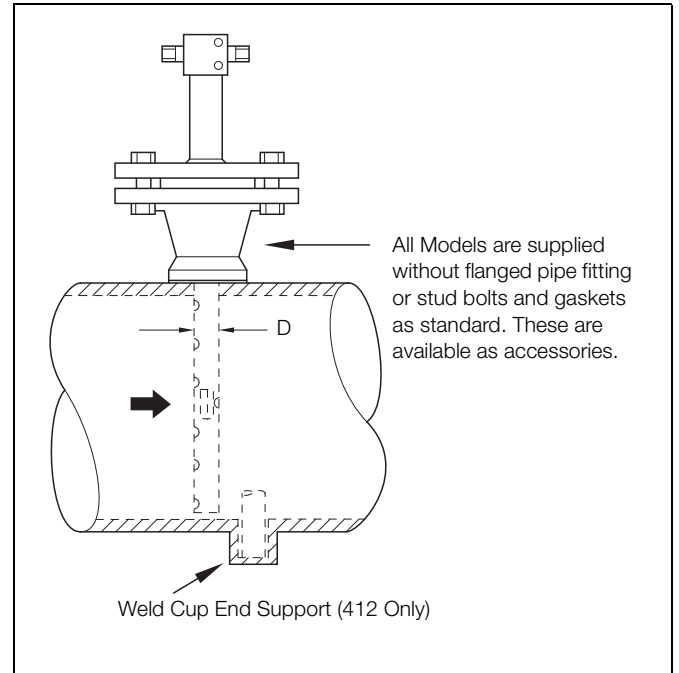
Basic Model	D mm (in.)	Fits Pipe Sizes mm (in.)
301	13 (0.5)	50 to 150 (2 to 6)
401**	25 (1)	100 to 1800 (4 to 70)
402*	25 (1)	100 to 5000 (4 to 200)

** For liquid flow applications where there is a possibility of process pulsations or intermittent excessive flow velocity, the end-support model should always be selected for pipe sizes over 250 mm (10 in.) internal diameter.

* With end support

Maximum Pressure / Temperature	
Model 301	50 Bar @ 400 °C (725 psi @ 752 °F)
Model 401, 402	50 Bar @ 400 °C (725 psi @ 752 °F)

Flanged Fitting – Standard



Models 311, 411 and 412

Basic Model	D mm (in.)	Fits Pipe Sizes mm (in.)
311	13 (0.5)	50 to 150 (2 to 6)
411**	25 (1)	100 to 1800 (4 to 70)
412*	25 (1)	100 to 5000 (4 to 200)

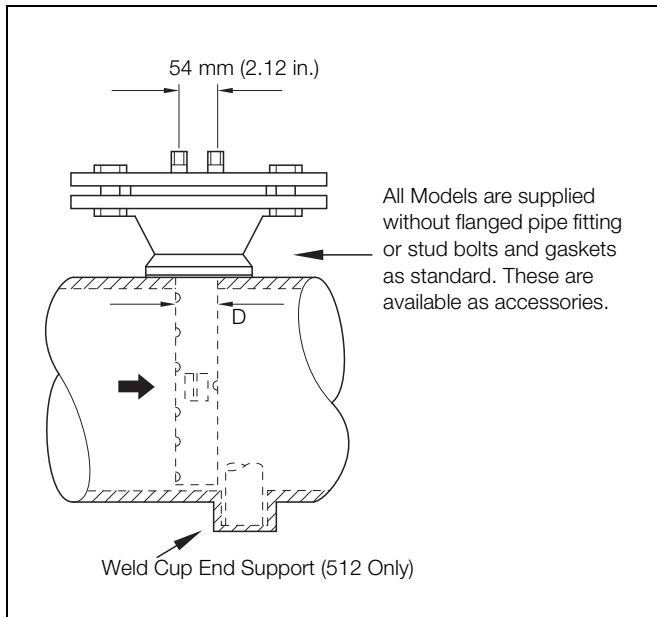
** For liquid flow applications where there is a possibility of process pulsations or intermittent excessive flow velocity, the end-support model should always be selected for pipe sizes over 250 mm (10 in.) internal diameter.

* With end support

Standard Flange Size	
Model 311	1 in. (DN 25)
Model 411	1 1/2 in. (DN 40)
(Other sizes available)	

Maximum Pressure / Temperature
All models as flange rating to class 1500 ANSI. For higher pressures / temperature consult factory.

Flanged Fitting – Extra Strength



Models 511 and 512

Basic Model	D mm (in.)	Fits Pipe Sizes mm (in.)
511*	60 (2.4)	250 to 1800 (10 to 70)
512**	60 (2.4)	400 to 8000 (16 to 315)

* For liquid flow applications where there is a possibility of process pulsations or intermittent excessive flow velocity, the end-support model should always be selected for pipe sizes over 600 mm (24 in.) internal diameter.

** With end support



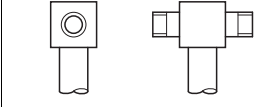
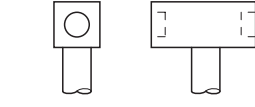
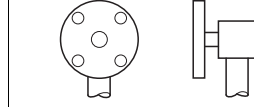
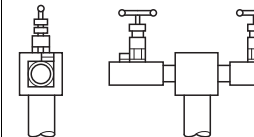
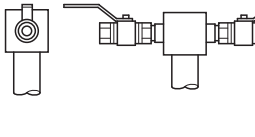
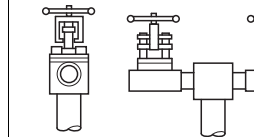
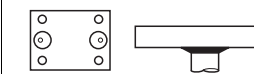
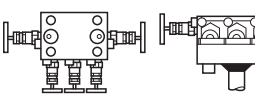
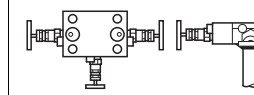
Standard Flange Size	
Model 511, 512	3 in. (DN 80)
Other sizes available	

Maximum Pressure / Temperature
All models as flange rating to class 2500 ANSI.

Options

Probe Material	Code
316 Stainless Steel	SS
304L Stainless Steel	4S
Monel 400	ML
Hastelloy C	HC

Probe Material	Code
6MO	6M
Duplex	DX
Super Duplex	SDX
Other	Specify

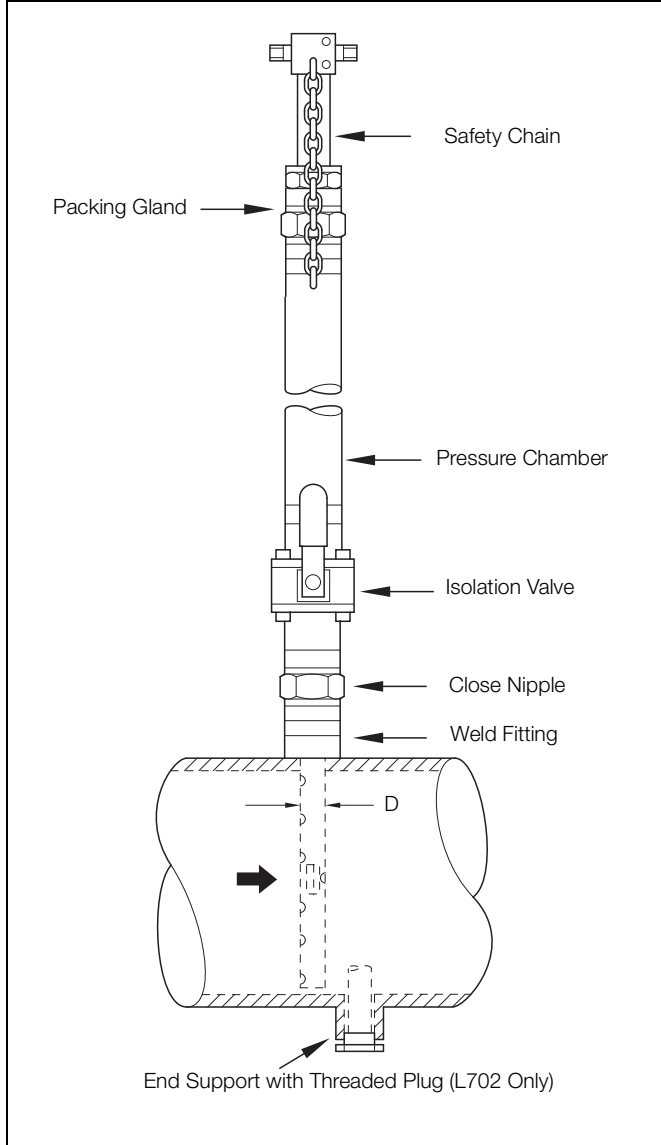
Male without valves		Female without valves		Flanged without valves	
Code example: 007M (1/2 in. NPT)		Code example: 006F (12 mm [1/2 in.] weld socket)		Code example: 009 (12 mm [1/2 in.] specify pressure class)	
With needle valves		With ball valves		With gate valves	
Code example: SV4 (st. steel 1/4 in. BSPT)		Code example: BB3 (brass 1/4 in. NPT)		Code example: CG8 (carbon steel 1/2 in BSPT)	
Direct mount head		Direct mount separate manifold		Direct mount integral manifold	
Code: 000 Specify accessory: 0VDM		Code: 000 Specify accessory: 3VDM (3 valve) 5VDM (5 valve)		Code: 000 Specify accessory: DM3V Bolting = 4 x M10 x 30 mm (others available)	

DP Output Connections/Valves

Withdrawable Types (Hot Tap)

Models L702, H702, H712 and H812 should not be installed via hot-tap methods into a pressurized pipe because of the requirement to fit an end support. However once installed they can be inserted and withdrawn under pressure.

Threaded Fitting – Low Pressure



Models L601, L701 and L702

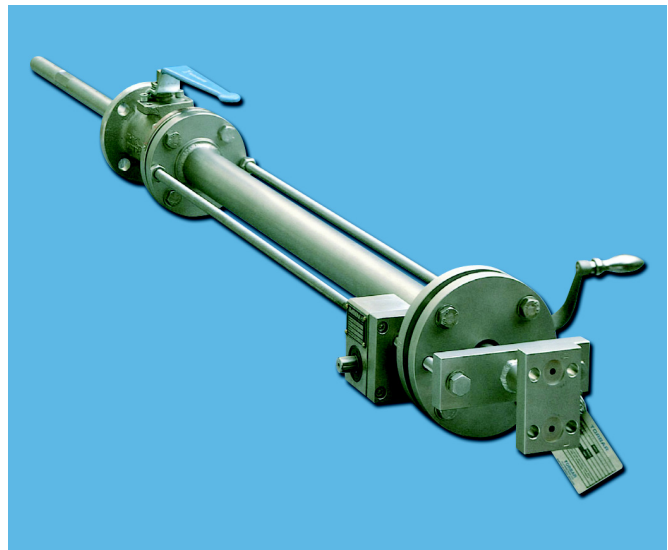
Basic Model	D mm (in.)	Fits Pipe Sizes mm (in.)
L601	13 (0.5)	50 to 150 (2 to 6)
L701*	25 (1)	100 to 1800 (4 to 70)
L702**	25 (1)	100 to 5000 (4 to 200)

* For liquid flow applications where there is a possibility of process pulsations or intermittent excessive flow velocity, the end-support model should always be selected for pipe sizes over 250 mm (10 in.) internal diameter.

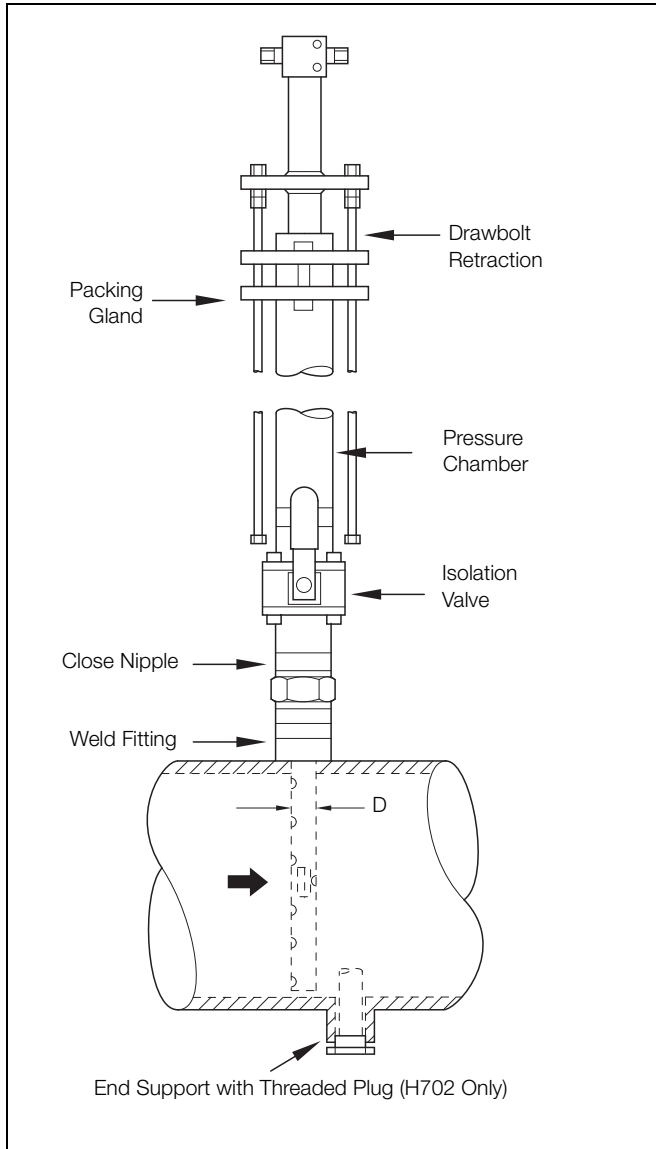
** With end support

Supplied with weld fittings, isolation valve and pressure chamber with safety chain as standard. Gland packing material is supplied as non-asbestos graphite ribbon as standard. Teflon is available. Please specify at time of order. For isolation valve details refer to page 9.

Maximum Pressure / Temperature	
With standard ball valve:	10 bar and 200 °C (145 psi and 392 °F)
With standard gate valve:	10 bar and 400 °C (145 psi and 752 °F) (Temperature is at valve)



Threaded Fitting – High Pressure



Model H701 and H702

Basic Model	D mm (in.)	Fits Pipe Sizes mm (in.)
L601	13 (0.5)	50 to 150 (2 to 6)
H701*	25 (1)	100 to 1800 (4 to 70)
H702**	25 (1)	100 to 5000 (4 to 200)

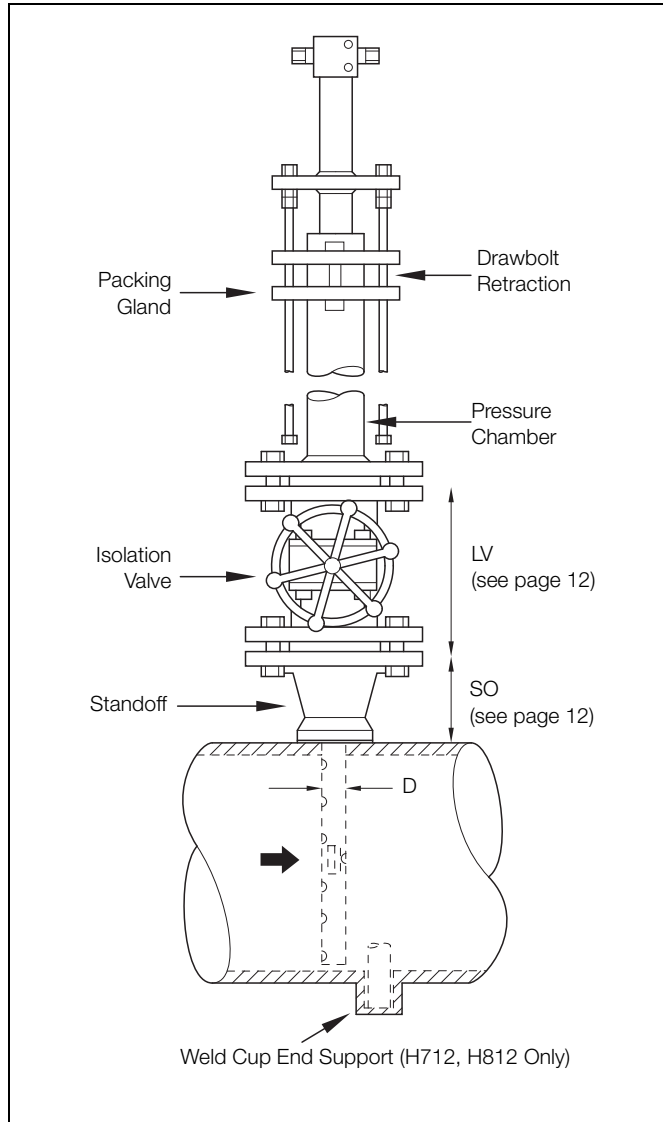
* For liquid flow applications where there is a possibility of process pulsations or intermittent excessive flow velocity, the end-support model should always be selected for pipe sizes over 250 mm (10 in.) internal diameter.

** With end support

Supplied with weld fittings, isolation valve, pressure chamber and draw bolt retraction (illustrated) as standard. Gland packing material is supplied as non-asbestos graphite ribbon as standard. Teflon is available (specify at time of order). Geared retraction – Optional. For isolation valve details refer to page 9.

Maximum Pressure / Temperature	
With standard ball valve:	40 bar and 200 °C (580 psi and 392 °F)
With standard gate valve:	40 bar and 400 °C (580 psi and 752 °F) (Temperature is at valve)

Flanged Fitting



Models H611, H711, H712, H811 and H812

Basic Model	D mm (in.)	Fits Pipe Sizes mm (in.)	Standard Flange Size
H611	13 (0.5)	50 to 150 (2 to 6)	1 1/2 in. (DN40)
H711**	25 (1)	100 to 1800 (4 to 70)	1 1/2 in. (DN40)
H712*	25 (1)	300 to 3000 (12 to 120)	1 1/2 in. (DN40)
H811**	60 (7.4)	300 to 2000 (12 to 80)	3 in. (DN80)
H812*	60 (7.4)	600 to 3000 (24 to 120)	3 in. (DN80)

Other sizes available

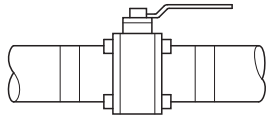
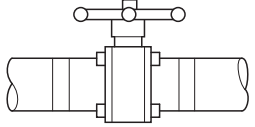
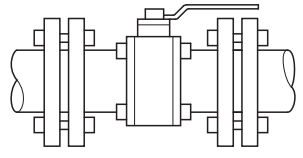
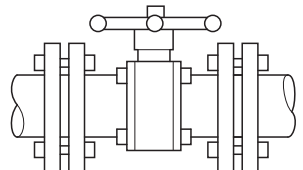
**For liquid flow applications where there is a possibility of process pulsations or intermittent excessive flow velocity, the end-support model should always be selected for pipe sizes over 250 mm (10 in.) (MODEL H712) 600 mm (24 in.) (MODEL H812) internal diameter.

*With end support

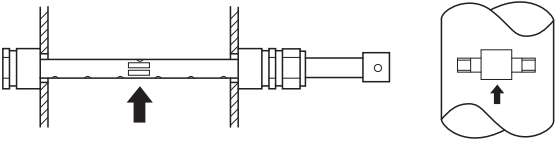

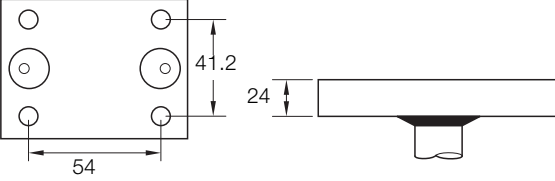
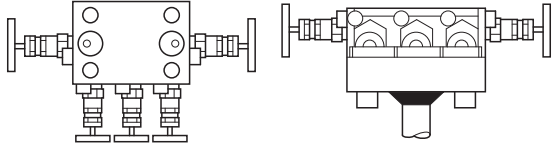
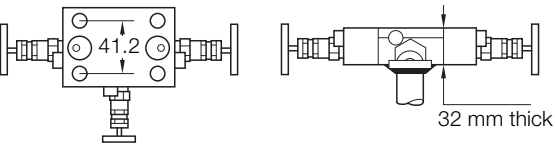
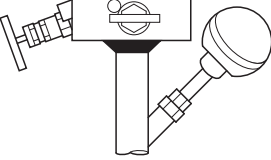
Supplied with isolation valve and pressure chamber, and draw bolt retraction assembly and without flanged pipe fitting or stud bolts and gasket (Available as accessories). Gland packing material is supplied as non-asbestos graphite ribbon as standard. Teflon is available. Please specify at time of order. Geared retraction – Optional. For isolation valve details refer to page 9.

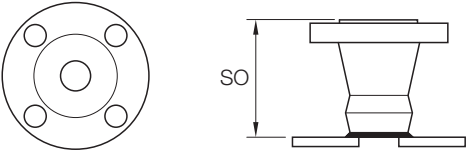
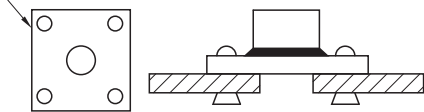
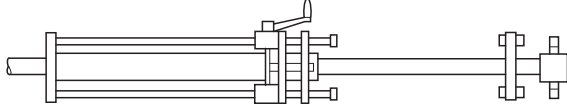
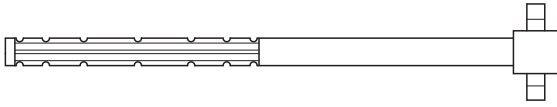
Maximum Pressure / Temperature
With standard ball valve: 100 bar and 200 °C (1450 psi and 392 °F)
With standard gate valve: 100 bar and 400 °C (1450 psi and 752 °F)
(Temperature is at valve)
(Pressure is 35 bar [500 psi] for H811, H812)

Process Isolation Valves

Valve Type	TORBAR Model	Valve Size	Code (* is Material See Below)	Maximum Temperature at Valve
Threaded Ball 	L601	3/4 in.	5B*	200 °C (392 °F)
	H601	1 1/4 in.	7B*	200 °C (392 °F)
	L701			
	L702			
	H701			
H702				
Threaded Gate 	H601	1 1/4 in.	7G*	400 °C (752 °F)
	L701			
	L702			
	H701			
	H702			
Flanged Ball 	H611	40 mm (1 1/2 in.)	8B*	200 °C (392 °F)
	H711	40 mm (1 1/2 in.)	8B*	200 °C (392 °F)
	H712	50 mm (2 in.)	6B*	200 °C (392 °F)
	H811	80 mm (3 in.)	9B*	200 °C (392 °F)
	H812			
Flanged Gate 	H611	40 mm (1 1/2 in.)	8G*	400 °C (752 °F)
	H711	40 mm (1 1/2 in.)	8G*	400 °C (752 °F)
	H712	50 mm (2 in.)	6G*	400 °C (752 °F)
	H811	80 mm (3 in.)	9G*	400 °C (752 °F)
	H812			
Code * Defines Valve Material 316SS – (S) Carbon Steel – (C) Monel – (M) For Other Material Specify (Example: 7GC Is 1 1/4 in. Gate Valve In Carbon Steel). When Valve Is Supplied By Purchaser, Whole Code Is: XXX				

Accessories

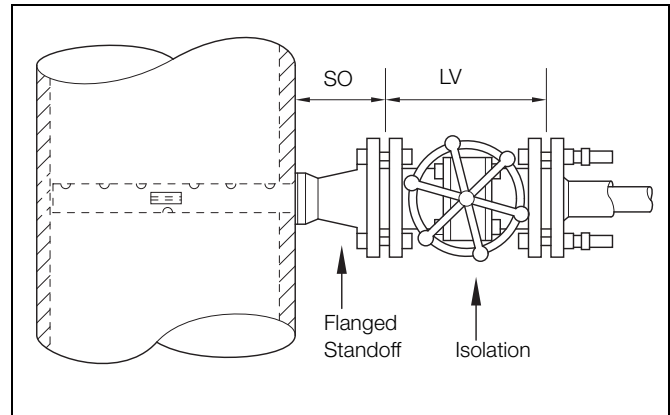
Description	Models	Illustration	Code
Vertical Pipe Installation	301, 311, 401, 402, 411, 412, 511, 512, L601, L701, L702, H601, H701, H702, H611, H711, H712, H811, H812		VS
	121, 122, 123		
Head for Direct Mounting of Valve Manifold or Transmitter	301, 311, 401, 402, 411, 412, 511, 512, L601, L701, L702, H601, H701, H702, H611, H711, H712		0VDM
Direct Mounting Head fitted with 3 or 5 Valve Manifold	301, 311, 401, 402, 411, 412, 511, 512, L601, L701, L702, H601, H701, H702, H611, H711, H712		3VDM (3 Valve) 5VDM (5 Valve)
Head with integral Valve Manifold (3 or 5) for fitting of transmitter by others. Transmitter fitted by ABB refer to TRIBAR	301, 311, 401, 402, 411, 412, 511, 512, L601, L701, L702, H601, H701, H702, H611, H711, H712		DM3V DM5V
PT100 Temperature Element fitted through TORBAR neck. For Hazardous Area Installations specify certification required. Maximum pressure 70 bar.	401, 402, 411, 412, 511, 512, L701, L702, H701, H702, H711, H712		NRTB Without Transmitter NRTT With Transmitter

Description	Models	Illustration	Code
<p>Flanged Pipe Fittings (Stand-Off). Material is specified by 'Pipe Fitting Material' in Model Number. Type, Size & Rating is specified with Model Number</p>	<p>311, 411, 412, 511, 512, H611, H711, H712, H811, H812</p>	 <p>Note: Length SO is given on page 12</p>	<p>FS ES Flanged end support</p>
<p>Stud Bolts, Nuts & Gasket</p>	<p>311, 411, 412, 511, 512, H611, H711, H712, H811, H812</p>	<p>Standard Materials: Stud, Bolts & Nuts: A193-B7/A 194-2H Gasket: Asbestos Free Glass/Aramid Fibre/Nitrile</p>	<p>SBG</p>
<p>Thin duct wall Mounting Plate. Recommended for large ducts with wall thickness of less than 2 mm</p>	<p>301, 401, 402, L601, L701, L702, H601, H701, H601, H702</p>	<p>Optional: 100 x 100 x 2 mm (4 x 4 x 0.08 in.) thick</p> 	<p>DF</p>
<p>Gear Retraction Assembly (Material: 316 Stainless Steel)</p>	<p>H701, H702, H601, H611, H711, H712, H811, H812</p>		<p>GR</p>
<p>Bi-Directional Probe</p>	<p>401, 402, 411, 412, 511, 512, L701, L702, H701, H702, H711, H712, H811</p>		<p>BW</p>

TORBAR Dimensional Information

Flanged Standoff Dimensions (Accessory FS) Overall Length SO mm (in.)				
ANSI Class	Size			
	1 in.	1 1/2 in.	2 in.	3 in.
150	83 (3.3)	95 (3.7)	102 (4)	118 (4.6)
300	89 (3.5)	100 (4)	108 (4.3)	127 (5)
600	95 (3.7)	109 (4.3)	117 (4.6)	137 (5.4)
900	106 (4.2)	122 (4.8)	146 (5.7)	156 (6.1)
1500	106 (4.2)	122 (4.8)	146 (5.7)	171 (6.7)
2500	122 (4.8)	150 (6)	171 (6.7)	222 (8.7)
DIN Class	Size			
	DN25	DN40	DN50	DN80
PN10	67 (2.6)	78 (3)	86 (3.4)	98 (3.9)
PN16	67 (2.6)	78 (3)	86 (3.4)	98 (3.9)
PN25	67 (2.6)	78 (3)	86 (3.4)	98 (3.9)
PN40	67 (2.6)	78 (3)	86 (3.4)	106 (4.2)
PN64	89 (3.5)	101 (4)	108 (4.3)	127 (5)
PN100	89 (3.5)	103 (4)	111 (4.4)	131 (5.2)
PN160	100 (4)	116 (4.6)	140 (5.5)	150 (6)
PN260	100 (4)	116 (4.6)	140 (5.5)	165 (6.5)

Flanged Isolation Valve Overall Length LV mm (in.)				
Size	ANSI Class			
	150	300	600	1500
1 in.	127 (5)	165 (6.5)	216 (8.5)	254 (10)
1 1/2 in.	165 (6.5)	191 (7.5)	241 (9.5)	305 (12)
2 in.	178 (7)	216 (8.5)	292 (11.2)	368 (14.5)
3 in.	203 (8)	283 (11.1)	355 (14)	381 (15)



Dimensions

Note. Actual values of LV, SO must be supplied to ABB if the stand-off or process isolation valves are to be supplied by the customer.

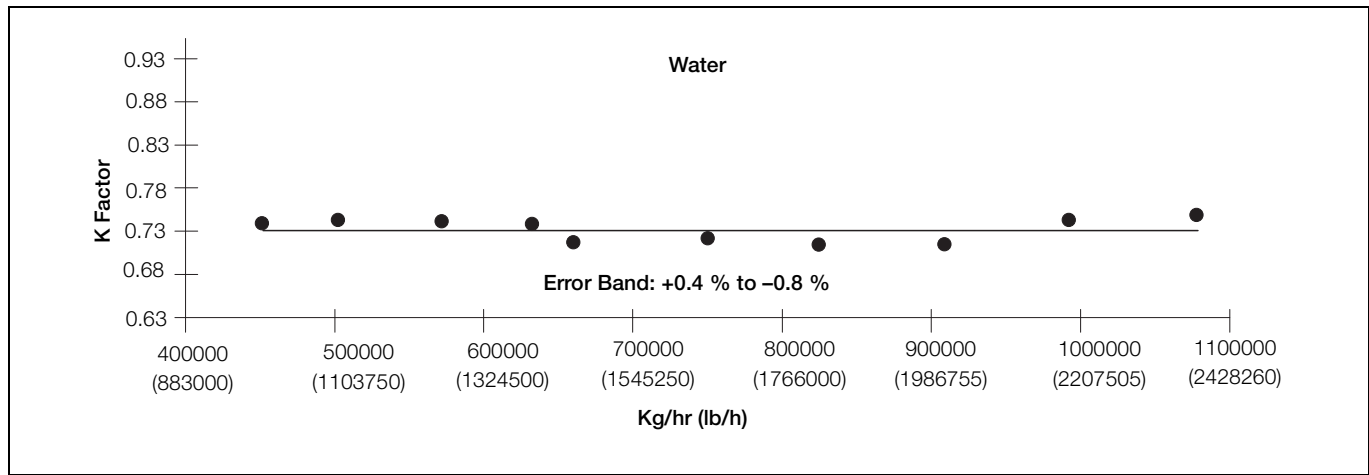
Torbar
Averaging pitot tubes

L601	Inserted Retracted	ID + 236 (9.3) Inserted + ID + Wall + 211 (8.3)	
L701	Inserted Retracted	ID + 346 (13.6) Inserted + ID + Wall + 208 (8.2)	
L702	Inserted Retracted	ID + Wall + 371 (14.6) Inserted + ID + Wall + 233 (9.2)	
H601 H701	Inserted Retracted	ID + 493 (19.4) Inserted + ID + 355 (14)	
H702	Inserted Retracted	ID + Wall + 518 (20.4) Inserted + ID + Wall + 380 (15)	
H611 H711	Inserted Retracted	ID + Wall + 2(SO + LV) + 340 (13.4) Inserted + ID + Wall + SO + LV	
H712	Inserted Retracted	ID + 2 (Wall + SO + LV) + 380 (15) Inserted + ID + 2 x Wall + SO + LV + 40 (1.6)	
H811	Inserted Retracted	ID + Wall + 2 (SO + LV) + 355 (14) Inserted + ID + Wall + SO + LV	
H812	Inserted Retracted	ID + 2 (Wall + SO + LV) + 419 (16.5) Inserted + ID + 2 x Wall + SO + LV + 60 (2.4)	
<p>For geared retraction units (accessory GR) add 100 mm (4 in.) to above dimensions Inserted and Retracted Lengths mm (in.) (Allows 5 % For Tolerancing) Lengths maybe affected if Flanged End Support fitted</p>			

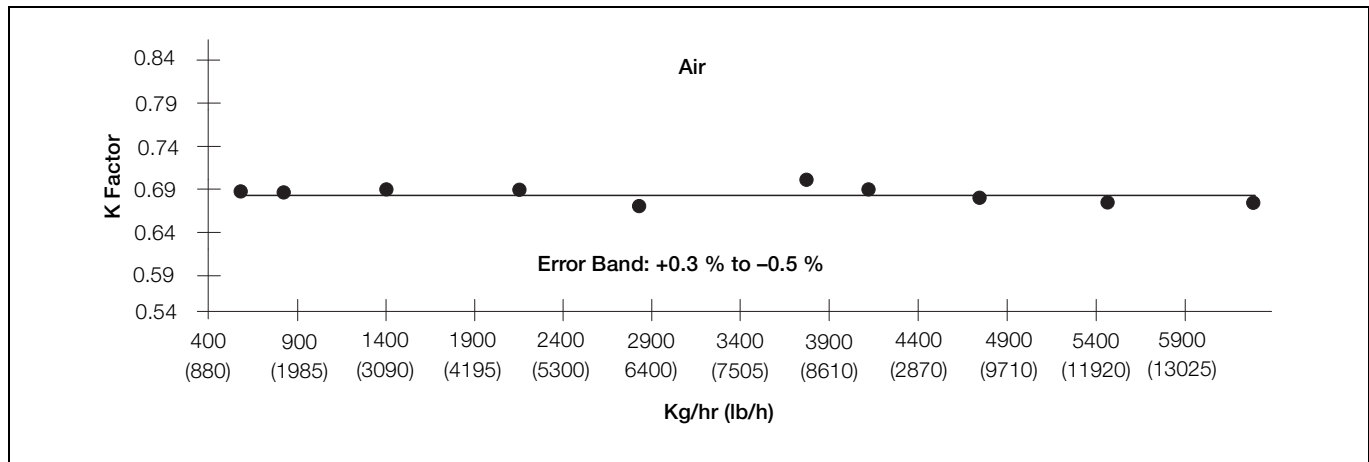
Withdrawable Types (Hot-Taps)

Independent Test Reports

A range of TORBAR models and sizes have been tested at Independent Flow Laboratories to determine the accuracy and repeatability of measurement. Those tests were conducted in both Air and Water.



Model 401 – Size: 16 in. – Serial No. Test 597



Model 401 – Size: 12 in. – Serial No. 20153

Full details of the test results above and of those shown in the table below are available on request.

Test Fluid	Model	Size mm (in.)	Serial Number	Error Band
Water	123	50 (2)	Test 197	+0.2 to -0.43 %
Water	301	100 (4)	Test 297	+1 to -1 %
Air	401	150 (6)	Test 397	+0.1 to -0.5 %
Air	402	450 (18)	20186	+0.6 to -0.5 %
Water	411	600 (24)	Test 697	+0.3 to -0.4 %

Differential Pressure Calculations & Resonance Frequency Check

TORBAR Coefficient K			
	Model Number		
Pipe Size (Internal diameter) mm (in.)	301 601 311 611	401 402 411 412 701 702 711 712	511 512 811 812
50 (2)	0.6483		
75 (3)	0.7027		
100 (4)	0.7497	0.6174	
150 (6)	0.7671	0.6505	
200 (8)		0.6647	
250 (10)		0.6794	0.6876
300 (12)		0.6941	0.7024
350 (14)		0.7160	0.7303
400 (16)		0.7380	0.7564
450 (18)		0.7402	0.7699
600 (24)		0.7468	0.7815
900 (36)		0.7473	0.7847
1200 (48)		0.7475	0.7849
1500 (60)		0.7476	0.7850
1800 (72)	and above	0.7476	0.7850
For sizes not shown above, determine K by extrapolation. If using classical flow equations from ISO5167, multiply K by 0.9091. Copies of derivation of equations available on request.			
For Models 121, 122, 123 (all sizes) K = 1			

TORBAR Coefficients

Flow to DP

Liquids (Volumetric)

$$DP = \left[\frac{Q_A \times \sqrt{D}}{K \times A \times 4.6285} \right]^2 \text{ mbar}$$

Gases (Volumetric)

$$DP = \frac{S \times P_f}{(T_f + 273) \times Z} \times \left(\frac{Q_D \times 4.0323}{K \times A} \right)^2$$

$$DP = \left[\frac{S \times (T_f + 273)}{P_f} \right] \left[\frac{Q_B}{K \times A \times 66.839} \right]^2 \times Z \text{ mbar}$$

Liquids / Gases / Steam (Mass)

$$DP = \left[\frac{Q_C}{K \times A \times \sqrt{D} \times 4.6285} \right]^2 \text{ mbar}$$

DP to Flow

Liquids (Volumetric)

$$\text{Flow}(Q) = \sqrt{DP} \times \left[\frac{K \times A \times 4.6285}{\sqrt{D}} \right] \text{ m}^3/\text{h}$$

Gases (Volumetric) – Actual Conditions

$$\text{Flow}(Q) = \sqrt{DP} \times \left[\frac{K \times A \times \sqrt{(T_f + 273)}}{\sqrt{S} \times 4.0323 \times \sqrt{P_f}} \right] \times \sqrt{Z} \text{ Am}^3/\text{h}$$

Gases (Volumetric) – Normal Conditions

$$\text{Flow}(Q) = \sqrt{DP} \times \left[\frac{K \times A \times 66.839 \times \sqrt{P_f}}{\sqrt{S} \times \sqrt{(T_f + 273)} \times \sqrt{Z}} \right] \text{ Nm}^3/\text{h}$$

Liquids / Gases / Steam (Mass)

$$\text{Flow}(Q) = \sqrt{DP} \times (K \times A \times \sqrt{D} \times 4.6285) \text{ kg/h}$$

Symbols & Units

Q_A = Flow (m^3/h)

Q_B = Flow (Nm^3/h) at 0 °C, 1 atm (1.01325 bar)

Q_C = Flow (kg/h)

Q_D = Flow (Am^3/h)

S = Specific gravity (Air = 1)

D = Density at actual conditions (kg/m^3)

Base Density of water at 4 °C = 999.972 kg/m^3

Density of water at 15.555 °C = 999.012 kg/m^3

Base Density of Air at 0 °C

1 atm (1.01325 bar) = 1.293 kg/m^3

A = Pipe internal cross-section area (cm^2)

T_f = Actual temperature (°C)

P_f = Actual pressure (bar Absolute)

K = TORBAR coefficient (see table)

Z = Compressibility factor (usually = 1)

DP = Differential Pressure (mbar)

Normal Conditions 0 °C, 1 Atmosphere (1.01325 bar)

Statement of Accuracy

The calculated differential pressure will lie within an uncertainty band of $\pm 1\%$ with 95 % confidence if the TORBAR is installed strictly in accordance with the published Installation Instructions. For applications which do not conform to those instructions, it is recommended that an on site calibration is performed in order to achieve the optimum accuracy.

Resonance Frequency Check

This check is not necessary for liquid flows because the maximum allowable DP is reached before resonance occurs (see table opposite), or for Models 121, 122, and 123. For Gas and Vapour flows a Resonance Frequency Check MUST be made. Equations have been derived for the various TORBAR models to determine low and high critical velocities (VL and VH) which define the narrow resonance band of velocities which should be outside the continuous operating flow range of the TORBAR.

The following table lists the equations to calculate the values of VL and VH. If the calculation shows VL to VH to be within the continuous operating flow range, then an alternative, suitable model of TORBAR should be selected to give acceptable values of VL and VH.

Always check that the maximum flow DP is less than the 'Maximum Allowable DP' as shown in the table on page 17.

TORBAR Model	Critical Velocities		Unsupported Length L (m)
	VL (m/s)	VH (m/s)	
301	$0.472 \div L^2$	$0.728 \div L^2$	ID + Wall + 0.05
311	$0.472 \div L^2$	$0.728 \div L^2$	ID + Wall + SO
L601	$0.472 \div L^2$	$0.728 \div L^2$	ID + Wall + 0.02
401	$1.843 \div L^2$	$2.840 \div L^2$	ID + Wall + 0.08 (3)
402	$8.08 \div L^2$	$12.44 \div L^2$	ID + 2 x Wall + 0.115
411	$1.843 \div L^2$	$2.840 \div L^2$	ID + Wall + SO
412	$8.08 \div L^2$	$12.44 \div L^2$	ID + 2 x Wall + SO + 0.05
L701	$1.843 \div L^2$	$2.840 \div L^2$	ID + Wall + 0.05
L702	$8.08 \div L^2$	$12.44 \div L^2$	ID + 2 x Wall + 0.10
H601	$0.472 \div L^2$	$0.728 \div L^2$	ID + Wall + 0.05
H701	$1.843 \div L^2$	$2.840 \div L^2$	ID + Wall + 0.05
H702	$8.08 \div L^2$	$12.44 \div L^2$	ID + 2 x Wall + 0.10
H611	$0.472 \div L^2$	$0.728 \div L^2$	ID + Wall + SO + LV + 0.05
H711	$1.843 \div L^2$	$2.840 \div L^2$	ID + Wall + SO + LV + 0.05
H712	$8.08 \div L^2$	$12.44 \div L^2$	ID + 2 x Wall + SO + LV + 0.10
511	$10.88 \div L^2$	$16.766 \div L^2$	ID + Wall + SO
512	$47.65 \div L^2$	$73.43 \div L^2$	ID + 2 x Wall + SO + 0.08
H811	$10.88 \div L^2$	$16.766 \div L^2$	ID + Wall + SO + LV + 0.05
H812	$47.65 \div L^2$	$73.43 \div L^2$	ID + 2 x Wall + SO + LV + 0.13
L = Unsupported Length (Metres) ID = Pipe Internal Diameter (Metres) Wall = Pipe Wall Thickness (Metres) SO = Overall Length of Flanged Pipe Fitting (m) – see page 9 LV = Overall Length of Isolation Valve (m) – see page 9 The above equations are derived from TORBAR resonance frequency data and calculations. Full details are available on request.			

Critical Velocity Calculation

Maximum Allowable DP

Depending on the model and size of TORBAR there is a maximum figure of Differential Pressure above which the TORBAR should NOT be used due to the imposition of excessive mechanical stresses. Check the table below to ensure that the application is suitable. If the calculated DP exceeds the maximum shown below, then select an other appropriate model to suit the application. For Bi-Directional configurations (accessory code BW), use 50 % of the figures in this table.

For liquid flow applications where there is a possibility of process pulsations or intermittent excessive flow velocity, then the end-support models should always be selected for pipe sizes over 250 mm (10 in.) diameter (400 and 700 series) and 600 mm (24 in.) (500 and 800 series).

Pipe Size (Internal Dia.)		TORBAR Base Model Number *				
		301 311 601 611	401 411 701 711	402 412 702 712	511 811	512 812
in.	mm	Maximum allowable DP in mbar (in.wg)				
2	50	6250 (2509)				
3	75	2790 (1120)				
4	100	1565 (628)	5100 (2047)			
6	150	695 (279)	2285 (917)			
8	200		1285 (516)			
10	250		820 (329)	3250 (1305)	3400 (365)	
12	300		570 (229)	2250 (903)	2350 (943)	
14	350		415 (167)	1680 (674)	1725 (693)	
16	400		320 (128)	1285 (516)	1335 (536)	
18	450		250 (100)	1015 (407)	1055 (424)	4225 (1696)
24	600		140 (56)	570 (229)	590 (237)	2375 (953)
36	900		50 (20)	250 (100)	265 (106)	1055 (424)
48	1200		30 (12)	140 (56)	145 (58)	590 (237)
60	1500		20 (8)	90 (36)	90 (36)	380 (153)
72	1800		10 (4)	60 (24)	65 (26)	265 (106)
Above 1800 mm (72 in.) – consult factory						
For Sizes Not Shown Above Determine Maximum Allowable DP By Extrapolation						
* For models 121, 122, 123 (all sizes) Maximum DP value is 2500 mbar. (84 in.wg)						
The above figures are theoretically derived and include a x10 safety factor over and above basic standards and specification. Full theoretical data is available on request.						

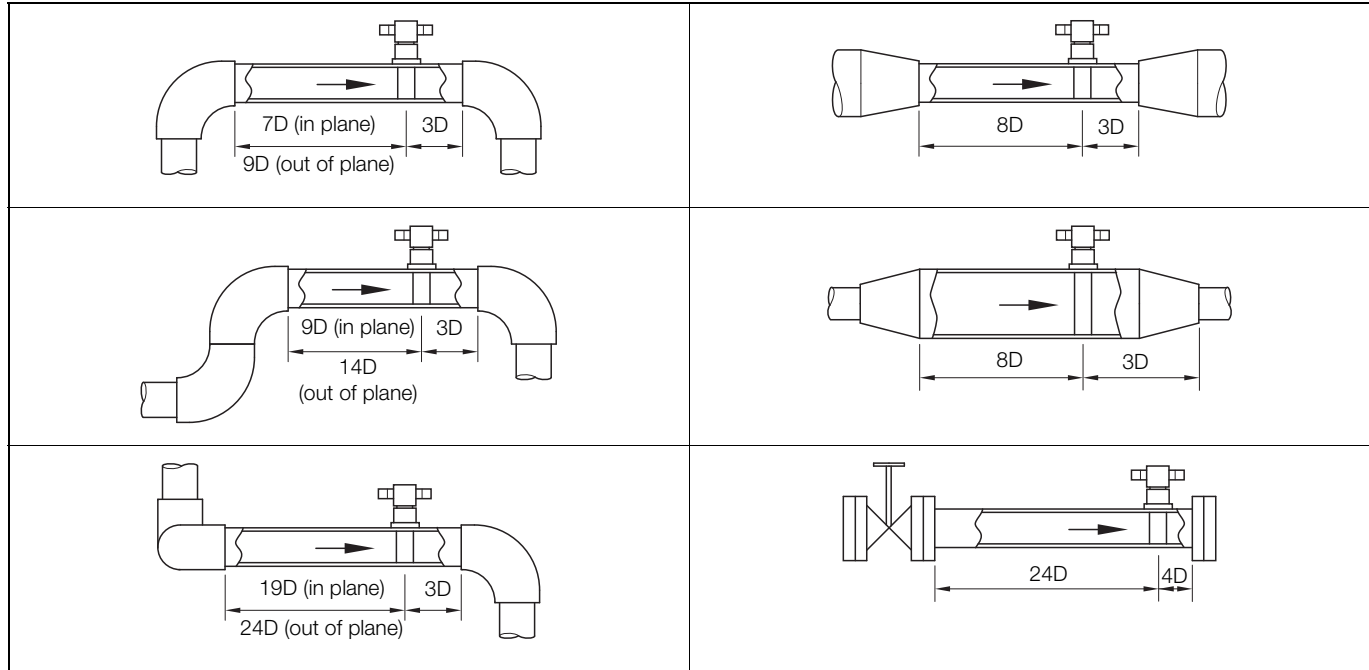
Installation & Location

Recommended Upstream & Downstream Distances

Correct location of the TORBAR in the piping system is important in order to optimize performance. Flow that is disturbed by upstream configurations such as elbows, T's and valves may have an adverse effect on accuracy unless the TORBAR is located at recommended positions shown in the table opposite. The diagrams illustrate the distances in multiples of pipe bore 'D' between the TORBAR and the upstream and downstream disturbances.

If the TORBAR is fitted within distances less than those shown, then absolute accuracy may be downgraded BUT repeatability of measurement will still be excellent due to inherent averaging characteristics.

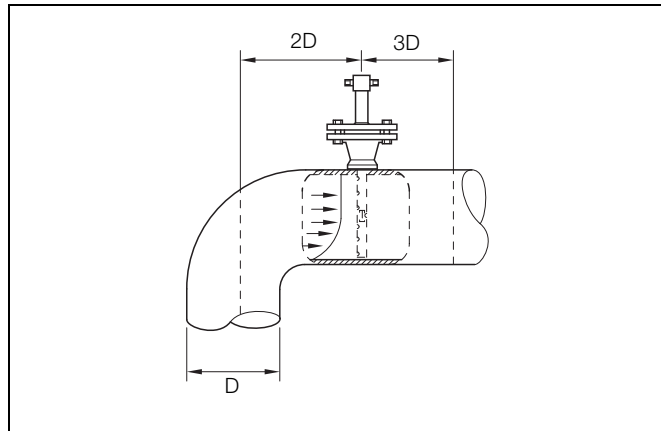
Where it is not possible to provide the specified distances and maximum accuracy is required, the use of a flow straightening spool piece allows for shorter distances.



Installation Pipe Lengths

Elbow Installation

The TORBAR can be installed 2 diameters downstream of a 90° elbow at the exit of the elbow to give an accuracy of ± 3 % to ± 5 %.



Elbow Installation

Orientation in Pipe

The TORBAR must be installed at right angles to the pipe run and across a pipe diameter within the tolerances shown in the diagrams opposite.

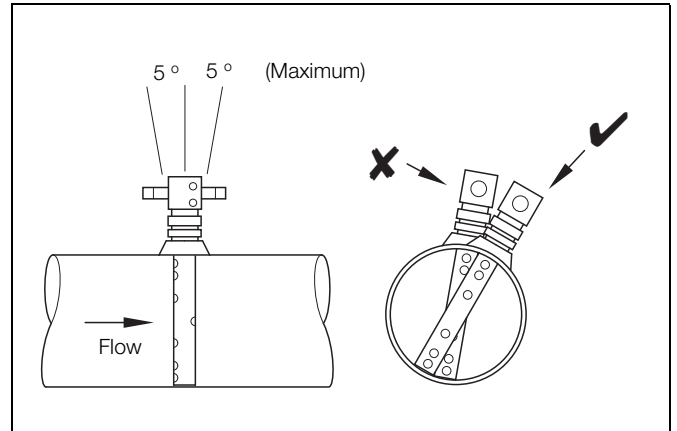
To avoid 'noisy' signal outputs, do not locate the TORBAR in a pulsating flow. A vibrating pipe can also distort the output signal and affect the structural limits of the TORBAR. This limitation particularly applies to the integrally mounted transmitter option DM3V and to the TRIBAR configuration.

For vertical pipe applications, the 'head' of the TORBAR is repositioned to ensure that DP connections are at the same vertical level. This is option VS. It is necessary to specify this option when ordering the TORBAR.

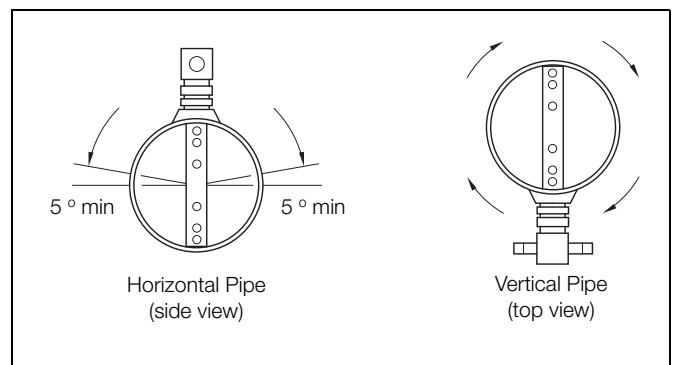
It is essential that in all steam installations the entire TORBAR head and fitting assembly are well lagged to prevent the formation of condensate in the TORBAR head. The TORBAR will not function correctly with condensate in the head. Filling tees or condensate pots should be fitted as appropriate.

Before installation or removal of a TORBAR it is imperative that careful reference is made to the appropriate installation instructions that are supplied with each TORBAR shipment. The installation instructions are also available separately on request.

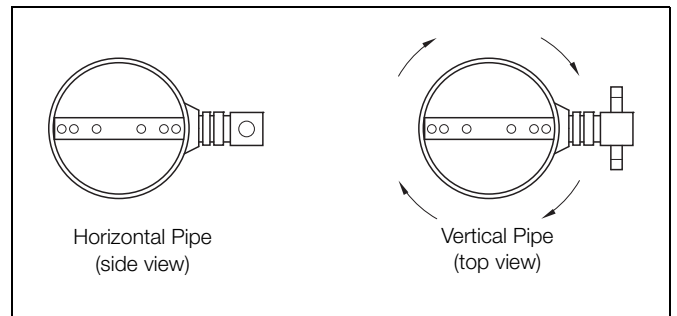
Warning. Refer to instruction manual before installing any TORBAR flowmeter.



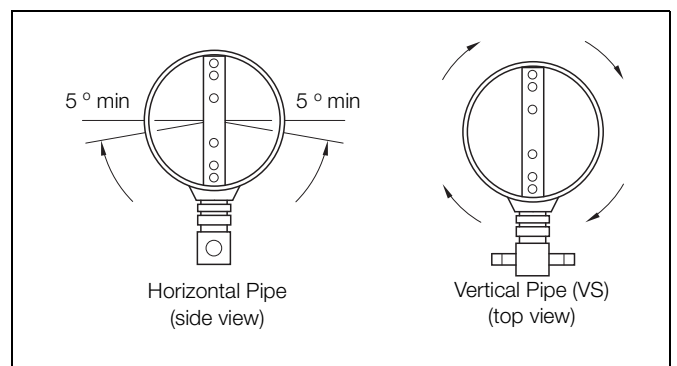
General Orientation



Gases



Steam



Liquids

TRIBAR – with Integrated DP Transmitter

Description

The TRIBAR is an accurate insertion flowmeter comprising an integral valve manifold and an ABB differential pressure transmitter connected to a TORBAR averaging insertion element.

The TRIBAR is suitable for the flow measurement of most liquids and gases at process temperatures of less than 160 °C (320 °F). It is not recommended for steam flow due to the temperature specification of the transmitter. This restriction of use applies to all flowmeters of this type.

For steam flow and other applications which fall outside of the TRIBAR specifications, the transmitter and manifold should be mounted remotely from the TORBAR. Please contact ABB or agent for details.

The TRIBAR concept provides several economic and operational advantages.

- Simple one or two hole installation
- Compact construction
- Low pressure loss/low operating costs
- Competitive pricing
- Zero transmission lags

The TRIBAR is available without the transmitter which can be fitted by the customer. For this optional arrangement specify a standard TORBAR with DM3V (integral manifold) option (see page 10).

Temperature Measurement

The TRIBAR can be supplied with an RTD element with or without a Transmitter. Refer to page 10, code NRTB or NRTT.

Installation & Location

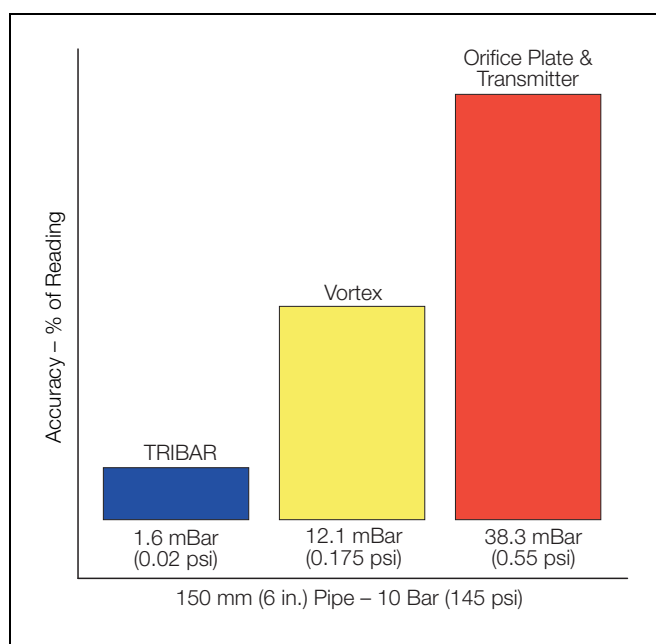
For basic information about the installation and location of the TRIBAR refer to pages 18 to 19.

Specifications & Options

Flowmeter Type	Insertion
Reference Accuracy	± 1.25 %
Repeatability of Measurement	0.1 %
Flow Turndown	10:1
Pipe Sizes	50 to 5000 mm (2 to 196 in.)
Integral Manifold	3-Valve Stainless Steel
Process Mounting	Compression or Flanged
Installation Option	By Hot-Tapping Under Pressure
Wetted Parts	316 Stainless Steel
Maximum Pressure	300 Bar (depends on process connection)
Maximum Temperature	160 °C (320 °F) At Process

DP Transmitter

Supply	11 V to 45 V DC (AC Optional)
Output	4 to 20 mA with Hart 5.1 superimposed (Optional Profibus PA)
Minimum DP Range	0 to 1 mBar to 0 to 20 mBar
Certification	Intrinsically Safe Eexia IIC T4/T5/T6
Electronics Housing	Coated Die-Cast Aluminium (Option Stainless Steel)
Ingress Protection	IP65 (Option IP68)
Cable Entry	M20 x 1.5 Cable Gland
Calibration Certificate	Available As Option
NACE Certificate	Available As Option



Pressure Loss

MASS TRIBAR – Compensated Mass Flowmeter

Description

The MASS TRIBAR is an insertion flowmeter comprising an integral valve manifold, a PT100 temperature element and an ABB Smart Multivariable Transmitter attached to a TORBAR averaging flow element.

The MASS TRIBAR measures pressure, temperature and differential pressure directly from the TORBAR and computes the compensated mass flow within the MV transmitter by automatically compensating for fluctuations in temperature and pressure.

The MASS TRIBAR is ideally suited for the flow measurement of liquids and gases and the totally integrated concept provides several direct advantages.

- Averaged Flow Profile Measurement
- Simple One or Two Hole Installation
- Compact Integral Construction
- RTD Easily Removable for Maintenance
- Zero Transmission Lags
- Low Pressure Loss/Low Operating Costs
- Single Product Sourcing



Application Limitation

For steam flow and other applications which fall outside of the MASS TRIBAR specifications, the multivariable transmitter and manifold should be mounted remotely. Please contact ABB or Agent for details of that arrangement.

Installation & Location

For the basic information about the installation and location of the MASS TRIBAR refer to page 17. Refer to the MV Transmitter data sheet for the transmitter calibration and set-up information and procedures.

Specification

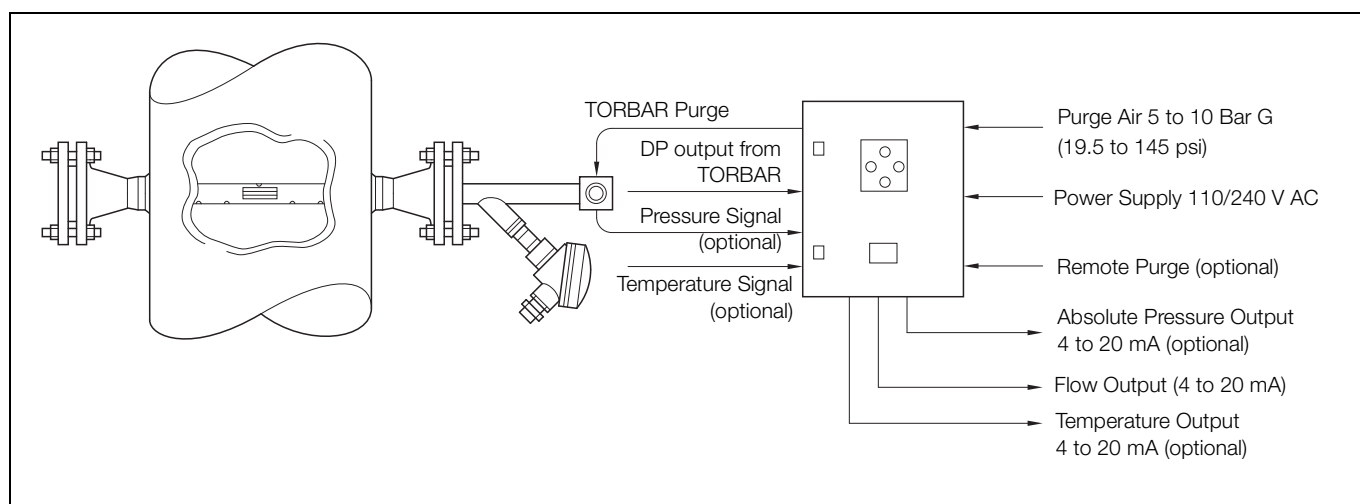
Accuracy	± 1 % Flow +0.1 % of calibrated span
Repeatability Of Measurement	0.2 %
Flowrange Turndown	10 to 1
Temperature Element	RTD 4-Wire
Maximum Pressure	100 Bar (1450 psi)
Maximum Temperature at Manifold/Transmitter Face	80 °C (176 °F)
Minimum Temperature at Manifold/Transmitter Face	-50 °C (-58 °F)
Ambient Temperature Range	-40 °C to 85 °C (-40 to 185 °F)
System	2-Wire (11 V to 45 V DC) external power supply required
Output	2-Wire 4 to 20 mA linear to mass flow
Digital HART protocol available to host which conforms to the HART protocol	
Pressure, temperature and DP variables are available through HART	
Process Indicator	Integral, 2-line, 6-character
Protection:	IP67. EEXia II CT4/T5/T6
Wetted Parts	316 Stainless steel
Pipe Sizes	100 mm to 5000 mm (4 to 196 in.)
Stability	± 0.1 % URL for 12 months

SG2000 – Stack Gas Flow Metering System

Introduction

The SG2000 series is a flow measurement system with integral purge to be used with the TORBAR for the measurement of gas flow rates in chimneys and stacks where the dust concentration is higher than 20 mg/m³ or where any moisture content may be a problem. The purge duration and frequency is programmable to keep the TORBAR sensing holes clean of contaminants.

The SG2000 is available with or without a DP transmitter and can be supplied with temperature and pressure compensation of the flow reading and separate stack pressure and temperature outputs when required. Other options and accessories are available.



Overview

Base Model	Options	Description	Purge	Output Signal 4 to 20 mA			
				Volumetric Flow	Mass Flow	Temp	Pabs
SG2000A		TORBAR + Purge without DP Transmitter	Standard	x	x	x	x
	-P	SG2000A + P _{abs} Transmitter		x	x	x	✓
	-T	SG2000A + Temperature Transmitter		x	x	✓	x
SG2000V		TORBAR + Purge + DP Transmitter (volumetric)	Standard	✓	x	x	x
	-P	SG2000V + P _{abs} Transmitter		✓	x	x	✓
	-T	SG2000V + Temperature Transmitter		✓	x	✓	x
SG2000M		TORBAR + Purge + MV Transmitter (mass)	Standard	x	✓	x	x
	-P	SG2000M + P _{abs} Transmitter		x	✓	x	✓
	-T	SG2000M + Temperature Transmitter		x	✓	✓	x
	-H	SG2000M + HART Splitter		x	✓	✓	✓

SG2000 Model Selection

Specifications

Performance Specifications

- Square root extraction of flow DP.
- The purge sequence is programmed by a programmable logic controller (PLC) and can be adjusted to purge once every one minute to once every 24 hours. The length of the purge time can be adjusted from one minute to 100 minutes.
- Accuracy (including TORBAR): $\pm 3\%$ of reading.
Repeatability: 0.5 %.
- Long term drift: $<0.5\%$ per year.
- Ambient temperature range: 0 to 40 °C (32 to 104 °F) (thermostatically controlled heater is available as an option).
- LCD display: Two line showing flow/DP units and alarm.
- Averaging: 0 to 60 seconds adjustable.
- Optional alarm outputs: Two volt-free contacts selectable NC/No. Rating: 1 A @ 110 V DC.
- Optional totalizer: One alarm relay selectable as totaliser. Max. pulse rate 100 pulses/min.

Physical Specifications

- Enclosure; Epoxy painted steel. IP66 (NEMA 4X) rated. Not suitable for use in hazardous area.
- Weight: Approx. 25 kg (11.34 lb).
- Process connections: 1/4 in. BSP Stainless steel.
- Supply air connection: 1/4 in. BSP Stainless steel.
- Electrical connection: by 20 mm (0.79 in.) knockouts. Gland by customer.
- Optional thermostatic internal heater available. Consult factory.

System Requirements

- Supply voltage: 100 to 240 V AC (50/60 Hz).
- Current consumption: <1 Amp.
- Purge gas supply: Clean and dry air or inert gas at 5 to 10 Bar g (72.5 to 145 psig) pressure.
- Gas consumption during purge is approximately 260 litres/min (57 gal/min).

Applicable Standards

- Emissions monitoring: BS EN 14181, ISO 10780:1999, BS ISO 14164:1994.
- CE Marking: EN61000-6-2:2001, EN61000-6-4:2001, EN61010-1:2001 Certified: 2006.

Additional information – Ordering Guide

Main Code

Inline Models – 121 and 122	XXX-	XX-	XX-	XXX-	XX-	X-	XXX-	XXX-	XX-
Model									
Inline with Weld-prep ends	121								
Inline with Threaded ends	122								
Nominal Pipe Size									
15 mm (1/2 in.) Schedule 80		15							
20 mm (3/4 in.) Schedule 80		20							
25 mm (1 in.) Schedule 80		25							
40 mm (1 1/2 in.) Schedule 80		40							
50 mm (2 in.) Schedule 80		50							
Other		99							
Probe Material									
Standard 316 SS			SS						
321L SS			2S						
304L SS			4S						
Monel 400			ML						
Hastelloy C276			HC						
UNS31254 (6MO)			6M						
Duplex SS (22Cr)			DX						
Super Duplex			SD						
Other			99						
Process Isolation Valve									
No Valve				000					
Pipe Fitting Material									
316 SS				SS					
321L SS				2S					
304L SS				4S					
Monel 400				ML					
Hastelloy C276				HC					
UNS31254 (6MO)				6M					
Duplex SS (22Cr)				DX					
Super Duplex				SD					
Other				99					
DP Connection Material									
With DM-series head or with no valves						0			
Brass						B			
Carbon Steel						C			
316 SS						S			
Monel 400						M			
Hastelloy C276						H			
UNS31254 (6MO)						6			
Other						9			

Optional Code

XXXX-	XXXX-	XX-	XX-	XX-	XXX
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Refer to page 26.

Continued on next page

Main Code

Optional Code

Inline Models – 121 and 122	XXX-	XX-	XX-	XXX-	XX-	X-	XXX-	XXX-	XX-
DP Connection Type & Size									
With DM-series head ¹							00		
¼ in. NPT M, without valves ¹							03M		
¼ in. NPT F, without valves ¹							03F		
¼ in. BSP M, without valves ¹							04M		
¼ in. BSP F, without valves ¹							04F		
½ in. NPT F Elbow mount, without valves ¹							05		
½ in. socket weld male, without valves ¹							06M		
½ in. socket weld female, without valves ¹							06F		
½ in. NPT M without valves ¹							07M		
½ in. NPT F without valves ¹							07F		
½ in. BSPT M, without valves ¹							08M		
½ in. BSPT F, without valves ¹							08F		
½ in. flanged, without valves (specify pressure class) ¹							09		
¼ in. NPT F Ball Valves ²							B3		
¼ in. BSP T Ball Valves ²							B4		
½ in. NPT F Ball Valves ³							B7		
¼ in. NPT F Needle Valves ⁴							V3		
¼ in. BSPT F Needle Valves ³							V4		
½ in. NPTF Needle Valves (on 90° elbow) ³							V5		
½ in. Socket Weld (male) Needle Valves ⁵							V6		
½ in. NPT F Needle Valves ⁶							V7		
½ in. BSPT F Needle Valves ³							V8		
½ in. Flanged 150lb Needle Valves ³							V9		
½ in. Flanged 300lb Needle Valves ³							VA		
½ in. Socket Weld (male) Gate Valves ⁷							G6		
½ in. NPT F Gate Valves ⁷							G7		
½ in. BSPT F Gate Valves ⁷							G8		
½ in. Flanged 150lb Gate Valves ³							G9		
½ in. Flanged 300lb Gate Valves ³							GA		
½ in. Socket Weld (male) Globe Valves ⁸							L6		
½ in. NPT F Globe Valves ⁸							L7		
½ in. NPT F Double Block & Bleed Valves ³							VD		
Flange Size and Rating									
No Flange								000	
Pipeline Orientation									
Horizontal Pipe									HS
Vertical Pipe									VS

XXXX-	XXXX-	XX-	XX-	XX-	XXX
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Refer to page 26.

- ¹ Only with DP Connection material = 0
- ² Only with DP Connection material = B, S
- ³ Only with DP Connection material = S
- ⁴ Only with DP Connection material = S, H
- ⁵ Only with DP Connection material = S, M
- ⁶ Only with DP Connection material = S, M, H
- ⁷ Only with DP Connection material = C, S
- ⁸ Only with DP Connection material = C

Main Code										Optional Code							
Inline Models – 121 and 122	XXX-	XX-	XX-	XXX-	XX-	X-	XXX-	XXX-	XX-	XXXX-	XXXX-	XX-	XX-	XX-	XXX		
Threaded Connection										BSPT							
BSPT Process Connection ¹										NPT							
NPT Process Connection ¹																	
DP Head Configuration										DM3V							
Integral 3-valve manifold ²										DM5V							
Integral 5-valve manifold ²																	
Degreasing												DG					
Degreasing (sensor only) for Oxygen service																	
Dye Penetrant Examination														DP			
Dye Penetrant NDE of welds																	
Hydrostatic Pressure Testing														HP			
Hydrostatic Pressure Test ¹																	
Material Certificates														31B			
EN 10204 3.1 certificates for material														31C			
EN 10204 3.2 certificates for material														PED			
PED (includes options DP, HP & 31B)																	

¹ Not with Type = 121

² Only with DP Connection material = 0 (see page 24) and DP Connection Type & size = 00 (see page 25)

Main Code

Optional Code

Inline Model – 123	XXX-	XX-	XX-	XXX	XX	X	XXX-	XXX-	XX-
Model									
Inline with Flanged ends	123								
Nominal Pipe Size									
15 mm (1/2 in.) Schedule 80		15							
20 mm (3/4 in.) Schedule 80		20							
25 mm (1 in.) Schedule 80		25							
40 mm (1 1/2 in.) Schedule 80		40							
50 mm (2 in.) Schedule 80		50							
Other		99							
Probe Material									
Standard 316 SS			SS						
321L SS			2S						
304L SS			4S						
Monel 400			ML						
Hastelloy C276			HC						
UNS31254 (6MO)			6M						
Duplex SS (22Cr)			DX						
Super Duplex			SD						
Other			99						
Process Isolation Valve									
No Valve				000					
Pipe Fitting Material									
316 SS					SS				
321L SS					2S				
304L SS					4S				
Monel 400					ML				
Hastelloy C276					HC				
UNS31254 (6MO)					6M				
Duplex SS (22Cr)					DX				
Super Duplex					SD				
Other					99				
DP Connection Material									
With DM-series head or with no valves						0			
Brass						B			
Carbon Steel						C			
316 SS						S			
Monel 400						M			
Hastelloy C276						H			
UNS31254 (6MO)						6			
Other						9			

XXXX-	XXX-	XX-	XX-	XX-	XXX
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Refer to page 30.

Continued on next page

Main Code

Optional Code

Inline Model – 123	XXX-	XX-	XX-	XXX	XX	X	XXX-	XXX-	XX-
DP Connection Type & Size									
With DM-series head ¹							00		
¼ in. NPT M, without valves ¹							03M		
¼ in. NPT F, without valves ¹							03F		
¼ in. BSP M, without valves ¹							04M		
¼ in. BSP F, without valves ¹							04F		
½ in. NPT F Elbow mount, without valves ¹							05		
½ in. socket weld male, without valves ¹							06M		
½ in. socket weld female, without valves ¹¹							06F		
½ in. NPT M without valves							07M		
½ in. NPT F without valves ¹							07F		
½ in. BSPT M, without valves ¹							08M		
½ in. BSPT F, without valves ¹							08F		
½ in. flanged, without valves (specify pressure class) ¹							09		
¼ in. NPT F Ball Valves ²							B3		
¼ in. BSP T Ball Valves ²							B4		
½ in. NPT F Ball Valves ³							B7		
¼ in. NPT F Needle Valves ⁴							V3		
¼ in. BSPT F Needle Valves ³							V4		
½ in. NPTF Needle Valves (on 90° elbow) ³							V5		
½ in. Socket Weld (male) Needle Valves ⁵							V6		
½ in. NPT F Needle Valves ⁶							V7		
½ in. BSPT F Needle Valves ³							V8		
½ in. Flanged 150lb Needle Valves ³							V9		
½ in. Flanged 300lb Needle Valves ³							VA		
½ in. Socket Weld (male) Gate Valves ⁷							G6		
½ in. NPT F Gate Valves ⁷							G7		
½ in. BSPT F Gate Valves ⁷							G8		
½ in. Flanged 150lb Gate Valves ³							G9		
½ in. Flanged 300lb Gate Valves ³							GA		
½ in. Socket Weld (male) Globe Valves ⁸							L6		
½ in. NPT F Globe Valves ⁸							L7		
½ in. NPT F Double Block & Bleed Valves ³							VD		

XXXX-	XXX-	XX-	XX-	XX-	XXX
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Refer to page 30.

Continued on next page

- ¹ Only with DP Connection material = 0
- ² Only with DP Connection material = B, S
- ³ Only with DP Connection material = S
- ⁴ Only with DP Connection material = S, H
- ⁵ Only with DP Connection material = S, M
- ⁶ Only with DP Connection material = S, M, H
- ⁷ Only with DP Connection material = C, S
- ⁸ Only with DP Connection material = C

Main Code

Optional Code

Inline Model – 123		XXX-	XX-	XX-	XXX	XX	X	XXX-	XXX-	XX-
Flange Size and Rating										
½ in. ANSI 150RF	J1F	DN20 PN10	M1F	1½ in. ANSI 600RTJ	A3R					
½ in. ANSI 300RF	J2F	DN20 PN16	M2F	1½ in. ANSI 900RTJ	A4R					
½ in. ANSI 600RF	J3F	DN20 PN25	M3F	1½ in. ANSI 1500RTJ	A5R					
½ in. ANSI 900RF	J4F	DN20 PN40	M4F	1½ in. ANSI 2500RTJ	A6R					
½ in. ANSI 1500RF	J5F	1 in. ANSI 150RF	G1F	DN40 PN10	D1F					
½ in. ANSI 2500RF	J6F	1 in. ANSI 300RF	G2F	DN40 PN16	D2F					
½ in. ANSI 300RTJ	J2R	1 in. ANSI 600RF	G3F	DN40 PN25	D3F					
½ in. ANSI 600RTJ	J3R	1 in. ANSI 900RF	G4F	DN40 PN40	D4F					
½ in. ANSI 900RTJ	J4R	1 in. ANSI 1500RF	G5F	2 in. ANSI 150RF	B1F					
½ in. ANSI 1500RTJ	J5R	1 in. ANSI 2500RF	G6F	2 in. ANSI 300RF	B2F					
½ in. ANSI 2500RTJ	J6R	1 in. ANSI 300RTJ	G2R	2 in. ANSI 600RF	B3F					
¾ in. ANSI 150RF	L1F	1 in. ANSI 600RTJ	G3R	2 in. ANSI 900RF	B4F					
¾ in. ANSI 300RF	L2F	1 in. ANSI 900RTJ	G4R	2 in. ANSI 1500RF	B5F					
¾ in. ANSI 600RF	L3F	1 in. ANSI 1500RTJ	G5R	2 in. ANSI 2500RF	B6F					
¾ in. ANSI 900RF	L4F	1 in. ANSI 2500RTJ	G6R	2 in. ANSI 300RTJ	B2R					
¾ in. ANSI 1500RF	L5F	DN25 PN10	H1F	2 in. ANSI 600RTJ	B3R					
¾ in. ANSI 2500RF	L6F	DN25 PN16	H2F	2 in. ANSI 900RTJ	B4R					
¾ in. ANSI 300RTJ	L2R	DN25 PN25	H3F	2 in. ANSI 1500RTJ	B5R					
¾ in. ANSI 600RTJ	L3R	DN25 PN40	H4F	2 in. ANSI 2500RTJ	B6R					
¾ in. ANSI 900RTJ	L4R	1½ in. ANSI 150RF	A1F	DN50 PN10	E1F					
¾ in. ANSI 1500RTJ	L5R	1½ in. ANSI 300RF	A2F	DN50 PN16	E2F					
¾ in. ANSI 2500RTJ	L6R	1½ in. ANSI 600RF	A3F	DN50 PN25	E3F					
DN15 PN10	P1F	1½ in. ANSI 900RF	A4F	DN50 PN40	E4F					
DN15 PN16	P2F	1½ in. ANSI 1500RF	A5F	Special flange	Z9Z					
DN15 PN25	P3F	1½ in. ANSI 2500RF	A6F							
DN15 PN40	P4F	1½ in. ANSI 300RTJ	A2R							
Pipeline Orientation										
Horizontal Pipe										HS
Vertical Pipe										VS

XXXX-	XXX-	XX-	XX-	XX-	XXX
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Refer to page 30.

Inline Model – 123	Main Code									Optional Code					
	XXX-	XX-	XX-	XXX	XX	X	XXX-	XXX-	XX-	XXXX-	XXX-	XX-	XX-	XX-	XXX
DP Head Configuration															
Integral 3-valve manifold ¹										DM3V					
Integral 5-valve manifold ¹										DM5V					
Studbolting & Gaskets															
Studbolting (A193/B7-A19) & standard gaskets											SBG				
Studbolting (A193/B7-A19) & spiral-wound SS gaskets											SBGS				
Degreasing															
Degreasing (sensor only) for Oxygen service												DG			
Dye Penetrant Examination															
Dye Penetrant NDE of welds													DP		
Hydrostatic Pressure Testing															
Hydrostatic Pressure Test														HP	
Material Certificates															
EN 10204 3.1 certificates for material															31B
EN 10204 3.2 certificates for material															31C
PED (includes options DP, HP & 31B)															PED

¹ Only with DP Connection material = 0 and DP Connection Type & size = 00

Permanent Models 300, 400 & 500 Series	Main Code							Optional Code	
	XXX-	XXXX-	XX-	XXX-	XX-	X-	XXX-	XXX-	XX-
Model									
Threaded Fitting for pipe sizes DN50 to DN150	301								
Threaded Fitting for pipe sizes DN100 to DN1800	401								
Threaded Fitting with end support for pipe sizes DN100 to DN5000	402								
Flanged Fitting for pipe sizes DN50 to DN150	311								
Flanged Fitting for pipe sizes DN100 to DN1800	411								
Flanged Fitting for pipe sizes DN200 to DN1800	511								
Flanged Fitting with end support for pipe sizes DN100 to DN5000	412								
Flanged Fitting with end support for pipe sizes DN300 to DN5000	512								
Nominal Pipe Size									
Nominally 50 mm inside diameter ¹ (specify actual id which must be in range 44...61 mm)		0050							
Nominally 75 mm inside diameter ¹ (specify actual id which must be in range 62...87 mm)		0075							
Nominally 100 mm inside diameter ² (specify actual id which must be in range 88...111 mm)		0100							
Nominally 125 mm inside diameter ² (specify actual id which must be in range 112...137 mm)		0125							
Nominally 150 mm inside diameter ² (specify actual id which must be in range 138...174 mm)		0150							
Nominally 200 mm inside diameter ² (specify actual id which must be in range 175...224 mm)		0200							
Nominally 250 mm inside diameter ² (specify actual id which must be in range 225...274 mm)		0250							
Nominally 300 mm inside diameter (specify actual id which must be in range 275...324 mm)		0300							
Nominally 350 mm inside diameter (specify actual id which must be in range 325...374 mm)		0350							
Nominally 400 mm inside diameter (specify actual id which must be in range 375...424 mm)		0400							
Nominally 450 mm inside diameter (specify actual id which must be in range 425...474 mm)		0450							
Nominally 500 mm inside diameter (specify actual id which must be in range 475...549 mm)		0500							
Nominally 600 mm inside diameter (specify actual id which must be in range 550...674 mm)		0600							
Nominally 750 mm inside diameter (specify actual id which must be in range 675...824 mm)		0750							
Nominally 900 mm inside diameter (specify actual id which must be in range 825...924 mm)		0900							
Nominally 1000 mm inside diameter (specify actual id which must be in range 925...1024 mm)		1000							
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.		.							
.		.							
Nominally 5000 mm inside diameter ³ (specify actual ID which must be in range 4925...5024 mm)		5000							
Other		9999							

Refer to page 34.

Continued on next page

		Main Code									Optional Code
Permanent Models 300, 400 & 500 Series		XXX-	XXXX-	XX-	XXX-	XX-	X-	XXX-	XXX-	XX-	
Probe Material											
Standard 316 SS				SS							
321L SS				2S							
304L SS				4S							
Monel 400				ML							
Hastelloy C276				HC							
UNS31254 (6MO)				6M							
Duplex SS (22Cr)				DX							
Super Duplex				SD							
Other				99							
Process Isolation Valve											
No Valve					000						
Pipe Fitting Material											
Carbon Steel										CS	
316 SS										SS	
321L SS										2S	
304L SS										4S	
Monel 400										ML	
Hastelloy C276										HC	
UNS31254 (6MO)										6M	
Duplex SS (22Cr)										DX	
Super Duplex										SD	
By Others										XX	
Other										99	
DP Connection Material											
With DM-series head or with no valves											0
Brass											B
Carbon Steel											C
316 SS											S
Monel 400											M
Hastelloy C276											H
UNS31254 (6MO)											6
Other											9
DP Connection Type & Size											
With DM head or with DM3V head ⁴	00	¼ in. NPT F Needle Valves ⁷									V3
¼ in. NPT M, without valves ⁴	03M	¼ in. BSPT F Needle Valves ⁶									V4
¼ in. NPT F, without valves ⁴	03F	½ in. NPTF Needle Valves (on 90° elbow) ⁶									V5
¼ in. BSP M, without valves ⁴	04M	½ in. Socket Weld (male) Needle Valves ⁸									V6
¼ in. BSP F, without valves ⁴	04F	½ in. NPT F Needle Valves ⁹									V7
½ in. NPT F Elbow mount, without valves ⁴	05	½ in. BSPT F Needle Valves ⁶									V8
½ in. socket weld male, without valves ⁴	06M	½ in. Flanged 150lb Needle Valves ⁶									V9
½ in. socket weld female, without valves ⁴	06F	½ in. Flanged 300lb Needle Valves ⁶									VA
½ in. NPT M without valves ⁴	07M	½ in. Socket Weld (male) Gate Valves ¹⁰									G6
½ in. NPT F without valves ⁴	07F	½ in. NPT F Gate Valves ¹⁰									G7
½ in. BSPT M, without valves ⁴	08M	½ in. BSPT F Gate Valves ¹⁰									G8
½ in. BSPT F, without valves ⁴	08F	½ in. Flanged 150lb Gate Valves ⁶									G9
½ in. flanged, without valves		½ in. Flanged 300lb Gate Valves ⁶									GA
(specify pressure class) ⁴	09	½ in. Socket Weld (male) Globe Valves ¹¹									L6
¼ in. NPT F Ball Valves ⁵	B3	½ in. NPT F Globe Valves ¹¹									L7
¼ in. BSP T Ball Valves ⁵	B4	½ in. NPT F Double Block &									VD
½ in. NPT F Ball Valves ⁶	B7	Bleed Valves ⁶									

Refer to page 34.

Continued on next page

Permanent Models 300, 400 & 500 Series	Main Code								Optional Code
	XXX-	XXXX-	XX-	XXX-	XX-	X-	XXX-	XXX-	XX-
Flange Size and Rating									
No Flange ¹²	000	1½ in. ANSI 900RTJ ¹⁴	A4R	DN25 PN160 ¹³					H7F
1 in. ANSI 150RF ¹³	G1F	1½ in. ANSI 1500RTJ ¹⁴	A5R	DN25 PN260 ¹³					H8F
1 in. ANSI 300RF ¹³	G2F	1½ in. ANSI 2500RTJ ¹⁴	A6R	DN40 PN10 ¹⁴					D1F
1 in. ANSI 600RF ¹³	G3F	3 in. ANSI 150RF ¹⁵	C1F	DN40 PN16 ¹⁴					D2F
1 in. ANSI 900RF ¹³	G4F	3 in. ANSI 300RF ¹⁵	C2F	DN40 PN25 ¹⁴					D3F
1 in. ANSI 1500RF ¹³	G5F	3 in. ANSI 600RF ¹⁵	C3F	DN40 PN40 ¹⁴					D4F
1 in. ANSI 2500RF ¹³	G6F	3 in. ANSI 900RF ¹⁵	C4F	DN40 PN64 ¹⁴					D5F
1 in. ANSI 300RTJ ¹³	G2R	3 in. ANSI 1500RF ¹⁵	C5F	DN40 PN100 ¹⁴					D6F
1 in. ANSI 600RTJ ¹³	G3R	3 in. ANSI 2500RF ¹⁵	C6F	DN40 PN160 ¹⁴					D7F
1 in. ANSI 900RTJ ¹³	G4R	3 in. ANSI 300RTJ ¹⁵	C2R	DN40 PN260 ¹⁴					D8F
1 in. ANSI 1500RTJ ¹³	G5R	3 in. ANSI 600RTJ ¹⁵	C3R	DN80 PN10 ¹⁵					F1F
1 in. ANSI 2500RTJ ¹³	G6R	3 in. ANSI 900RTJ ¹⁵	C4R	DN80 PN16 ¹⁵					F2F
1½ in. ANSI 150RF ¹⁴	A1F	3 in. ANSI 1500RTJ ¹⁵	C5R	DN80 PN25 ¹⁵					F3F
1½ in. ANSI 300RF ¹⁴	A2F	3 in. ANSI 2500RTJ ¹⁵	C6R	DN80 PN40 ¹⁵					F4F
1½ in. ANSI 600RF ¹⁴	A3F	DN25 PN10 ¹³	H1F	DN80 PN64 ¹⁵					F5F
1½ in. ANSI 900RF ¹⁴	A4F	DN25 PN16 ¹³	H2F	DN80 PN100 ¹⁵					F6F
1½ in. ANSI 1500RF ¹⁴	A5F	DN25 PN25 ¹³	H3F	DN80 PN160 ¹⁵					F7F
1½ in. ANSI 2500RF ¹⁴	A6F	DN25 PN40 ¹³	H4F	DN80 PN260 ¹⁵					F8F
1½ in. ANSI 300RTJ ¹⁴	A2R	DN25 PN64 ¹³	H5F	Special flange ¹⁶					Z9Z
1½ in. ANSI 600RTJ ¹⁴	A3R	DN25 PN100 ¹³	H6F						
Pipeline Orientation									
Horizontal Pipe									HS
Vertical Pipe									VS

Refer to page 34.

¹ 301, 311 only

² Not 512

³ Type = 402, 412, 512 only

⁴ Only with DP Connection material = 0

⁵ Only with DP Connection material = B, S

⁶ Only with DP Connection material = S

⁷ Only with DP Connection material = S, H

⁸ Only with DP Connection material = S, M

⁹ Only with DP Connection material = S, M, H

¹⁰ Only with DP Connection material = C, S

¹¹ Only with DP Connection material = C

¹² 301, 401,402 only

¹³ 311 only

¹⁴ 411,412 only

¹⁵ 511,512 only

¹⁶ 311, 411,412, 511, 512 only

Optional Code

Permanent Models 300, 400 & 500 Series	XXXX-	XXXX-	XXXX-	XX-	XX-	XX-	XXXX-	XX-	XX-	XX-	XX-	XX-	XXX
Threaded Connection													
BSP Process Connection ⁵	BSPT												
NPT Process Connection ⁵	NPT												
DP Head Configuration													
Direct mounting head ¹		0VDM											
Direct mounting head with fitted 3-valve manifold ¹		3VDM											
Direct mounting head with fitted 5-valve manifold ¹		5VDM											
3-valve assembly on ¼" BSPTM Nipples (316/Plastic) ¹		3PV4											
Integral 3-valve manifold ¹		DM3V											
Integral 5-valve manifold ¹		DM5V											
PT100 sensor													
Integral PT100 Sensor Neck Mounted Aluminium IP65 Head ⁶			NRTB										
Integral PT100 Sensor Neck Mounted Aluminium IP65 Head + Tx ⁶			NRTT										
Temperature Transmitter													
Exd temperature Transmitter (with NRTB, NRTT only) ⁶													HZ
Flanged Standoff													
Flanged Standoff (matches Flange Size & Rating and Pipe Fitting selections made above) ²													FS
2 Flanged Standoff (matches Flange Size & Rating and Pipe Fitting selections made above)+ 1 Flanged End Support (316) ³													FE
1 Flanged End Support in 316 ³													ES
Flanged Standoff supplied by customer ⁴													CS
Frequency Collar													
Frequency Collar (with Flanged Standoff= FS, FE,CS only) ⁴													FC
Studbolting & Gaskets													
Studbolting (A193/B7-A19) & standard gaskets ⁴													SBG
Studbolting (A193/B7-A19) & spiral-wound SS gaskets ⁴													SBGS
Duct Mounting													
Duct Mounting Plate (in same material as selected for Pipe Fitting above) ⁵													DF
Bidirectional													
Bidirectional Sensor ⁶													BW
Degreasing													
Degreasing (sensor only) for Oxygen service													DG
Dye Penetrant Examination													
Dye Penetrant NDE of welds													DP
Hydrostatic Pressure Testing													
Hydrostatic Pressure Test													HP
Material Certificates													
EN 10204 3.1 certificates for material													31B
EN 10204 3.2 certificates for material													31C
PED (incl. DP, 31B & HP)													PED

¹ Only with DP Connection material = 0 and DP Connection Type & size = 00

² 311, 411, 412, 511, 512 only

³ 412, 512 only

⁴ 411, 412, 511, 512 only

⁵ 301, 401, 402 only

⁶ 401, 402, 411, 412, 511, 512 only

Withdrawable Models L600, L700, H600, H700 & H800 series	Main Code										Optional Code	
	XXX-	XXXX-	XX-	XX-	X-	XX-	X-	XX-	XXX-	XX-	XX	
Model												Refer to page 38
Threaded Fitting, Low Pressure Withdrawable Averaging Pitot Tube for pipe sizes DN50 to DN150	L601											
Threaded Fitting, Low Pressure Withdrawable Averaging Pitot Tube for pipe sizes DN100 to DN3000	L701											
Threaded Fitting, Low Pressure Withdrawable Averaging Pitot Tube with end support for pipe sizes 100 to DN3000	L702											
Threaded Fitting, High Pressure Withdrawable Averaging Pitot Tube for pipe sizes DN50 to DN150	H601											
Flanged Fitting, High Pressure Withdrawable Averaging Pitot Tube for pipe sizes DN50 to DN150	H611											
Threaded Fitting, High Pressure Withdrawable Averaging Pitot Tube for pipe sizes DN100 to DN1800	H701											
Threaded Fitting, High Pressure Withdrawable Averaging Pitot Tube with end support for pipe sizes DN100 to DN3000	H702											
Flanged Fitting, High Pressure Withdrawable Averaging Pitot Tube for pipe sizes DN100 to DN1800	H711											
Flanged Fitting, High Pressure Withdrawable Averaging Pitot Tube with end support for pipe sizes DN100 to DN3000	H712											
Flanged Fitting, High Pressure Withdrawable Averaging Pitot Tube for pipe sizes DN100 to DN2000	H811											
Flanged Fitting, High Pressure Withdrawable Averaging Pitot Tube with end support for pipe sizes DN100 to DN3000	H812											
Nominal Pipe Size												
Nominally 50 mm inside diameter ¹ (specify actual id which must be in range 44...61 mm)		0050										
Nominally 75 mm inside diameter ¹ (specify actual id which must be in range 62...87 mm)		0075										
Nominally 100 mm inside diameter (specify actual id which must be in range 88...111 mm)		0100										
Nominally 125 mm inside diameter (specify actual id which must be in range 112...137 mm)		0125										
Nominally 150 mm inside diameter (specify actual id which must be in range 138...174 mm)		0150										
Nominally 200 mm inside diameter (specify actual id which must be in range 175...224 mm)		0200										
Nominally 250 mm inside diameter (specify actual id which must be in range 225...274 mm)		0250										
Nominally 300 mm inside diameter (specify actual id which must be in range 275...324 mm)		0300										
Nominally 350 mm inside diameter (specify actual id which must be in range 325...374 mm)		0350										
Nominally 400 mm inside diameter (specify actual id which must be in range 375...424 mm)		0400										
Nominally 450 mm inside diameter (specify actual id which must be in range 425...474 mm)		0450										
Nominally 500 mm inside diameter (specify actual id which must be in range 475...549 mm)		0500										
Nominally 600 mm inside diameter (specify actual id which must be in range 550...674 mm)		0600										
Nominally 750 mm inside diameter (specify actual id which must be in range 675...824 mm)		0750										

Continued on next page

Withdrawable Models L600, L700, H600, H700 & H800 series	Main Code											Optional Code
	XXX-	XXXX-	XX-	XX-	X-	XX-	X-	XX-	XXX-	XX-	XX	
Nominal Pipe Size (continued)												Refer to page 38
Nominally 900 mm inside diameter (specify actual id which must be in range 825...924 mm)		0900										
Nominally 1000 mm inside diameter (specify actual id which must be in range 925...1024 mm)		1000										
Nominally 1100 mm inside diameter (specify actual id which must be in range 1025...1124 mm)		1100										
.		.										
.		.										
.		.										
Nominally 3000 mm inside diameter ² (specify actual id which must be in range 2925...3024 mm)		3000										
Other		9999										
Probe Material												
Standard 316 SS											SS	
321L SS											2S	
304L SS											4S	
Monel 400											ML	
Hastelloy C276											HC	
UNS31254 (6MO)											6M	
Duplex SS (22Cr)											DX	
Super Duplex											SD	
Other											99	
Process Isolation Valve												
Threaded Ball Valve ¼ in. ³											5B	
Threaded Ball Valve 1¼ in. ¹⁵											7B	
Flanged Ball Valve 1½ in. ¹⁶											8B	
Threaded Gate Valve 1¼ in. ¹⁵											7G	
Flanged Gate Valve 1½ in. ¹⁶											8G	
Flanged Ball Valve 3 in.											9B	
Flanged Gate Valve 3 in.											9G	
Valve supplied by Customer											XX	
Process Isolation Valve Material												
Carbon Steel											C	
316 SS											S	
Monel 400											M	
By Others											X	
Other											9	
Pipe Fitting Material												
Carbon Steel											CS	
316 SS											SS	
321L SS											2S	
304L SS											4S	
Monel 400											ML	
Hastelloy C276											HC	
UNS31254 (6MO)											6M	
Duplex SS (22Cr)											DX	
Super Duplex											SD	
By Others											XX	
Other											99	

Continued on next page

Withdrawable Models L600, L700, H600, H700 & H800 series	Main Code										Optional Code	
	XXX-	XXXX-	XX-	XX-	X-	XX-	X-	XX-	XXX-	XX-	XX	
DP Connection Material												
With DM head or with DM3V head or with no valves												0
Brass												B
Carbon Steel												C
316 SS												S
Monel 400												M
Hastelloy C276												H
UNS31254 (6MO)												6
Other												9
DP Connection Type & Size												
With DM head or with DM3V head ⁴	00	¼ in. NPT F Needle Valves ⁷										V3
¼ in. NPT M, without valves ⁴	03M	¼ in. BSPT F Needle Valves ⁶										V4
¼ in. NPT F, without valves ⁴	03F	½ in. NPTF Needle Valves (on 90° elbow) ⁶										V5
¼ in. BSP M, without valves ⁴	04M	½ in. Socket Weld (male) Needle Valves ⁸										V6
¼ in. BSP F, without valves ⁴	04F	½ in. NPT F Needle Valves ⁹										V7
½ in. NPT F Elbow mount, without valves ⁴	05	½ in. BSPT F Needle Valves ⁶										V8
½ in. socket weld male, without valves ⁴	06M	½ in. Flanged 150lb Needle Valves ⁶										V9
½ in. socket weld female, without valves ⁴	06F	½ in. Flanged 300lb Needle Valves ⁶										VA
½ in. NPT M without valves ⁴	07M	½ in. Socket Weld (male) Gate Valves ¹⁰										G6
½ in. NPT F without valves ⁴	07F	½ in. NPT F Gate Valves ¹⁰										G7
½ in. BSPT M, without valves ⁴	08M	½ in. BSPT F Gate Valves ¹⁰										G8
½ in. BSPT F, without valves ⁴	08F	½ in. Flanged 150lb Gate Valves ⁶										G9
½ in. flanged, without valves (specify pressure class) ⁴	09	½ in. Flanged 300lb Gate Valves ⁶										GA
¼ in. NPT F Ball Valves ⁵	B3	½ in. Socket Weld (male) Globe Valves ¹¹										L6
¼ in. BSP T Ball Valves ⁵	B4	½ in. NPT F Globe Valves ¹¹										L7
½ in. NPT F Ball Valves ⁶	B7	½ in. NPT F Double Block & Bleed Valves ⁶										VD
Flange Size and Rating												
No Flange ¹⁴	000	1½ in. ANSI 1500RTJ ¹²	A5R	DN40 PN64 ¹²								D5F
1½ in. ANSI 150RF ¹²	A1F	1½ in. ANSI 2500RTJ ¹²	A6R	DN40 PN100 ¹²								D6F
1½ in. ANSI 300RF ¹²	A2F	3 in. ANSI 150RF ¹³	C1F	DN40 PN160 ¹²								D7F
1½ in. ANSI 600RF ¹²	A3F	3 in. ANSI 300RF ¹³	C2F	DN40 PN260 ¹²								D8F
1½ in. ANSI 900RF ¹²	A4F	3 in. ANSI 600RF ¹³	C3F	DN80 PN10 ¹³								F1F
1½ in. ANSI 1500RF ¹²	A5F	3 in. ANSI 1500RF ¹³	C5F	DN80 PN16 ¹³								F2F
1½ in. ANSI 2500RF ¹²	A6F	DN40 PN10 ¹²	D1F	DN80 PN25 ¹³								F3F
1½ in. ANSI 300RTJ ¹²	A2R	DN40 PN16 ¹²	D2F	Special flange								Z9Z
1½ in. ANSI 600RTJ ¹²	A3R	DN40 PN25 ¹²	D3F									
1½ in. ANSI 900RTJ ¹²	A4R	DN40 PN40 ¹²	D4F									
Pipeline Orientation												
Horizontal Pipe												HS
Vertical Pipe												VS
Threaded Connection												
BSPT Process Connection ¹⁴												BSPT
NPT Process Connection ¹⁴												NPT

Refer to page 38

¹ L601, H601, H611, only

² Not H701, H711

³ L601 only

⁴ Only with DP Connection material = 0

⁵ Only with DP Connection material = B, S

⁶ Only with DP Connection material = S

⁷ Only with DP Connection material = S, H

⁸ Only with DP Connection material = S, M

⁹ Only with DP Connection material = S, M, H

¹⁰ Only with DP Connection material = C, S

¹¹ Only with DP Connection material = C

¹² H611, H711, H712 only

¹³ H811, H812 only

¹⁴ L601, H601, L701, L702, H701, H702 only

¹⁵ H601, L701, L702, H701, H702 only

¹⁶ H611, H711, H712 only

Optional Code

Withdrawable Models L600, L700, H600, H700 & H800 Series	XXXX-	XXXX-	XX-	XX-	XX-	XXXX-	XX-	XX-	XX-	XX-	XX-	XXX
DP Head Configuration												
Direct mounting head ¹	0VDM											
Direct mounting head with fitted 3-valve manifold ¹	3VDM											
Direct mounting head with fitted 5-valve manifold ¹	5VDM											
3-valve assembly on ¼ in. BSPTM Nipples (316/Plastic) ¹	3PV4											
Integral 3-valve manifold ¹	DM3V											
Integral 5-valve manifold ¹	DM5V											
PT100 sensor												
Integral PT100 Sensor Neck Mounted Aluminium IP65 Head ⁴		NRTB										
Integral PT100 Sensor Neck Mounted Aluminium IP65 Head + Tx ⁴		NRTT										
Temperature Transmitter												
Exd temperature Transmitter (⁴ with NRTB, NRTT only)												HZ
Flanged Standoff												
Flanged Standoff (matches Flange Size & Rating and Pipe Fitting selections made above) ³												FS
2 Flanged Standoff (matches Flange Size & Rating and Pipe Fitting selections made above) + 1 Flanged End Support (316) ²												FE
1 Flanged End Support in 316 ²												ES
Flanged Standoff supplied by customer ³												CS
Frequency Collar												
Frequency Collar (with Flanged Standoff= FS, FE,CS only)												FC
Studbolting & Gaskets												
Studbolting (A193/B7-A19) & std gaskets ³												SBG
Studbolting (A193/B7-A19) & spiral wound SS gaskets ³												SBGS
Duct Mounting												
Duct Mounting Plate (in same material as selected for Pipe Fitting above)												DF
Bidirectional												
Bidirectional Sensor ⁴												BW
Degreasing												
Degreasing (sensor only) for Oxygen service												DG
Dye Penetrant Examination												
Dye Penetrant NDE of welds												DP
Hydrostatic Pressure Testing												
Hydrostatic Pressure Test												HP
Material Certificates												
EN 10204 3.1 certificates for material												31B
EN 10204 3.2 certificates for material												31C
PED (incl. DP, 31B & HP)												PED

¹ Only with DP Connection material = 0 and DP Connection Type & size = 00

² H712, H812 only

³ H611, H711, H712, H811, H812 only

⁴ L701, L702, H711, H712, H811, H812 only

Torbar
Averaging pitot tubes

Notes

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