

### DESCRIPTION

The Ellipse<sup>®</sup> Annular Flanged Flow Meter is a multi-ported, self-averaging differential pressure flow element for liquid and gas applications. The Ellipse flow meter is designed with a series of ports facing the upstream velocity pressures and flow sensing ports strategically located ahead of the trailing edge flow separation.

### COMPONENTS

All sensors are furnished with 1/2 in. (12 mm) instrument valves, flanged mounting hardware (with the proper ratings), and ID tag as standard equipment. Available options include integral 3-valve or 5-valve transmitter mount manifold and integral RTD temperature sensor.

### FEATURES

- Patented elliptical design
- Single point pipe entry for DP, temperature and static pressure
- No dampening software required
- Low pressure loss (typically 3% of DP in a 12 in. (304 mm) line) due to the patented aerodynamic profile
- NIST traceable calibration, optional independent labs
- Accuracy:  $\pm 0.75\%$  of reading, repeatability:  $\pm 0.1\%$  of reading
- Turndown Ratio: 17:1; no vacuum effects
- No moving part construction provides long, trouble-free service life
- True static pressure measurement rather than a calculated value
- Overcomes loss of accuracy caused by fluid separation at the sensor body

### CONFIGURATION

The flow element has a two-piece construction: an elliptical shape and two 100% independent flow sensing chambers. This construction prevents signal degradation and mixing, and does not require dampening hardware or software. The impact velocity sensing holes (high pressure) are located along the leading edge and the true static sensing holes (low pressure) are on the exterior probe side. This does not generate any vortices or vacuum effects that impinge on the static pressure measurement sensing area and has a drag coefficient of 0.32 or less. Each flow sensor is complete with instrument shutoff valves with provisions to accept a transmitter or direct indicating meter. An identification tag is supplied with specific flow station measurement information, as required.



### MAXIMUM ALLOWABLE DP (INCHES OF WATER COLUMN)

Pipe Size	Single Support Probe Size (in.)			Double Support Probe Size (in.)		
	7/8	1-1/4	2-1/4	7/8	1-1/4	2-1/4
2 in. (50.80 mm)	880	—	—	2380	—	—
2-1/2 in. (63.50 mm)	525	—	—	1558	—	—
3 in. (76.20 mm)	396	—	—	1283	—	—
3-1/2 in. (88.90 mm)	283	—	—	1117	—	—
4 in. (101.60 mm)	197	—	—	980	—	—
5 in. (127.00 mm)	153	—	—	757	—	—
6 in. (152.40 mm)	126	—	—	669	—	—
8 in. (203.20 mm)	114	360	—	512	—	—
10 in. (254.80 mm)	100	240	779	315	960	—
12 in. (304.80 mm)	87	175	660	250	700	—
14 in. (355.60 mm)	53	147	610	195	585	—
16 in. (406.40 mm)	—	113	495	—	450	—
18 in. (457.20 mm)	—	90	410	—	360	—
20 in. (508.00 mm)	—	74	346	—	295	—
24 in. (609.60 mm)	—	68	315	—	270	952
26 in. (660.40 mm)	—	50	218	—	215	878
30 in. (762.00 mm)	—	34	187	—	155	780
32 in. (812.80 mm)	—	—	136	—	—	550
36 in. (914.40 mm)	—	—	105	—	—	410
42 in. (1066.80 mm)	—	—	85	—	—	350

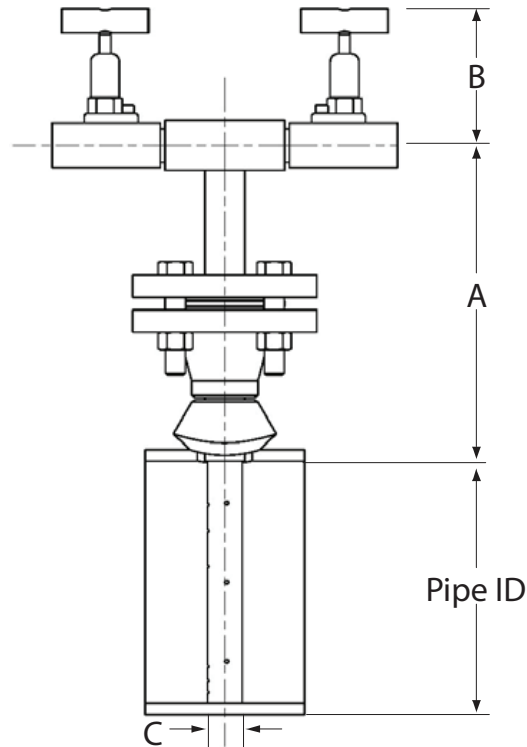
## SPECIFICATIONS

<b>Applications</b>	Air, liquids and gases
<b>Pipe Size</b>	2...72 in. (50...1830 mm)
<b>Pressure</b>	Vary per flange ratings
<b>Temperature</b>	Vary per flange ratings
<b>Accuracy</b>	±0.75% of reading
<b>Repeatability</b>	±0.1%
<b>Turndown Ratio</b>	17:1 with no vacuum effect
<b>Reynolds Number</b>	>75,000: Maintains most accurate flow measurements <75,000: Consult factory for estimated results
<b>Resonance</b>	If greater than 0.8, use double support per ASME PTC 19.3

## STANDARD COMPONENTS

Component	Specifications
Head	T-type
Connection	316 SS 1/4 in. or 1/2 in. FNPT
Fitting	CS 3000 lb. weld
Sensor Instrument Valves	ASTM A105 316/316L SS Ellipse (2 per sensor)
ID Tag	1/2 in., CS 316 SS with wire
Sensor Flange	150 lbs. 316/316L SS
Gasket	CS with SS spiral wound ring
Mounting Flange	CS 150 lbs. ASTM A105 with nuts and bolts

## DIMENSIONS



	Probe Length		Probe Width
	A	B	C
<b>AF0</b>	6.62 in. (168.1 mm)	3.13 in. (79.5 mm)	0.5 in. (12.7 mm)
<b>AF</b>	8.0 in. (203.2 mm)	3.13 in. (79.5 mm)	0.87 in. (22.1 mm)
<b>AF1</b>	8.75 in. (222.2 mm)	3.13 in. (79.5 mm)	1.25 in. (31.8 mm)
<b>*AF2</b>	13.92 in. (353.6 mm)	—	2.25 in. (57.2 mm)

**PART NUMBER CONSTRUCTION**

**Ellipse®** Annular Flanged  
1/2 in. DIAMETER

PAF0									
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<b><u>PIPE SIZE</u></b>								
2 in.	A							
2-1/2 in.	B							
3 in.	C							
3-1/2 in.	D							
4 in.	E							
5 in.	F							
<b><u>SCHEDULE</u></b>								
STD/40/40S	A							
80/80S/XS	B							
160	C							
XXH	D							
5S	E							
10S	F							
<b><u>PIPE ORIENTATION</u></b>								
Horizontal	A							
Vertical	B							
<b><u>PROBE MATERIAL</u></b>								
316/316L SS							1	
Monel®							2	
Inconel®							3	
Hastelloy®							4	
Other							X	
<b><u>INSTRUMENT CONNECTION</u></b>								
1/4 in. NPT								A
<b><u>CONNECTION / FLANGE RATING</u></b>								
3/4 in. RF Flange 150# CS								A
3/4 in. RF Flange 300# CS								B
3/4 in. RF Flange 600# CS								C
3/4 in. RF Flange 900/1500# CS								D
3/4 in. RF Flange 150# SS								E
3/4 in. RF Flange 300# SS								F
3/4 in. RF Flange 600# SS								G
3/4 in. RF Flange 900/1500# SS								H
<b><u>PIPE MOUNTING</u></b>								
A105 CS 3000#								1
316/316L SS 3000#								2
A105 CS 3000# w/Double Support								3
316/316L SS 3000# w/Double Support								4
Not Required								Z
<b><u>INSTRUMENT VALVE</u></b>								
1/4 in. Needle CS								A
1/4 in. Needle SS								B
Not Required								Z

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

Transmitter mount not available for Model AF0. Please see Model AF

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)



Ellipse® Annular Flanged  
1-1/4 in. DIAMETER

PAF1 -

<b>PIPE SIZE</b>									
12 in.	J								
14 in.	K								
16 in.	L								
18 in.	M								
20 in.	N								
24 in.	O								
30 in.	P								
36 in.	Q								
42 in.	R								
48 in.	S								
60 in.	T								
72 in.	U								
<b>SCHEDULE</b>									
STD	A								
20	B								
30	C								
40	D								
60	E								
80	F								
100	G								
120	H								
140	I								
160	J								
XH	K								
XXH	L								
5S	M								
10S	N								
40S	O								
80S	P								
<b>PIPE ORIENTATION</b>									
Horizontal	A								
Vertical	B								
<b>PROBE MATERIAL</b>									
316/316L SS	1								
Monel®	2								
Inconel®	3								
Hastelloy®	4								
Other	X								
<b>INSTRUMENT CONNECTION</b>									
1/2 in. NPT	A								
1/2 in. Socket	B								
TT3 (Integral 3-Valve Trans Mount - Max Temp 225° F)	C								
TT5 (Integral 5-Valve Trans Mount - Max Temp 225° F)	D								
(RTD is not available with Integral 5-Valve Manifold. If RTD is required, select "E" Transmitter Flange Connection and the appropriate manifold valve under the Instrument Valve section below.)									
Transmitter Flange Connection	E								
<b>CONNECTION / FLANGE RATING</b>									
1-1/2 in. RF Flange 150# CS	A								
1-1/2 in. RF Flange 300# CS	B								
1-1/2 in. RF Flange 600# CS	C								
1-1/2 in. RF Flange 900/1500# CS	D								
1-1/2 in. RF Flange 150# SS	E								
1-1/2 in. RF Flange 300# SS	F								
1-1/2 in. RF Flange 600# SS	G								
1-1/2 in. RF Flange 900/1500# SS	H								
<b>PIPE MOUNTING</b>									
A105 CS 3000#	1								
316/316L SS 3000#	2								
A105 CS 3000# w/Double Support	3								
316/316L SS 3000# w/Double Support	4								
Not Required	Z								
<b>INSTRUMENT VALVE</b>									
1/2 in. Needle CS	A								
1/2 in. Needle SS	B								
1/2 in. Gate CS	C								
1/2 in. Gate SS	D								
Not Required	Z								
ONLY AVAILABLE WITH OPTION "E" UNDER INSTRUMENT CONNECTION									
Flg x Flg 3-Valve Manifold CS - Max Temp 225° F	E								
Flg x Flg 3-Valve Manifold SS - Max Temp 225° F	F								
Flg x Flg 5-Valve Manifold CS - Max Temp 225° F	G								
Flg x Flg 5-Valve Manifold SS - Max Temp 225° F	H								
Customer Supplied Valve Manifold	I								
<b>RTD (Max Temp 480° F. consult factory for higher temp options)</b>									
100 Ohm RTD 3-Wire w/Explosion Proof Head	1								
100 Ohm RTD 3-Wire, Integral w/Aluminum Head	2								
Not Required	Z								

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)

Ellipse® Annular Flanged  
2-1/4 in. DIAMETER

PAF2	-									
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**PIPE SIZE**

12 in.	J
14 in.	K
16 in.	L
18 in.	M
20 in.	N
24 in.	O
30 in.	P
36 in.	Q
42 in.	R
48 in.	S
60 in.	T
72 in.	U

**SCHEDULE**

STD	A
20	B
30	C
40	D
60	E
80	F
100	G
120	H
140	I
160	J
XH	K
XXH	L
5S	M
10S	N
40S	O
80S	P

**PIPE ORIENTATION**

Horizontal	A
Vertical	B

**PROBE MATERIAL**

316/316L SS	1
Monel®	2
Inconel®	3
Hastelloy®	4
Other	X

**INSTRUMENT CONNECTION**

1/2 in. NPT	A
1/2 in. Socket	B
TT3 (Integral 3-Valve Trans Mount - Max Temp 225° F)	C
TT5 (Integral 5-Valve Trans Mount - Max Temp 225° F)	D
(RTD is not available with Integral 5-Valve Manifold. If RTD is required, select "E" Transmitter Flange Connection and the appropriate manifold valve under the Instrument Valve section below.)	
Transmitter Flange Connection	E

**CONNECTION / FLANGE RATING**

3 in. RF Flange 150# CS	A
3 in. RF Flange 300# CS	B
3 in. RF Flange 600# CS	C
3 in. RF Flange 900/1500# CS	D
3 in. RF Flange 150# SS	E
3 in. RF Flange 300# SS	F
3 in. RF Flange 600# SS	G
3 in. RF Flange 900/1500# SS	H

**PIPE MOUNTING**

A105 CS 3000#	1
316/316L SS 3000#	2
A105 CS 3000# w/Double Support	3
316/316L SS 3000# w/Double Support	4
Not Required	Z

**INSTRUMENT VALVE**

1/2 in. Needle CS	A
1/2 in. Needle SS	B
1/2 in. Gate CS	C
1/2 in. Gate SS	D
Not Required	Z
ONLY AVAILABLE WITH OPTION "E" UNDER INSTRUMENT CONNECTION	
Fig x Fig 3-Valve Manifold CS - Max Temp 225° F	E
Fig x Fig 3-Valve Manifold SS - Max Temp 225° F	F
Fig x Fig 5-Valve Manifold CS - Max Temp 225° F	G
Fig x Fig 5-Valve Manifold SS - Max Temp 225° F	H
Customer Supplied Valve Manifold	I

**RTD (Max Temp 480° F, consult factory for higher temp options)**

100 Ohm RTD 3-Wire w/Explosion Proof Head	1
100 Ohm RTD 3-Wire, Integral w/Aluminum Head	2
Not Required	Z

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)

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**[www.badgermeter.com](http://www.badgermeter.com)**



### DESCRIPTION

The Preso ELLIPSE® Annular Threaded Steam Flow Meter is a multi-ported, self averaging differential pressure flow element for steam applications. The Ellipse flow meter is designed with a series of ports facing the upstream velocity pressures and flow sensing ports strategically located ahead of the trailing edge flow separation.

### COMPONENTS

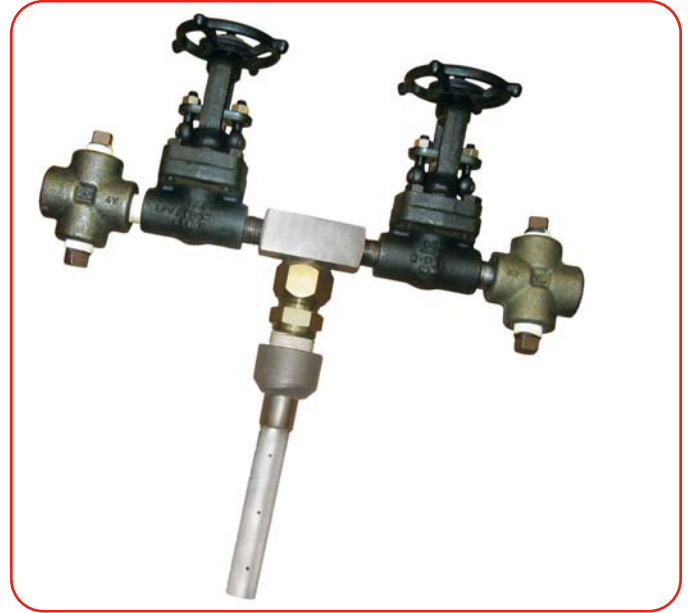
All sensors are furnished with 1/2 in. instrument gate valves (class 800), threaded cross tees, threaded weld fitting, compression fitting, and ID tag as standard equipment. Available options include integral 3-valve or 5-valve transmitter mount manifold and integral RTD temperature sensor.

### FEATURES

- Patented elliptical design
- Single point pipe entry for DP, temperature and static pressure
- No dampening software required
- Low pressure loss (typically 3% of DP in a 12 in. (304 mm) line) due to the patented aerodynamic profile
- NIST traceable calibration, optional independent labs
- Accuracy:  $\pm 0.75\%$  of reading, repeatability:  $\pm 0.1\%$  of reading
- Turndown Ratio: 17:1; no vacuum effects
- No moving part construction provides long, trouble-free service life
- True static pressure measurement rather than a calculated value
- Overcomes loss of accuracy caused by fluid separation at the sensor body

### CONFIGURATION

The flow element has a two-piece construction: an elliptical shape and two 100% independent flow sensing chambers. This construction prevents signal degradation and mixing, and does not require dampening hardware or software. The impact velocity sensing holes (high pressure) are located along the leading edge and the true static sensing holes (low pressure) are on the exterior probe side. This does not generate any vortices or vacuum effects that impinge on the static pressure measurement sensing area and has a drag coefficient of 0.32 or less. Each flow sensor is complete with instrument shutoff valves with provisions to accept a transmitter or direct indicating meter. An identification tag is supplied with specific flow station measurement information, as required.



### MAXIMUM ALLOWABLE DP (INCHES OF WATER COLUMN)

Pipe Size	Single Support Probe Size (in.)		Double Support Probe Size (in.)	
	7/8	1-1/4	7/8	1-1/4
2 in. (50.80 mm)	880	—	2380	—
2-1/2 in. (63.50 mm)	525	—	1558	—
3 in. (76.20 mm)	396	—	1283	—
3-1/2 in. (88.90 mm)	283	—	1117	—
4 in. (101.60 mm)	197	—	980	—
5 in. (127.00 mm)	153	—	757	—
6 in. (152.40 mm)	126	—	669	—
8 in. (203.20 mm)	114	360	512	—
10 in. (254.80 mm)	100	240	315	960
12 in. (304.80 mm)	87	175	250	700
14 in. (355.60 mm)	53	147	195	585
16 in. (406.40 mm)	—	113	—	450
18 in. (457.20 mm)	—	90	—	360
20 in. (508.00 mm)	—	74	—	295
24 in. (609.60 mm)	—	68	—	270
26 in. (660.40 mm)	—	50	—	215
30 in. (762.00 mm)	—	34	—	155
32 in. (812.80 mm)	—	—	—	—
36 in. (914.40 mm)	—	—	—	—
42 in. (1066.80 mm)	—	—	—	—

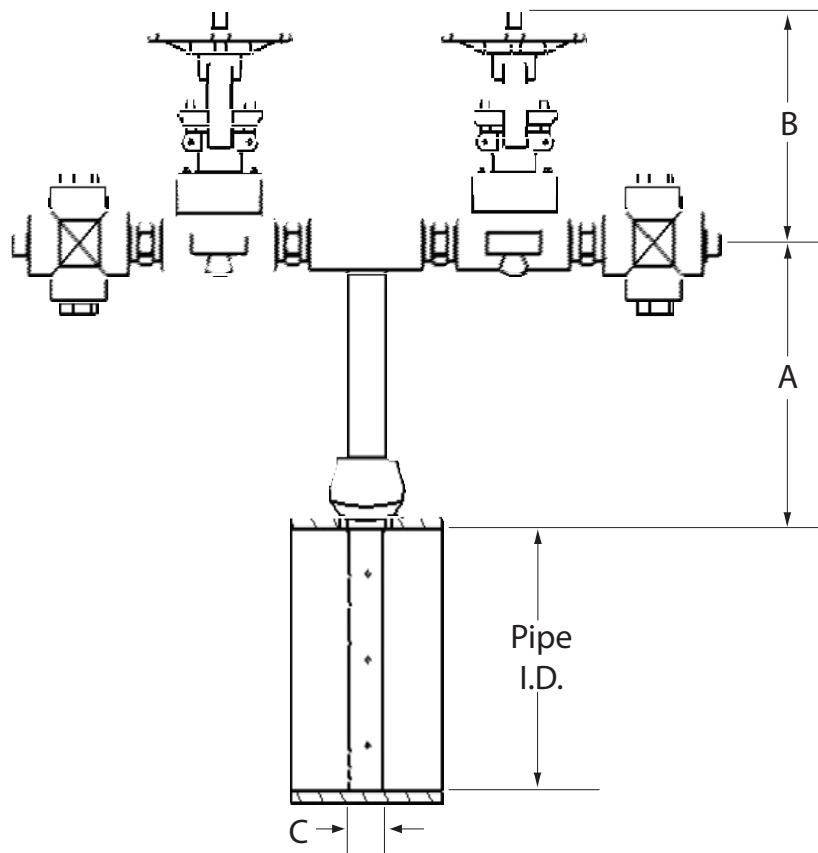
## SPECIFICATIONS

<b>Applications</b>	Steam
<b>Pipe Size</b>	2...48 in. (50...1220 mm)
<b>Pressure</b>	600 PSI (4100 kPa) max.
<b>Temperature</b>	480 F (250 C) max.
<b>Accuracy</b>	±0.75% of reading
<b>Repeatability</b>	±0.1%
<b>Turndown Ratio</b>	17:1 with no vacuum effect
<b>Reynolds Number</b>	>75,000: Maintains most accurate flow measurements <75,000: Consult factory for estimated results
<b>Resonance</b>	If greater than 0.8, use double support per ASME PTC 19.3

## STANDARD COMPONENTS

Component	Specifications
Head	T-type
Connection	316 SS 1/4 in. or 1/2 in. FNPT
Compression Fitting	CS with SS ferrule
Weld Fitting	CS 3000 lb. — ASTM A105
Ellipse Sensor	316/316L SS
ID Tag	SS with wire

## DIMENSIONS



	Probe Length		Probe Width
	A	B	C
<b>AS</b>	6.63 in. (168.28 mm)	5.81 in. (147.65 mm)	0.87 in. (22.23 mm)
<b>AS1</b>	6.75 in. (171.45 mm)	5.81 in. (147.65 mm)	1.25 in. (31.75 mm)



Ellipse®  
Annular Threaded Steam  
1-1/4 in. DIAMETER

PAS1 -

<b>PIPE SIZE</b>									
12 in.	J								
14 in.	K								
16 in.	L								
18 in.	M								
20 in.	N								
24 in.	O								
30 in.	P								
36 in.	Q								
42 in.	R								
48 in.	S								
<b>SCHEDULE</b>									
STD	A								
20	B								
30	C								
40	D								
60	E								
80	F								
100	G								
120	H								
140	I								
160	J								
XH	K								
XXH	L								
5S	M								
10S	N								
40S	O								
80S	P								
<b>PIPE ORIENTATION</b>									
Horizontal	A								
Vertical	B								
<b>PROBE MATERIAL</b>									
316/316L SS	1								
Monel®	2								
Inconel®	3								
Hastelloy®	4								
Other	X								
<b>INSTRUMENT CONNECTION</b>									
1/2 in. NPT	A								
1/2 in. Socket	B								
TT3 (Integral 3-Valve Trans Mount - Max Temp 225° F)	C								
TT5 (Integral 5-Valve Trans Mount - Max Temp 225° F)	D								
(RTD is not available with Integral 5-Valve Manifold. If RTD is required, select "E" Transmitter Flange Connection and the appropriate manifold valve under the Instrument Valve section below.)									
Transmitter Flange Connection	E								
<b>CONNECTION</b>									
CS Compression Fitting w/SS Ferrule	A								
SS Compression Fitting w/SS Ferrule	B								
<b>PIPE MOUNTING</b>									
A105 CS 3000#	1								
316/316L SS 3000#	2								
A105 CS 3000# w/Double Support	3								
316/316L SS 3000# w/Double Support	4								
Not Required	Z								
<b>INSTRUMENT VALVE</b>									
1/2 in. Gate CS w/Cross	A								
1/2 in. Gate SS w/Cross	B								
Not Required	Z								
ONLY AVAILABLE WITH OPTION "E" UNDER INSTRUMENT CONNECTION									
Fig x Fig 3-Valve Manifold CS - Max Temp 225° F	E								
Fig x Fig 3-Valve Manifold SS - Max Temp 225° F	F								
Fig x Fig 5-Valve Manifold CS - Max Temp 225° F	G								
Fig x Fig 5-Valve Manifold SS - Max Temp 225° F	H								
Customer Supplied Valve Manifold	I								
<b>RTD (Max Temp 480° F, consult factory for higher temp options)</b>									
100 Ohm RTD 3-Wire w/Explosion Proof Head	1								
100 Ohm RTD 3-Wire, Integral w/Aluminum Head	2								
Not Required	Z								

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)

**Control. Manage. Optimize.**

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All sensors are furnished with 1/2 in. instrument gate valves (with proper class rating), threaded cross tees, flanged mounting hardware (with proper class rating), and ID tag as standard equipment. Available options include integral 3-valve or 5-valve transmitter mount manifold and integral RTD temperature sensor.

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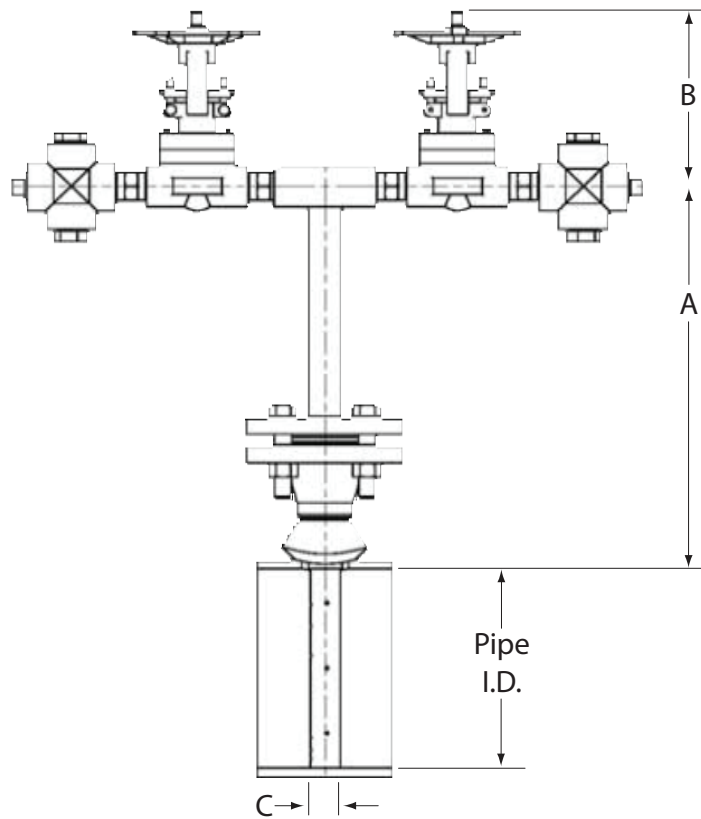
## SPECIFICATIONS

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<b>Temperature</b>	Vary per flange ratings
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<b>Repeatability</b>	±0.1%
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Component	Specifications
Head	T-type
Connection	316 SS 1/2 in. FNPT
Compression Fitting	CS with SS ferrule
Weld Fitting	CS 3000 lb. — ASTM A105
Ellipse Sensor	316/316L SS
ID Tag	SS with wire

## DIMENSIONS



	Probe Length		Probe Width
	A	B	C
<b>ASF</b>	11.63 in. (295.40 mm)	5.25 in. (133.35 mm)	0.87 in. (22.23 mm)
<b>ASF1</b>	11.63 in. (295.40 mm)	5.25 in. (133.35 mm)	1.25 in. (31.75 mm)
<b>ASF2*</b>	10.00 in. (254 mm)	5.25 in. (133.35 mm)	2.25 in. (57.15 mm)

ASF2 probe design not pictured. Contact factory for more information.

**PART NUMBER CONSTRUCTION**

Ellipse®

Annular Flanged Steam  
7/8 in. DIAMETER

PASF -

**PIPE SIZE**

2 in.	A
2-1/2 in.	B
3 in.	C
3-1/2 in.	D
4 in.	E
5 in.	F
6 in.	G
8 in.	H
10 in.	I
12 in.	J
14 in.	K

**SCHEDULE**

STD	A
20	B
30	C
40	D
60	E
80	F
100	G
120	H
140	I
160	J
XH	K
XXH	L
5S	M
10S	N
40S	O
80S	P

**PIPE ORIENTATION**

Horizontal	A
Vertical	B

**PROBE MATERIAL**

316/316L SS	1
Monel®	2
Inconel®	3
Hastelloy®	4
Other	X

**INSTRUMENT CONNECTION**

1/2 in. NPT	A
1/2 in. Socket	B
TT3 (Integral 3-Valve Trans Mount - Max Temp 225° F)	C
TT5 (Integral 5-Valve Trans Mount - Max Temp 225° F)	D
(RTD is not available with Integral 5-Valve Manifold. If RTD is required, select "E" Transmitter Flange Connection and the appropriate manifold valve under the Instrument Valve section below.)	
Transmitter Flange Connection	E

**CONNECTION / FLANGE RATING**

1-1/4 in. RF Flange 150# CS	A
1-1/4 in. RF Flange 300# CS	B
1-1/4 in. RF Flange 600# CS	C
1-1/4 in. RF Flange 900/1500# CS	D
1-1/4 in. RF Flange 150# SS	E
1-1/4 in. RF Flange 300# SS	F
1-1/4 in. RF Flange 600# SS	G
1-1/4 in. RF Flange 900/1500# SS	H

**PIPE MOUNTING**

A105 CS 3000#	1
316/316L SS 3000#	2
A105 CS 3000# w/Double Support	3
316/316L SS 3000# w/Double Support	4
Not Required	Z

**INSTRUMENT VALVE**

1/2 in. Gate CS w/Cross	A
1/2 in. Gate SS w/Cross	B
Not Required	Z
ONLY AVAILABLE WITH OPTION "E" UNDER INSTRUMENT CONNECTION	
Flg x Flg 3-Valve Manifold CS - Max Temp 225° F	E
Flg x Flg 3-Valve Manifold SS - Max Temp 225° F	F
Flg x Flg 5-Valve Manifold CS - Max Temp 225° F	G
Flg x Flg 5-Valve Manifold SS - Max Temp 225° F	H
Customer Supplied Valve Manifold	I

**RTD (Max Temp 480° F, consult factory for higher temp options)**

100 Ohm RTD 3-Wire w/Explosion Proof Head	1
100 Ohm RTD 3-Wire, Integral w/Aluminum Head	2
Not Required	Z

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)

**Ellipse®**

Annular Flanged Steam  
1-1/4 in. DIAMETER

PAS F1 -

**PIPE SIZE**

12 in.	J
14 in.	K
16 in.	L
18 in.	M
20 in.	N
24 in.	O
30 in.	P
36 in.	Q
42 in.	R
48 in.	S

**SCHEDULE**

STD	A
20	B
30	C
40	D
60	E
80	F
100	G
120	H
140	I
160	J
XH	K
XXH	L
5S	M
10S	N
40S	O
80S	P

**PIPE ORIENTATION**

Horizontal	A
Vertical	B

**PROBE MATERIAL**

316/316L SS	1
Monel®	2
Inconel®	3
Hastelloy®	4
Other	X

**INSTRUMENT CONNECTION**

1/2 in. NPT	A
1/2 in. Socket	B
TT3 (Integral 3-Valve Trans Mount - Max Temp 225° F)	C
TT5 (Integral 5-Valve Trans Mount - Max Temp 225° F)	D
(RTD is not available with Integral 5-Valve Manifold. If RTD is required, select "E" Transmitter Flange Connection and the appropriate manifold valve under the Instrument Valve section below.)	
Transmitter Flange Connection	E

**CONNECTION / FLANGE RATING**

1-1/2 in. RF Flange 150# CS	A
1-1/2 in. RF Flange 300# CS	B
1-1/2 in. RF Flange 600# CS	C
1-1/2 in. RF Flange 900/1500# CS	D
1-1/2 in. RF Flange 150# SS	E
1-1/2 in. RF Flange 300# SS	F
1-1/2 in. RF Flange 600# SS	G
1-1/2 in. RF Flange 900/1500# SS	H

**PIPE MOUNTING**

A105 CS 3000#	1
316/316L SS 3000#	2
A105 CS 3000# w/Double Support	3
316/316L SS 3000# w/Double Support	4
Not Required	Z

**INSTRUMENT VALVE**

1/2 in. Gate CS w/Cross	A
1/2 in. Gate SS w/Cross	B
Not Required	Z
ONLY AVAILABLE WITH OPTION "E" UNDER INSTRUMENT CONNECTION	
Fig x Fig 3-Valve Manifold CS - Max Temp 225° F	E
Fig x Fig 3-Valve Manifold SS - Max Temp 225° F	F
Fig x Fig 5-Valve Manifold CS - Max Temp 225° F	G
Fig x Fig 5-Valve Manifold SS - Max Temp 225° F	H
Customer Supplied Valve Manifold	I

**RTD (Max Temp 480° F, consult factory for higher temp options)**

100 Ohm RTD 3-Wire w/Explosion Proof Head	1
100 Ohm RTD 3-Wire, Integral w/Aluminum Head	2
Not Required	Z

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)



**Ellipse®**

Annular Flanged Steam  
2-1/4 in. DIAMETER

PASF2

--	--	--	--	--	--	--	--	--	--

<b>PIPE SIZE</b>									
12 in.	J								
14 in.	K								
16 in.	L								
18 in.	M								
20 in.	N								
24 in.	O								
30 in.	P								
36 in.	Q								
42 in.	R								
48 in.	S								
<b>SCHEDULE</b>									
STD	A								
20	B								
30	C								
40	D								
60	E								
80	F								
100	G								
120	H								
140	I								
160	J								
XH	K								
XXH	L								
5S	M								
10S	N								
40S	O								
80S	P								
<b>PIPE ORIENTATION</b>									
Horizontal	A								
Vertical	B								
<b>PROBE MATERIAL</b>									
316/316L SS	1								
Monel®	2								
Inconel®	3								
Hastelloy®	4								
Other	X								
<b>INSTRUMENT CONNECTION</b>									
1/2 in. NPT	A								
1/2 in. Socket	B								
TT3 (Integral 3-Valve Trans Mount - Max Temp 225° F)	C								
TT5 (Integral 5-Valve Trans Mount - Max Temp 225° F)	D								
(RTD is not available with Integral 5-Valve Manifold. If RTD is required, select "E" Transmitter Flange Connection and the appropriate manifold valve under the Instrument Valve section below.)									
Transmitter Flange Connection	E								
<b>CONNECTION / FLANGE RATING</b>									
3 in. RF Flange 150# CS	A								
3 in. RF Flange 300# CS	B								
3 in. RF Flange 600# CS	C								
3 in. RF Flange 900/1500# CS	D								
3 in. RF Flange 150# SS	E								
3 in. RF Flange 300# SS	F								
3 in. RF Flange 600# SS	G								
3 in. RF Flange 900/1500# SS	H								
<b>PIPE MOUNTING</b>									
A105 CS 3000#	1								
316/316L SS 3000#	2								
A105 CS 3000# w/Double Support	3								
316/316L SS 3000# w/Double Support	4								
Not Required	Z								
<b>INSTRUMENT VALVE</b>									
1/2 in. Gate CS w/Cross	A								
1/2 in. Gate SS w/Cross	B								
Not Required	Z								
ONLY AVAILABLE WITH OPTION "E" UNDER INSTRUMENT CONNECTION									
Fig x Fig 3-Valve Manifold CS - Max Temp 225° F	E								
Fig x Fig 3-Valve Manifold SS - Max Temp 225° F	F								
Fig x Fig 5-Valve Manifold CS - Max Temp 225° F	G								
Fig x Fig 5-Valve Manifold SS - Max Temp 225° F	H								
Customer Supplied Valve Manifold	I								
<b>RTD (Max Temp 480° F, consult factory for higher temp options)</b>									
100 Ohm RTD 3-Wire w/Explosion Proof Head	1								
100 Ohm RTD 3-Wire, Integral w/Aluminum Head	2								
Not Required	Z								

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)

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### DESCRIPTION

The Ellipse<sup>®</sup> Annular Low Pressure Wet Tap Flow Meter is a multi-ported, self-averaging differential pressure flow element for liquid (without system shutdown), air and gas applications. The Ellipse flow meter is designed with a series of ports facing the upstream velocity pressures and flow sensing ports strategically located ahead of the trailing edge flow separation.

### COMPONENTS

All sensors are furnished with 1/2 in. instrument valves, threaded weld fitting, threaded ball valve, threaded cage nipple, threaded compression fitting, and ID tag as standard equipment. Available options include integral 3-valve or 5-valve transmitter mount manifold and integral RTD temperature sensor.

### FEATURES

- Single point pipe entry for DP, temperature and static pressure
- No dampening software required
- Low pressure loss (typically 3% of DP in a 12 in. (304 mm) line)
- Accuracy:  $\pm 0.75\%$  of reading, repeatability:  $\pm 0.1\%$  of reading
- Turndown Ratio: 17:1; no vacuum effects
- No moving part construction provides long, trouble-free service life
- True static pressure measurement rather than a calculated value
- Overcomes loss of accuracy caused by fluid separation at the sensor body

### CONFIGURATION

The flow element has a two-piece construction: an elliptical shape and two 100% independent flow sensing chambers. This construction prevents signal degradation and mixing, and does not require dampening hardware or software. The impact velocity sensing holes (high pressure) are located along the leading edge and the true static sensing holes (low pressure) are on the exterior probe side. This does not generate any vortices or vacuum effects that impinge on the static pressure measurement sensing area and has a drag coefficient of 0.32 or less. Each flow sensor is complete with instrument shut off valves with provisions to accept a transmitter or direct indicating meter. An identification tag is supplied with specific flow station measurement information as required.



### SPECIFICATIONS

<b>Applications</b>	Liquid (without system shutdown), air, gas
<b>Pipe Sizes</b>	2...48 inches (50... 1220 mm)
<b>Pressure</b>	150 psi (1034 kPa) maximum
<b>Temperature</b>	150° F (66° C) maximum
<b>Accuracy</b>	$\pm 0.75\%$ of reading
<b>Repeatability</b>	$\pm 0.1\%$
<b>Turndown Ratio</b>	17:1 with no vacuum effect
<b>Reynolds Number</b>	>75,000: Maintains most accurate flow measurements <75,000: Consult factory for estimated results
<b>Resonance</b>	If greater than 0.8, use double support.

### STANDARD COMPONENTS

Component	Specifications
Head	T-type
Connection	316 SS 1/4 in. or 1/2 in. FNPT
Compression Fitting	CS with SS ferrule
Isolation Ball Valves	316 SS, NPT
Reducer Coupling	CD
Weld Fitting	CS 3000 lb, ASTM A105
Nipples	CS, schedule 40
Ellipse Sensor	316 SS
ID Tag	316 SS with wire
Instrument Valves	2 per sensor, 1/4 in. or 1/2 in., CS



**Ellipse®**

Annular Low Pressure Wet Tap  
1-1/4 in. DIAMETER

PAHR1 -

**PIPE SIZE**

- 12 in.
- 14 in.
- 16 in.
- 18 in.
- 20 in.
- 24 in.
- 30 in.
- 36 in.
- 42 in.
- 48 in.
- 60 in.
- 72 in.

- J
- K
- L
- M
- N
- O
- P
- Q
- R
- S
- T
- U

**SCHEDULE**

- STD
- 20
- 30
- 40
- 60
- 80
- 100
- 120
- 140
- 160
- XH
- XXH
- 5S
- 10S
- 40S
- 80S

- A
- B
- C
- D
- E
- F
- G
- H
- I
- J
- K
- L
- M
- N
- O
- P

**PIPE ORIENTATION**

- Horizontal
- Vertical

- A
- B

**PROBE MATERIAL**

- 316/316L SS
- Monel®
- Inconel®
- Hastelloy®
- Other

- 1
- 2
- 3
- 4
- X

**INSTRUMENT CONNECTION**

- 1/2 in. NPT
- 1/2 in. Socket
- TT3 (Integral 3-Valve Trans Mount - Max Temp 225° F)
- TT5 (Integral 5-Valve Trans Mount - Max Temp 225° F)
- (RTD is not available with Integral 5-Valve Manifold. If RTD is required, select "E" Transmitter Flange Connection and the appropriate manifold valve under the Instrument Valve section below.)
- Transmitter Flange Connection

- A
- B
- C
- D
- E

**CONNECTION**

- CS Compression Fitting w/SS Ferrule
- SS Compression Fitting w/SS Ferrule

- A
- B

**INSERTION MECHANISM**

- CS Nipple & SS Isolation Valve
- SS Cage Nipple & SS Isolation Valve
- Other

- A
- B
- X

**PIPE MOUNTING\***

- A105 CS 3000#
- 316/316L SS 3000#
- Not Required

- 1
- 2
- Z

**INSTRUMENT VALVE**

- 1/2 in. Needle CS
- 1/2 in. Needle SS
- 1/2 in. Gate CS
- 1/2 in. Gate SS
- Not Required
- ONLY AVAILABLE WITH OPTION "E" UNDER INSTRUMENT CONNECTION
- Fig x Flg 3-Valve Manifold CS - Max Temp 225° F
- Flg x Flg 3-Valve Manifold SS - Max Temp 225° F
- Flg x Flg 5-Valve Manifold CS - Max Temp 225° F
- Flg x Flg 5-Valve Manifold SS - Max Temp 225° F
- Customer Supplied Valve Manifold

- A
- B
- C
- D
- Z
- E
- F
- G
- H
- I

**RTD (Max Temp 480° F, consult factory for higher temp options)**

- 100 Ohm RTD 3-Wire w/Explosion Proof Head
- 100 Ohm RTD 3-Wire, Integral w/Aluminum Head
- Not Required

- 1
- 2
- Z

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)  
\*Double Supports are not recommended for Hot Tap / Wet Tap models.

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**[www.badgermeter.com](http://www.badgermeter.com)**



### DESCRIPTION

The Ellipse<sup>®</sup> Annular High Pressure Hot Tap Flow Meter is a multi-ported, self-averaging differential pressure flow element for air, liquid and gas applications. The Ellipse flow meter is designed with a series of ports facing the upstream velocity pressures and flow sensing ports strategically located ahead of the trailing edge flow separation.

### COMPONENTS

All sensors are furnished with 1/2 in. instrument valves, threaded weld fitting, threaded ball valve, threaded insert/retract mechanism with rods, and ID tag as standard equipment. Available options include integral 3-valve or 5-valve transmitter mount manifold and integral RTD temperature sensor.

### FEATURES

- Hot-tap model installs without system shutdown
- Single point pipe entry for DP, temperature and static pressure
- No dampening software required
- Low pressure loss (typically 3% of DP in a 12 in. (304 mm) line) due to the patented aerodynamic profile
- Optional NIST traceable calibration
- Accuracy:  $\pm 0.75\%$  of reading, repeatability:  $\pm 0.1\%$  of reading
- Turndown Ratio: 17:1; no vacuum effects
- No moving part construction provides long, trouble-free service life
- True static pressure measurement rather than a calculated value
- Overcomes loss of accuracy caused by fluid separation at the sensor body

### CONFIGURATION

The flow element has a two-piece construction: an elliptical shape and two 100% independent flow sensing chambers. This construction prevents signal degradation and mixing, and does not require dampening hardware or software. The impact velocity sensing holes (high pressure) are located along the leading edge and the true static sensing holes (low pressure) are on the exterior probe side. This does not generate any vortices or vacuum effects that impinge on the static pressure measurement sensing area and has a drag coefficient of 0.32 or less. Each flow sensor is complete with instrument shutoff valves or optional integral manifold valve for direct transmitter mount. An identification tag is supplied with specific flow station measurement information, as required.



### MAXIMUM ALLOWABLE DP (INCHES OF WATER COLUMN)

Pipe Size	Single Support Probe Size (in.)		Double Support Probe Size (in.)	
	7/8	1-1/4	7/8	1-1/4
2 in. (50.80 mm)	880	—	2380	—
2-1/2 in. (63.50 mm)	525	—	1558	—
3 in. (76.20 mm)	396	—	1283	—
3-1/2 in. (88.90 mm)	283	—	1117	—
4 in. (101.60 mm)	197	—	980	—
5 in. (127.00 mm)	153	—	757	—
6 in. (152.40 mm)	126	—	669	—
8 in. (203.20 mm)	114	360	512	—
10 in. (254.80 mm)	100	240	315	960
12 in. (304.80 mm)	87	175	250	700
14 in. (355.60 mm)	53	147	195	585
16 in. (406.40 mm)	—	113	—	450
18 in. (457.20 mm)	—	90	—	360
20 in. (508.00 mm)	—	74	—	295
24 in. (609.60 mm)	—	68	—	270
26 in. (660.40 mm)	—	50	—	215
30 in. (762.00 mm)	—	34	—	155

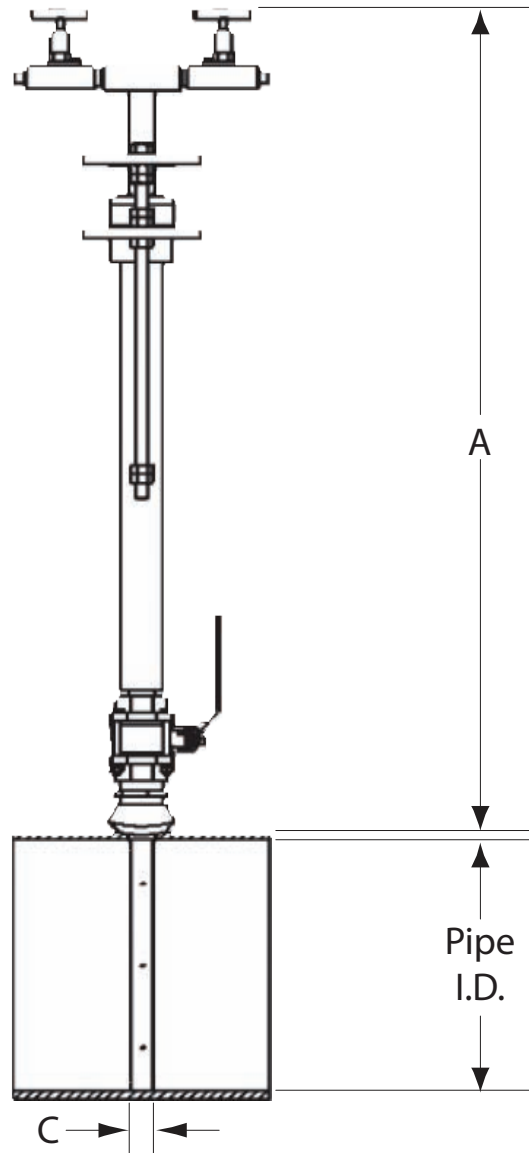
## SPECIFICATIONS

<b>Applications</b>	Air, liquids and gases
<b>Pipe Size</b>	2...30 in. (50...760 mm)
<b>Pressure</b>	800 PSI (5515 kPa) max. Consult factory for higher pressure
<b>Temperature</b>	800° F (426° C) max. Consult factory for higher temperature
<b>Accuracy</b>	±0.75% of reading
<b>Repeatability</b>	±0.1%
<b>Turndown Ratio</b>	17:1 with no vacuum effect
<b>Reynolds Number</b>	>75,000: Maintains most accurate flow measurements <75,000: Consult factory for estimated results
<b>Resonance</b>	Less than 0.8 but greater than 1.2. If greater than 0.8, use double support. System shutdown is required when the double support option is used. Select larger diameter Ellipse to avoid double support.

## STANDARD COMPONENTS

Component	Specifications
Head	T-type
Connection	316 SS 1/4 in. or 1/2 in. FNPT
Fitting	CS 3000 lb. weld – ASTM A105
Ellipse Sensor	316/316L SS
Instrument Valves	2 per sensor, CS 1/4 in. or 1/2 in.
Sensor Flange	150 lbs 316/316L SS
Packing Chamber	CS with molythane or graphite packing gland
Packing Chamber Flange	CS 150 lb with SS cap
Isolation Ball Valve	316-SS, NPT threaded
Nuts and Bolts	CS threaded
Nipples	CS, schedule 40

**DIMENSIONS**



Schedule	AHL "A" Dimensions			AHL1 "A" Dimensions			Probe Width "C"	
	Pipe Size in. (mm)	Inserted in. (mm)	Retracted in. (mm)	Pipe Size in. (mm)	Inserted in. (mm)	Retracted in. (mm)	Model	C in. (mm)
Standard Schedule	2 (50.80)	29.5 (749.30)	38.5 (977.90)	12 (304.80)	42.125 (1069.98)	61.75 (1568.45)	AHL	0.875 (22.225)
	2-1/2 (63.50)	30 (762.00)	39.5 (1003.30)	14 (355.60)	44.125 (1120.78)	65 (1651.00)	AHL1	1.25 (31.750)
	3 (76.20)	30.5 (774.70)	40.5 (1028.70)	16 (406.40)	46.125 (1171.58)	69 (1752.60)	—	—
	3-1/2 (88.90)	31 (787.40)	41.5 (1054.10)	18 (457.20)	48.125 (1222.38)	73 (1854.20)	—	—
	4 (101.60)	31.5 (800.10)	42.5 (1079.50)	20 (508.00)	50.125 (1273.18)	77 (1955.80)	—	—
	5 (127.00)	32.5 (825.50)	44.5 (1130.30)	24 (609.60)	54.125 (1374.78)	85 (2159.00)	—	—
	6 (152.40)	33.375 (847.725)	46.5 (1181.10)	30 (762.00)	60.125 (1527.18)	97 (2463.80)	—	—
	8 (203.20)	35.375 (898.525)	50.5 (1282.70)	—	—	—	—	—
	10 (254.80)	37.375 (949.325)	54.5 (1384.30)	—	—	—	—	—
	12 (304.80)	39.375 (1000.13)	58.5 (1485.90)	—	—	—	—	—
	14 (355.60)	41.375 (1050.93)	61.75 (1568.45)	—	—	—	—	—

**PART NUMBER CONSTRUCTION**

Ellipse®  
Annular High Pressure Hot Tap  
7/8 in. DIAMETER

PAHL -

**PIPE SIZE**

2 in.	A
2-1/2 in.	B
3 in.	C
3-1/2 in.	D
4 in.	E
5 in.	F
6 in.	G
8 in.	H
10 in.	I
12 in.	J
14 in.	K
16 in.	L
18 in.	M
20 in.	N
24 in.	O
30 in.	P
36 in.	Q

**SCHEDULE**

STD	A
20	B
30	C
40	D
60	E
80	F
100	G
120	H
140	I
160	J
XH	K
XXH	L
5S	M
10S	N
40S	O
80S	P

**PIPE ORIENTATION**

Horizontal	A
Vertical	B

**PROBE MATERIAL**

316/316L SS	1
Monel®	2
Inconel®	3
Hastelloy®	4
Other	X

**INSTRUMENT CONNECTION**

1/2 in. NPT	A
1/2 in. Socket	B
TT3 (Integral 3-Valve Trans Mount - Max Temp 225° F)	C
TT5 (Integral 5-Valve Trans Mount - Max Temp 225° F)	D
(RTD is not available with Integral 5-Valve Manifold. If RTD is required, select "E" Transmitter Flange Connection and the appropriate manifold valve under the Instrument Valve section below.)	
Transmitter Flange Connection	E

**INSERTION MECHANISM / ISOLATION BALL VALVE**

CS Cage Nipple & Rods	A
SS Cage Nipple & Rods	B
CS Gear Drive, Cage Nipple & Rods	C
SS Gear Drive, Cage Nipple & Rods	D
NOTE: SS Gear Drive - SS for Housing and Wetted Parts Only	
Other	X

**PACKING MATERIAL**

Molythane (-65...200° F, 140° F in water and high water-based fluids)	1
Viton®/Fluorocarbon (-20° F to 400° F)	2
Graphoil (1200° F)	3
EPDM (-65...300° F, 400° F in steam)	4
Fluoromyte (-65...300° F)	5
Other	X

**PIPE MOUNTING\***

A105 CS 3000#	1
316/316L SS 3000#	2
Supplied Separately by Preso	3
Not Required	Z

**INSTRUMENT VALVE**

1/2 in. Needle CS	A
1/2 in. Needle SS	B
1/2 in. Gate CS	C
1/2 in. Gate SS	D
Not Required	Z
ONLY AVAILABLE WITH OPTION "E" UNDER INSTRUMENT CONNECTION	
Fig x Fig 3-Valve Manifold CS - Max Temp 225° F	E
Fig x Fig 3-Valve Manifold SS - Max Temp 225° F	F
Fig x Fig 5-Valve Manifold CS - Max Temp 225° F	G
Fig x Fig 5-Valve Manifold SS - Max Temp 225° F	H
Customer Supplied Valve Manifold	I

**RTD (Max Temp 480° F, consult factory for higher temp options)**

100 Ohm RTD 3-Wire w/Explosion Proof Head	1
100 Ohm RTD 3-Wire, Integral w/Aluminum Head	2
Not Required	Z

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)  
\*Double Supports are not recommended for Hot Tap / Wet Tap models.



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### DESCRIPTION

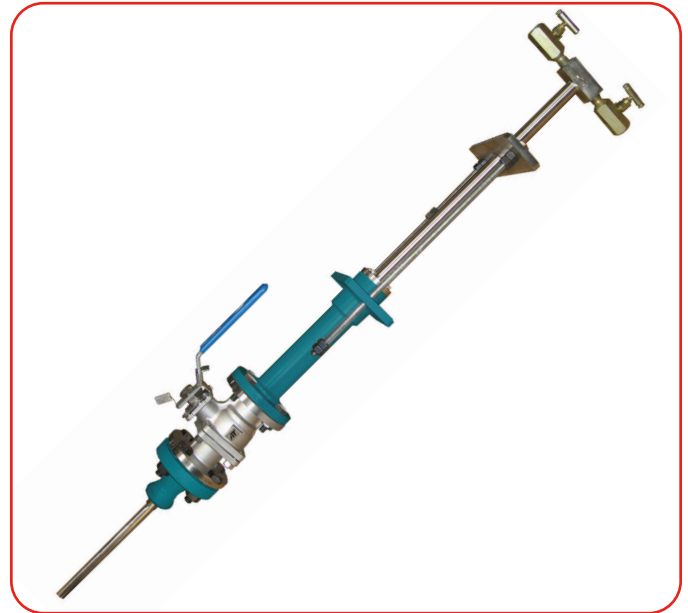
The Ellipse<sup>®</sup> Annular Flanged Hot-tap Flow Meter is a multi-ported, self-averaging differential pressure flow element for saturated and superheated steam. The Ellipse flow meter is designed with a series of ports facing the upstream velocity pressures and flow sensing ports strategically located ahead of the trailing edge flow separation.

### COMPONENTS

All sensors are furnished with 1/2 in. instrument valves, flanged mounting hardware (with the proper rating), flanged ball valve (with the proper rating), insert/retract mechanism with rods, and ID tag as standard equipment. Available options include integral 3-valve or 5-valve transmitter mount manifold and integral RTD temperature sensor.

### CONFIGURATION

The flow element has a two-piece construction: an elliptical shape and two 100% independent flow sensing chambers. This construction prevents signal degradation and mixing, and does not require dampening hardware or software. The impact velocity sensing holes (high pressure) are located along the leading edge and the true static sensing holes (low pressure) are on the exterior probe side. This does not generate any vortices or vacuum effects that impinge on the static pressure measurement sensing area and has a drag coefficient of 0.32 or less. Each flow sensor is complete with instrument shut off valves with provisions to accept a transmitter or direct indicating meter. An identification tag is supplied with specific flow station measurement information as required.



### FEATURES

- Patented elliptical design
- Single point pipe entry for DP, temperature and static pressure
- No dampening software required
- Low pressure loss (typically 3% of DP in a 12 in. (304 mm) line)
- Accuracy:  $\pm 0.75\%$  of reading, repeatability:  $\pm 0.1\%$  of reading
- Turndown Ratio: 17:1; no vacuum effects
- No moving part construction provides long, trouble-free service life
- True static pressure measurement rather than a calculated value
- Overcomes loss of accuracy caused by fluid separation at the sensor body

## SPECIFICATIONS

<b>Applications</b>	Saturated and superheated steam
<b>Pipe Size</b>	2...48 in. (50...1219 mm)
<b>Pressure</b>	Pressure and temperature depend on flange ratings, ANSI B16.5 standards
<b>Temperature</b>	800° F (427° C) Maximum
<b>Flow Range</b>	2.6...21,130 GPM
<b>Gear Drive</b>	Option available
<b>Accuracy</b>	±0.75% of reading
<b>Repeatability</b>	±0.1%
<b>Turndown Ratio</b>	17:1 with no vacuum effect
<b>Reynolds Number</b>	>75,000: Maintains most accurate flow measurements <75,000: Consult factory for estimated results

## STANDARD COMPONENTS

Component	Specifications
Head	T-type
Connection	316 SS 1/4 in. or 1/2 in. FNPT
Fitting	CS 3000 lb weld - ASTM A105
Instrument Valves	2 per sensor, 316/316L SS Ellipse
ID Tag	316 SS with wire
Sensor Flange	150 lb 316/316L SS
Packing Chamber	CS with molythane or graphite packing gland
Packing Chamber Flange	CS 150 lb with SS cap
Isolation Ball Valve	316 SS, NPT threaded
Nuts and Bolts	CS threaded
Nipples	CS, schedule 40
Diameter	7/8 in., 1-1/4 in. or 2-1/4 in. diameters

## OPTIONAL COMPONENTS

Component	Specifications
Rods, Bolts and Nuts	316 SS
Packing Chamber and Flange	316 SS
Spiral Wound Gasket	316 SS
300 lb., 600 lb. or Higher Flange Rating	CS or 316 SS ANSI B16.5
Temperature Port with RTD Output	—
Static Pressure Port	With SS plug







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### DESCRIPTION

The Ellipse® Annular Threaded Hot-tap Steam Flow Meter is a multi-ported, self-averaging differential pressure flow element for saturated and super-heated steam applications. The Ellipse flow meter is designed with a series of ports facing the upstream velocity pressures and flow sensing ports strategically located ahead of the trailing edge flow separation.

### COMPONENTS

All sensors are furnished with 1/2 in. instrument gate valves, threaded cross tees, threaded weld fitting, threaded gate valve, threaded insert/retract mechanism w/rods, and ID tag as standard equipment. Available options include integral 3-valve or 5-valve transmitter mount manifold and integral RTD temperature sensor.

### FEATURES

- Hot-tap model installs without system shutdown
- Single point pipe entry for DP, temperature and static pressure
- No dampening software required
- Low pressure loss (typically 3% of DP in a 12 in. (304 mm) line) due to the patented aerodynamic profile
- Optional NIST traceable calibration
- Accuracy:  $\pm 0.75\%$  of reading, repeatability:  $\pm 0.1\%$  of reading
- Turndown Ratio: 17:1; no vacuum effects
- No moving part construction provides long, trouble-free service life
- True static pressure measurement rather than a calculated value
- Overcomes loss of accuracy caused by fluid separation at the sensor body

### CONFIGURATION

The flow element has a two-piece construction: an elliptical shape and two 100% independent flow sensing chambers. This construction prevents signal degradation and mixing, and does not require dampening hardware or software. The impact velocity sensing holes (high pressure) are located along the leading edge and the true static sensing holes (low pressure) are on the exterior probe side. This does not generate any vortices or vacuum effects that impinge on the static pressure measurement sensing area and has a drag coefficient of 0.32 or less. Each flow sensor is complete with instrument shutoff valves or optional integral manifold valve for direct transmitter mount. An identification tag is supplied with specific flow station measurement information, as required.



### MAXIMUM ALLOWABLE DP (INCHES OF WATER COLUMN)

Pipe Size	Single Support Probe Size (in.)		Double Support Probe Size (in.)	
	7/8	1-1/4	7/8	1-1/4
2 in. (50.80 mm)	880	—	2380	—
2-1/2 in. (63.50 mm)	525	—	1558	—
3 in. (76.20 mm)	396	—	1283	—
3-1/2 in. (88.90 mm)	283	—	1117	—
4 in. (101.60 mm)	197	—	980	—
5 in. (127.00 mm)	153	—	757	—
6 in. (152.40 mm)	126	—	669	—
8 in. (203.20 mm)	114	360	512	—
10 in. (254.80 mm)	100	240	315	960
12 in. (304.80 mm)	87	175	250	700
14 in. (355.60 mm)	53	147	195	585
16 in. (406.40 mm)	—	113	—	450
18 in. (457.20 mm)	—	90	—	360
20 in. (508.00 mm)	—	74	—	295
24 in. (609.60 mm)	—	68	—	270

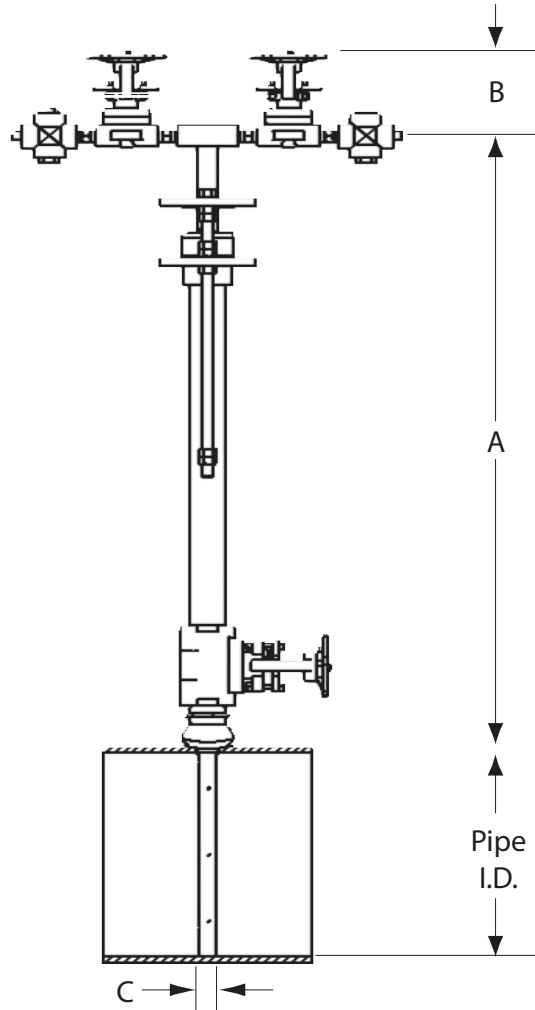
## SPECIFICATIONS

<b>Applications</b>	Saturated and super-heated steam
<b>Pipe Size</b>	2...24 in. (50...610 mm)
<b>Pressure</b>	800 PSI (5515 kPa) max. Consult factory for higher pressure
<b>Temperature</b>	800° F (426° C) max. Consult factory for higher temperature
<b>Accuracy</b>	±0.75% of reading
<b>Repeatability</b>	±0.1%
<b>Turndown Ratio</b>	17:1 with no vacuum effect
<b>Reynolds Number</b>	>75,000: Maintains most accurate flow measurements <75,000: Consult factory for estimated results
<b>Resonance</b>	Less than 0.8 but greater than 1.2. If greater than 0.8, use double support. System shutdown is required when the double support option is used. Select larger diameter Ellipse to avoid double support.

## STANDARD COMPONENTS

<b>Component</b>	<b>Specifications</b>
Head	T-type
Connection	316 SS 1/4 in. or 1/2 in. FNPT
Fitting	CS 3000 lb. weld – ASTM A105
Ellipse Sensor	316/316L SS
Instrument Valves	2 per sensor, CS 1/4 in. or 1/2 in.
Sensor Flange	150 lbs 316/316L SS
Packing Chamber	CS with molythane or graphite packing gland
Packing Chamber Flange	CS 150 lbs with SS cap
Isolation Ball Valve	316-SS, NPT threaded
Nuts and Bolts	CS threaded
Nipples	CS, schedule 40
ID Tag	316 SS with wire

**DIMENSIONS**



Schedule	AHS "A" Dimensions			AHS1 "A" Dimensions			Probe Width "C"	
	Pipe Size in. (mm)	Inserted in. (mm)	Retracted in. (mm)	Pipe Size in. (mm)	Inserted in. (mm)	Retracted in. (mm)	Model	C in. (mm)
Standard Schedule	2 (50.80)	29.5 (749.30)	38.5 (977.90)	12 (304.80)	42.125 (1069.98)	61.75 (1568.45)	AHS	0.875 (22.225)
	2-1/2 (63.50)	30 (762.00)	39.5 (1003.30)	14 (355.60)	44.125 (1120.78)	65 (1651.00)	AHS1	1.25 (31.750)
	3 (76.20)	30.5 (774.70)	40.5 (1028.70)	16 (406.40)	46.125 (1171.58)	69 (1752.60)	—	—
	3-1/2 (88.90)	31 (787.40)	41.5 (1054.10)	18 (457.20)	48.125 (1222.38)	73 (1854.20)	—	—
	4 (101.60)	31.5 (800.10)	42.5 (1079.50)	20 (508.00)	50.125 (1273.18)	77 (1955.80)	—	—
	5 (127.00)	32.5 (825.50)	44.5 (1130.30)	24 (609.60)	54.125 (1374.78)	85 (2159.00)	—	—
	6 (152.40)	33.375 (847.725)	46.5 (1181.10)	—	—	—	—	—
	8 (203.20)	35.375 (898.525)	50.5 (1282.70)	—	—	—	—	—
	10 (254.80)	37.375 (949.325)	54.5 (1384.30)	—	—	—	—	—
	12 (304.80)	39.375 (1000.13)	58.5 (1485.90)	—	—	—	—	—
14 (355.60)	41.375 (1050.93)	61.75 (1568.45)	—	—	—	—	—	

**PART NUMBER CONSTRUCTION**

Ellipse®  
Annular Threaded Hot-tap Steam  
7/8 in. DIAMETER

PAHS -

<b>PIPE SIZE</b>		A								
2 in.		B								
2-1/2 in.		C								
3 in.		D								
3-1/2 in.		E								
4 in.		F								
5 in.		G								
6 in.		H								
8 in.		I								
10 in.		J								
12 in.		K								
14 in.										
<b>SCHEDULE</b>		A								
STD		B								
20		C								
30		D								
40		E								
60		F								
80		G								
100		H								
120		I								
140		J								
160		K								
XH		L								
XXH		M								
5S		N								
10S		O								
40S		P								
80S										
<b>PIPE ORIENTATION</b>		A								
Horizontal		B								
Vertical										
<b>PROBE MATERIAL</b>										
316/316L SS								1		
Monel®								2		
Inconel®								3		
Hastelloy®								4		
Other								X		
<b>INSTRUMENT CONNECTION</b>										
1/2 in. NPT								A		
1/2 in. Socket								B		
TT3 (Integral 3-Valve Trans Mount - Max Temp 225° F)								C		
TT5 (Integral 5-Valve Trans Mount - Max Temp 225° F)								D		
(RTD is not available with Integral 5-Valve Manifold. If RTD is required, select "E" Transmitter Flange Connection and the appropriate manifold valve under the Instrument Valve section below.)										
Transmitter Flange Connection								E		
<b>INSERTION MECHANISM / ISOLATION BALL VALVE</b>										
CS Cage Nipple & Rods								A		
SS Cage Nipple & Rods								D		
CS Gear Drive, Cage Nipple & Rods								G		
SS Gear Drive, Cage Nipple & Rods								J		
NOTE: SS Gear Drive - SS for Housing and Wetted Parts Only										
Other								X		
<b>PACKING MATERIAL</b>										
EPDM (-65...300° F, 400° F in steam)								1		
Viton®/Fluorocarbon (-20...400° F)								2		
Graphoil (1200° F)								3		
Fluoromyte (-65...300° F)								4		
Other								X		
<b>PIPE MOUNTING*</b>										
A105 CS 3000#								1		
316/316L SS 3000#								2		
Supplied Separately by Preso								3		
Not Required								Z		
<b>INSTRUMENT VALVE</b>										
1/2 in. Gate CS w/Cross									A	
1/2 in. Gate SS w/Cross									B	
Not Required									Z	
ONLY AVAILABLE WITH OPTION "E" UNDER INSTRUMENT CONNECTION										
Flg x Flg 3-Valve Manifold CS - Max Temp 225° F									E	
Flg x Flg 3-Valve Manifold SS - Max Temp 225° F									F	
Flg x Flg 5-Valve Manifold CS - Max Temp 225° F									G	
Flg x Flg 5-Valve Manifold SS - Max Temp 225° F									H	
Customer Supplied Valve Manifold									I	
<b>RTD (Max Temp 480° F, consult factory for higher temp options)</b>										
100 Ohm RTD 3-Wire w/Explosion Proof Head									1	
100 Ohm RTD 3-Wire, Integral w/Aluminum Head									2	
Not Required									Z	

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)  
\*Double Supports are not recommended for Hot Tap / Wet Tap models.

**Ellipse®**

Annular Threaded Hot Tap Steam  
1-1/4 in. DIAMETER

PAHS1																				
-------	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

<b>PIPE SIZE</b>																					
14 in.		K																			
16 in.		L																			
18 in.		M																			
20 in.		N																			
24 in.		O																			
<b>SCHEDULE</b>																					
STD		A																			
20		B																			
30		C																			
40		D																			
60		E																			
80		F																			
100		G																			
120		H																			
140		I																			
160		J																			
XH		K																			
XXH		L																			
5S		M																			
10S		N																			
40S		O																			
80S		P																			
<b>PIPE ORIENTATION</b>																					
Horizontal		A																			
Vertical		B																			
<b>PROBE MATERIAL</b>																					
316/316L SS																				1	
Monel®																				2	
Inconel®																				3	
Hastelloy®																				4	
Other																				X	
<b>INSTRUMENT CONNECTION</b>																					
1/2 in. NPT																				A	
1/2 in. Socket																				B	
TT3 (Integral 3-Valve Trans Mount - Max Temp 225° F)																				C	
TT5 (Integral 5-Valve Trans Mount - Max Temp 225° F)																				D	
(RTD is not available with Integral 5-Valve Manifold. If RTD is required, select "E" Transmitter Flange Connection and the appropriate manifold valve under the Instrument Valve section below.)																					
Transmitter Flange Connection																				E	
<b>INSERTION MECHANISM / ISOLATION BALL VALVE</b>																					
CS Cage Nipple & Rods																				A	
SS Cage Nipple & Rods																				B	
CS Gear Drive, Cage Nipple & Rods																				C	
SS Gear Drive, Cage Nipple & Rods																				D	
NOTE: SS Gear Drive - SS for Housing and Wetted Parts Only																					
Other																				X	
<b>PACKING MATERIAL</b>																					
EPDM (-65...300° F, 400° F in steam)																				1	
Viton®/Fluorocarbon (-20...400° F)																				2	
Graphoil (1200° F)																				3	
Fluoromyte (-65...300° F)																				4	
Other																				X	
<b>PIPE MOUNTING*</b>																					
A105 CS 3000#																				1	
316/316L SS 3000#																				2	
Supplied Separately by Preso																				3	
Not Required																				Z	
<b>INSTRUMENT VALVE</b>																					
1/2 in. Gate CS w/Cross																				A	
1/2 in. Gate SS w/Cross																				B	
Not Required																				Z	
ONLY AVAILABLE WITH OPTION "E" UNDER INSTRUMENT CONNECTION																					
Fig x Fig 3-Valve Manifold CS - Max Temp 225° F																				E	
Fig x Fig 3-Valve Manifold SS - Max Temp 225° F																				F	
Fig x Fig 5-Valve Manifold CS - Max Temp 225° F																				G	
Fig x Fig 5-Valve Manifold SS - Max Temp 225° F																				H	
Customer Supplied Valve Manifold																				I	
<b>RTD (Max Temp 480° F, consult factory for higher temp options)</b>																					
100 Ohm RTD 3-Wire w/Explosion Proof Head																				1	
100 Ohm RTD 3-Wire, Integral w/Aluminum Head																				2	
Not Required																				Z	

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)  
\*Double Supports are not recommended for Hot Tap / Wet Tap models.

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### DESCRIPTION

The Ellipse<sup>®</sup> Annular Hot-tap Flanged Flow Meter is a multi-ported, self-averaging differential pressure flow element for saturated and super-heated steam. The Ellipse flow meter is designed with a series of ports facing the upstream velocity pressures and flow sensing ports strategically located ahead of the trailing edge flow separation.

### CONFIGURATION

The flow element has a two-piece construction: an elliptical shape and two 100% independent flow sensing chambers. This construction prevents signal degradation and mixing, and does not require dampening hardware or software. The impact velocity sensing holes (high pressure) are located along the leading edge and the true static sensing holes (low pressure) are on the exterior probe side. This does not generate any vortices or vacuum effects that impinge on the static pressure measurement sensing area and has a drag coefficient of 0.32 or less. An identification tag is supplied with specific flow station measurement information, as required.

### COMPONENTS

All sensors are furnished with 1/2 in. (12 mm) instrument valves, flanged mounting hardware (with the proper ratings), and ID tag as standard equipment. Available options include integral 3-valve or 5-valve transmitter mount manifold and integral RTD temperature sensor.



### FEATURES

- Patented elliptical design
- Single point pipe entry for DP, temperature and static pressure
- No dampening software required
- Low pressure loss (typically 3% of DP in a 12 in. (304 mm) line) due to the patented aerodynamic profile
- NIST traceable calibration, optional independent labs
- Accuracy:  $\pm 0.75\%$  of reading, repeatability:  $\pm 0.1\%$  of reading
- Turndown Ratio: 17:1; no vacuum effects
- No moving part construction provides long, trouble-free service life
- True static pressure measurement rather than a calculated value
- Overcomes loss of accuracy caused by fluid separation at the sensor body

## STANDARD COMPONENTS

Component	Specifications
Head	T-type
Connection	316 SS 1/4 in. or 1/2 in. FNPT
Ellipse Sensor	316/316L SS
Instrument Valves	2 per sensor, 1/4 in. or 1/2 in. CS
ID Tag	316 SS with wire
Sensor Flange	150 lb 316/316L SS
Packing Chamber	CS with molythane or graphite packing gland
Packing Chamber Flange	CS 150 lb with SS cap
Isolation Ball Valve	316 SS, NPT threaded
Nuts and Bolts	CS threaded
Nipples	CS, schedule 40
Diameter	7/8 in., 1-1/4 in. or 2-1/4 in.

## OPTIONAL COMPONENTS

Component	Specifications
Rods, Bolts and Nuts	316 SS
Packing Chamber and Flange	316 SS
Spiral Wound Gasket	316 SS
300 lb., 600 lb. or Higher Flange Rating	CS or 316 SS ANSI B16.5
Temperature Port with RTD Output	—
Static Pressure Port	With SS plug

## SPECIFICATIONS

<b>Applications</b>	Steam
<b>Pipe Size</b>	2...72 in. (50...1830 mm)
<b>Pressure</b>	800° F (427° C) Maximum
<b>Temperature</b>	800° F (427° C) Maximum
<b>Flow Range</b>	2.6...34,340 GPM
<b>Accuracy</b>	±0.75% of reading
<b>Repeatability</b>	±0.1%
<b>Turndown Ratio</b>	17:1 with no vacuum effect
<b>Reynolds Number</b>	>75,000: Maintains most accurate flow measurements <75,000: Consult factory for estimated results



Part Number Matrix

Ellipse\*

Annular Flanged Hot-tap Steam  
1-1/4 in. DIAMETER

PAHZ1

--	--	--	--	--	--	--	--	--	--

<b>PIPE SIZE</b>									
12 in.	A								
14 in.	B								
16 in.	C								
18 in.	D								
20 in.	E								
24 in.	F								
30 in.	G								
36 in.	H								
42 in.	I								
48 in.	J								
60 in.	K								
72 in.	L								
<b>SCHEDULE</b>									
STD	A								
20	B								
30	C								
40	D								
60	E								
80	F								
100	G								
120	H								
140	I								
160	J								
XH	K								
XXH	L								
5S	M								
10S	N								
40S	O								
80S	P								
<b>PIPE ORIENTATION</b>									
Horizontal	A								
Vertical	B								
<b>PROBE MATERIAL</b>									
316/316L SS		1							
Monel®		2							
Inconel®		3							
Hastelloy®		4							
Other		X							
<b>INSTRUMENT CONNECTION</b>									
1/2 in. NPT			A						
1/2 in. Socket			B						
TT3 (Integral 3-Valve Trans Mount - Max Temp 225° F)			C						
TT5 (Integral 5-Valve Trans Mount - Max Temp 225° F)			D						
(RTD is not available with Integral 5-Valve Manifold. If RTD is required, select "E" Transmitter Flange Connection and the appropriate manifold valve under the Instrument Valve section below.)									
Transmitter Flange Connection			E						
<b>INSERTION MECHANISM / ISOLATION BALL VALVE</b>									
150# CS Cage Nipple & Rods			A						
300# CS Cage Nipple & Rods			B						
600# CS Cage Nipple & Rods			C						
150# SS Cage Nipple & Rods			D						
300# SS Cage Nipple & Rods			E						
600# SS Cage Nipple & Rods			F						
150# CS Gear Drive, Cage Nipple & Rods			G						
300# CS Gear Drive, Cage Nipple & Rods			H						
600# CS Gear Drive, Cage Nipple & Rods			I						
150# SS Gear Drive, Cage Nipple & Rods			J						
300# SS Gear Drive, Cage Nipple & Rods			K						
600# SS Gear Drive, Cage Nipple & Rods			L						
NOTE: SS Gear Drive - SS for Housing and Wetted Parts Only									
Other			X						
<b>PACKING MATERIAL</b>									
EPDM (-65...300° F, 400° F in steam)		1							
Viton®/Fluorocarbon (-20...400° F)		2							
Graphoil (1200° F)		3							
Fluoromyte (-65...300° F)		4							
Other		X							
<b>PIPE MOUNTING*</b>									
A105 CS 3000#						1			
316/316L SS 3000#						2			
Supplied Separately by Preso						3			
Not Required						Z			
<b>INSTRUMENT VALVE</b>									
1/2 in. Gate CS w/Cross							A		
1/2 in. Gate SS w/Cross							B		
Not Required							Z		
ONLY AVAILABLE WITH OPTION "E" UNDER INSTRUMENT CONNECTION									
Flg x Flg 3-Valve Manifold CS - Max Temp 225° F							E		
Flg x Flg 3-Valve Manifold SS - Max Temp 225° F							F		
Flg x Flg 5-Valve Manifold CS - Max Temp 225° F							G		
Flg x Flg 5-Valve Manifold SS - Max Temp 225° F							H		
Customer Supplied Valve Manifold							I		
<b>RTD (Max Temp 480° F, consult factory for higher temp options)</b>									
100 Ohm RTD 3-Wire w/Explosion Proof Head								1	
100 Ohm RTD 3-Wire, Integral w/Aluminum Head								2	
Not Required								Z	

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)  
\*Double Supports are not recommended for Hot Tap / Wet Tap models.



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### DESCRIPTION

The Preso ELLIPSE<sup>®</sup> Model BAR (Annular Commercial) is a multi-ported, self-averaging differential pressure type ELLIPSE<sup>®</sup> flow element.

### CONFIGURATION

The flow element has a two-piece construction: an elliptical shape and two 100% independent flow sensing chambers. This construction prevents signal degradation and mixing, and does not require dampening hardware or software. The impact velocity sensing holes are located along the leading edge and the true static sensing holes are on the exterior probe side. This does not generate any vortices or vacuum effects that impinge on the static pressure measurement sensing area and has a drag coefficient of 0.32 or less. Each flow sensor is complete with instrument shutoff valves with provisions to accept a transmitter or direct indicating meter. An identification tag is supplied with specific flow station measurement information, as required.

### ACCURACY AND REPEATABILITY

The accuracy of the flow element is within  $\pm 0.75\%$  with a repeatability of  $\pm 0.1\%$  and turndown ratio of 17:1 in the corresponding and appropriate range of Reynolds' Numbers. Certified, independent test data is available from NIST laboratories in similar line sizes as well as in liquids and gases.

### APPLICABLE FLUIDS

Liquids and gases.

### COMPONENTS

All sensors are furnished with 1/4 in. instrument ball valves, threaded weld fitting, compression fitting, and ID tag as standard equipment. Quick connect fittings are available as an option.



### FEATURES

- No separation effects on the low (static) pressure
- Turndown ratio of 17:1
- No vacuum effects
- No vortex generation
- Very high repeatability
- Accuracy of  $\pm 0.75\%$  uncalibrated
- Low drag coefficient

## METER SPECIFICATIONS

Name	Specification
Probe Construction	316 Stainless steel
Head	"Y" type, brass 1/8 in. FNPT
Pipe Mounting	3000# CS thread-o-let
Instrument Valves	1/4 in. SAE flare brass ball type
ID Tag	Polycarbonate
Temperature Maximum *	250° F (120° C)
Pressure Maximum *	400 PSIG (2760 kPa)

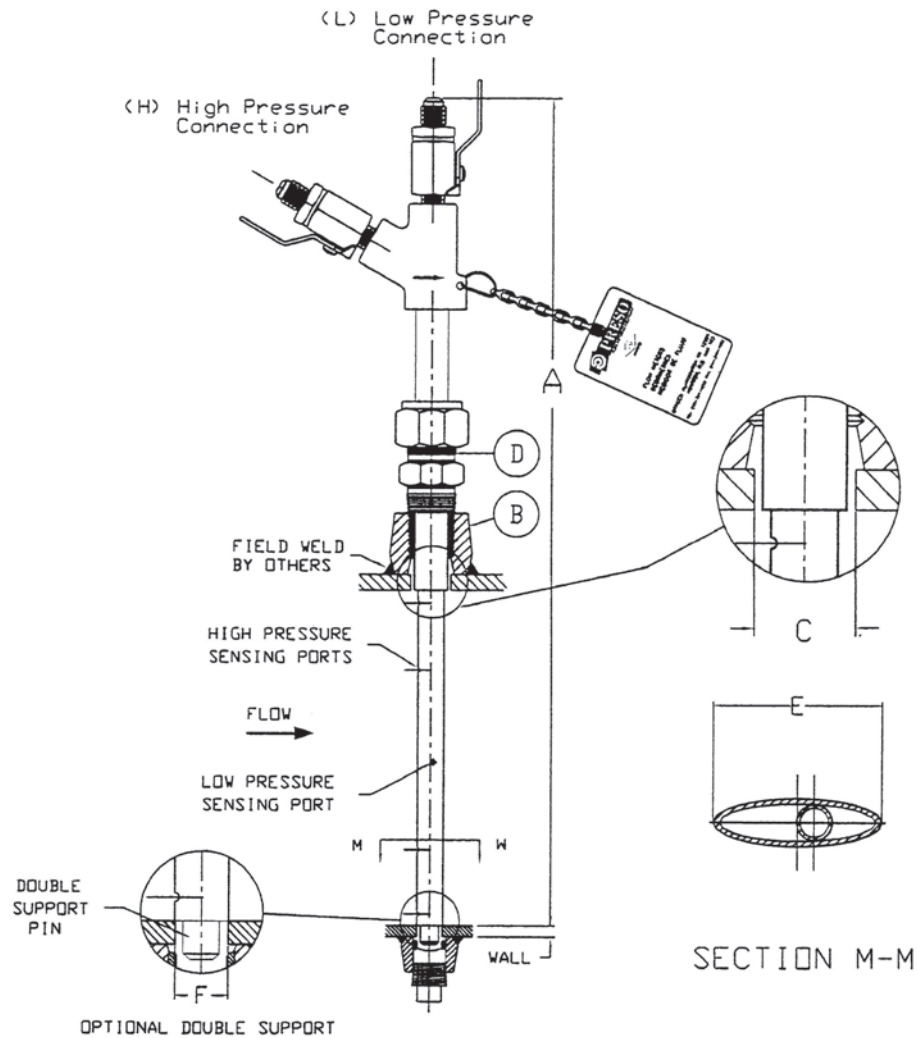
\* For higher pressure and temperature application please consult factory

## PIPE SIZE SPECIFICATIONS

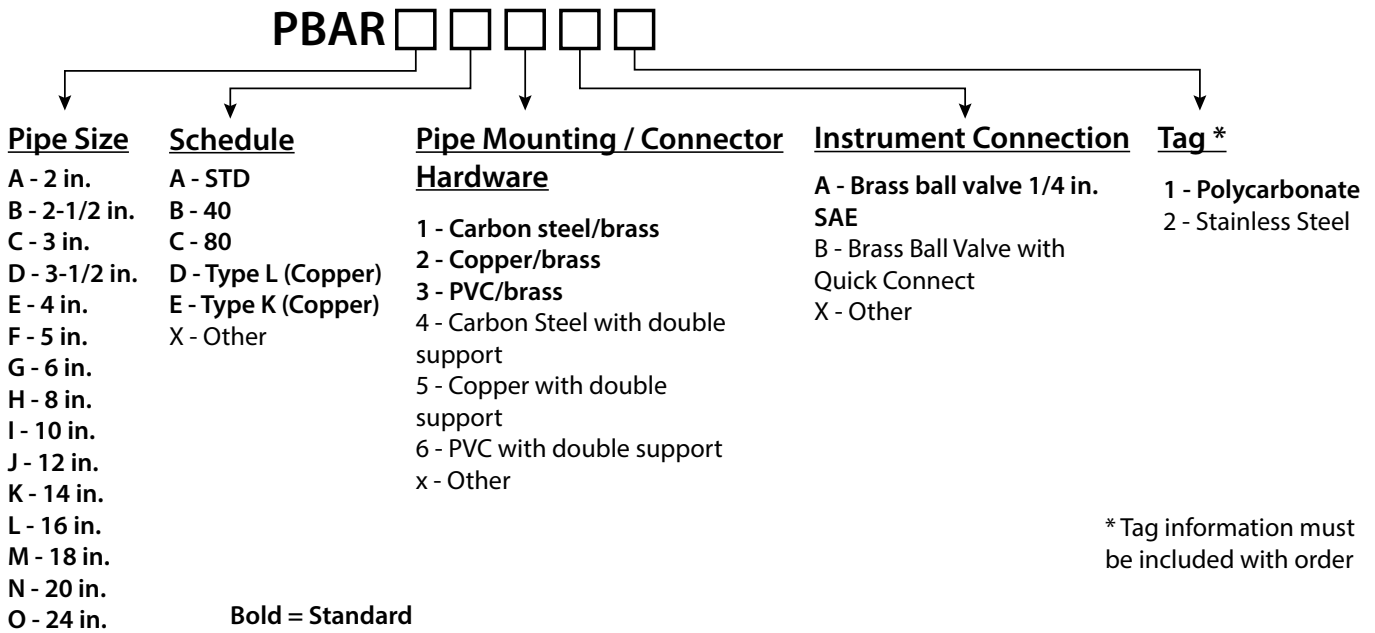
BAR Pipe Size (in.)	ELLIPSE size (in.)	Sensor Connection
2...5	1/2	1/2 in. Brass compression with SS ferrule
6...12	7/8	1 in. CS compression with SS ferrule
14...24	1-1/4	1-1/4 in. Brass compression with SS ferrule

**DIMENSIONS**

Size	Model	B in. (mm)	C in. (mm)	D in. (mm)	E Ellipse in. (mm)	F in. (mm)	App. Weight lbs (kg)
2 in.	PBARAXXX	0.5 (12.70)	0.625 (15.875)	0.5 (12.70)	0.5 (12.70)	0.375 (9.525)	2 (0.91)
2-1/2 in.	PBARBXXX	0.5 (12.70)	0.625 (15.875)	0.5 (12.70)	0.5 (12.70)	0.375 (9.525)	3 (1.36)
3 in.	PBARCXXX	0.5 (12.70)	0.625 (15.875)	0.5 (12.70)	0.5 (12.70)	0.375 (9.525)	3 (1.36)
3-1/2 in.	PBARDXXX	0.5 (12.70)	0.625 (15.875)	0.5 (12.70)	0.5 (12.70)	0.375 (9.525)	3.5 (1.59)
4 in.	PBAREXXX	0.5 (12.70)	0.625 (15.875)	0.5 (12.70)	0.5 (12.70)	0.375 (9.525)	3.5 (1.59)
5 in.	PBARFXXX	0.5 (12.70)	0.625 (15.875)	0.5 (12.70)	0.5 (12.70)	0.375 (9.525)	4 (1.81)
6 in.	PBARGXXX	1 (25.40)	1.125 (28.575)	1 (25.40)	0.875 (22.225)	0.5 (12.70)	4.5 (2.04)
8 in.	PBARHXXX	1 (25.40)	1.125 (28.575)	1 (25.40)	0.875 (22.225)	0.5 (12.70)	4.5 (2.04)
10 in.	PBARIXXX	1 (25.40)	1.125 (28.575)	1 (25.40)	0.875 (22.225)	0.5 (12.70)	5 (2.27)
12 in.	PBARJXXX	1 (25.40)	1.125 (28.575)	1 (25.40)	0.875 (22.225)	0.5 (12.70)	5.5 (2.49)
14 in.	PBARKXXX	1.25 (31.75)	1.375 (34.925)	1.25 (31.75)	1.25 (31.75)	0.875 (22.225)	6.5 (2.95)
16 in.	PBARLXXX	1.25 (31.75)	1.375 (34.925)	1.25 (31.75)	1.25 (31.75)	0.875 (22.225)	7 (3.18)
18 in.	PBARMXXX	1.25 (31.75)	1.375 (34.925)	1.25 (31.75)	1.25 (31.75)	0.875 (22.225)	7.5 (3.40)
20 in.	PBARNXXX	1.25 (31.75)	1.375 (34.925)	1.25 (31.75)	1.25 (31.75)	0.875 (22.225)	8 (3.63)
24 in.	PBAROXXX	1.25 (31.75)	1.375 (34.925)	1.25 (31.75)	1.25 (31.75)	0.875 (22.225)	9 (4.08)



**PART NUMBER MATRIX**



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#### DESCRIPTION

The Preso ELLIPSE<sup>®</sup> Model BHL (Annular Hot Tap Dual Rod) is a multi-ported, self averaging differential pressure flow element.

#### CONFIGURATION

The flow element has a two piece construction: an elliptical shape and two 100% independent flow sensing chambers. This construction prevents signal degradation and mixing, and does not require dampening hardware or software. The impact velocity sensing holes are located along the leading edge and the true static sensing holes are on the exterior probe side. This does not generate any vortices or vacuum effects that impinge on the static pressure measurement sensing area and has a drag coefficient of 0.32 or less. Each flow sensor is complete with instrument shutoff valves with provisions to accept a transmitter or direct indicating meter. An identification tag is supplied with specific flow station measurement information, as required.

#### ACCURACY & REPEATABILITY

The accuracy of the flow element is within  $\pm 0.75\%$  with a repeatability of  $\pm 0.1\%$  and turndown ratio of 17:1 in the corresponding and appropriate range of Reynolds' Numbers. Certified, independent test data is available from NIST laboratories in similar line sizes as well as in liquids and gases.

#### APPLICABLE FLUIDS

Liquids and gases.

#### COMPONENTS

All sensors are furnished with 1/4 in. instrument ball valves, threaded weld fitting, threaded ball valve, threaded insert/retract mechanism with rods, and ID tag as standard equipment. Available options include: Integral 3-valve or 5-valve transmitter mount manifold and integral RTD temperature sensor.



#### FEATURES

- No separation effects on the low (static) pressure
- Turndown ratio of 17:1
- No vacuum effects
- No vortex generation
- Very high repeatability
- Accuracy of  $\pm 0.75\%$  uncalibrated
- Low drag coefficient

## SPECIFICATIONS

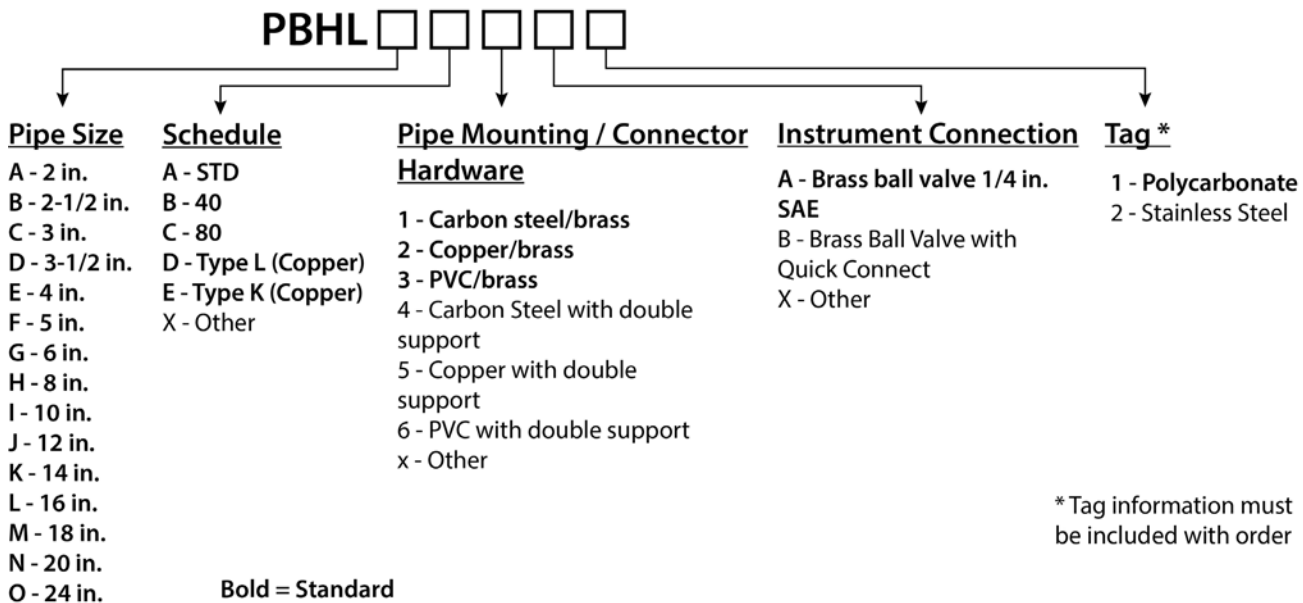
Name	Specification
Probe Construction	316 Stainless steel
Head	"Y" type, brass 1/8 in. FNPT
Instrument Valves	1/4 in. SAE flare brass ball type
Packing Gland	Molythane with CS cage nipple & close nipple
Retract Assembly	CS rods, nuts & bolts
ID Tag	Polycarbonate
Temperature Maximum *	250° F (120° C)
Pressure Maximum *	400 PSIG (2760 kPa)

\* For higher pressure and temperature application please consult factory

## PIPE SIZE SPECIFICATIONS

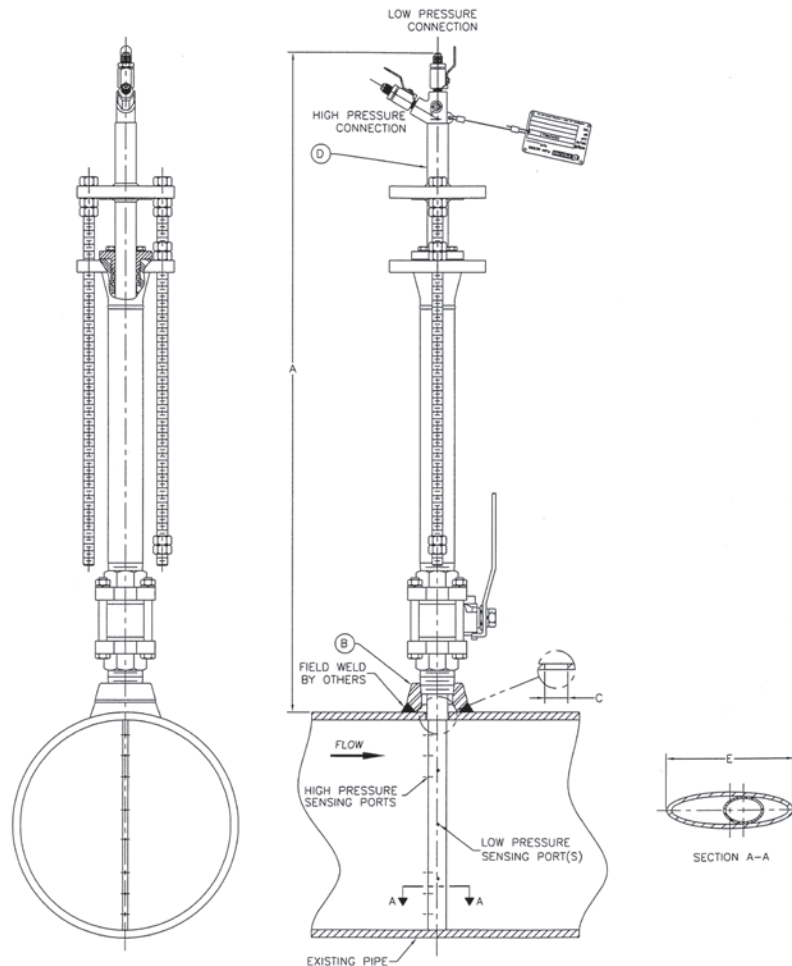
BHL Pipe Size (in.)	ELLIPSE size (in.)	Pipe Mounting	Isolating Valve
2...5	1/2	3/4 in. 3000# CS thread-o-let	3/4 in. Bronze ball valve
6...12	7/8	1-1/4 in. 3000# CS thread-o-let	1-1/4 in. Bronze ball valve
14...24	1-1/4	1-1/2 in. 3000# CS thread-o-let	1-1/2 in. Bronze ball valve

## MODEL SELECTOR



**SUBMITTAL DATA**

SIZE	MODEL	A HEIGHT inch (mm)	B NPT inch (mm)	C DIA inch (mm)	D DIA inch (mm)	E ELLIPSE inch (mm)
2 in.	PBHLAXXX	22.75 (577.9)	0.75 (19)	0.625 (15.8)	0.5 (12.7)	0.5 (12.7)
2-1/2 in.	PBHLBXXX	24.25 (616)	0.75 (19)	0.625 (15.8)	0.5 (12.7)	0.5 (12.7)
3 in.	PBHLCXXX	23.75 (603.2)	0.75 (19)	0.625 (15.8)	0.5 (12.7)	0.5 (12.7)
3-1/2 in.	PBHLDXXX	24.25 (616)	0.75 (19)	0.625 (15.8)	0.5 (12.7)	0.5 (12.7)
4 in.	PBHLEXXX	24.25 (616)	0.75 (19)	0.625 (15.8)	0.5 (12.7)	0.5 (12.7)
5 in.	PBHLFXXX	25.75 (654)	0.75 (19)	0.625 (15.8)	0.5 (12.7)	0.5 (12.7)
6 in.	PBHLGXXX	33 (838.2)	1.25 (31.7)	1.0 (25.4)	1.0 (25.4)	0.875 (22.2)
8 in.	PBHLHXXX	35 (889)	1.25 (31.7)	1.0 (25.4)	1.0 (25.4)	0.875 (22.2)
10 in.	PBHLIXXX	37 (939.8)	1.25 (31.7)	1.0 (25.4)	1.0 (25.4)	0.875 (22.2)
12 in.	PBHLJXXX	39 (990.6)	1.25 (31.7)	1.0 (25.4)	1.0 (25.4)	0.875 (22.2)
14 in.	PBHLKXXX	44 (1117.6)	1.5 (38.1)	1.25 (31.7)	1.25 (31.7)	1.25 (31.7)
16 in.	PBHLLXXX	46 (1168.4)	1.5 (38.1)	1.25 (31.7)	1.25 (31.7)	1.25 (31.7)
18 in.	PBMLMXXX	48 (1219.2)	1.5 (38.1)	1.25 (31.7)	1.25 (31.7)	1.25 (31.7)
20 in.	PBHLNXXX	50 (1270)	1.5 (38.1)	1.25 (31.7)	1.25 (31.7)	1.25 (31.7)
24 in.	PBHLQXXX	54 (1371.6)	1.5 (38.1)	1.25 (31.7)	1.25 (31.7)	1.25 (31.7)



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### DESCRIPTION

The Preso ELLIPSE<sup>®</sup> Model BAR (Annular Commercial) is a multi-ported, self averaging differential pressure type ELLIPSE flow element.

### CONFIGURATION

The flow element has a two-piece construction: an elliptical shape and two 100% independent flow sensing chambers. This construction prevents signal degradation and mixing, and does not require dampening hardware or software. The impact velocity sensing holes are located along the leading edge and the true static sensing holes are on the exterior probe side. This does not generate any vortices or vacuum effects that impinge on the static pressure measurement sensing area and has a drag coefficient of 0.32 or less. Each flow sensor is complete with instrument shutoff valves with provisions to accept a transmitter or direct indicating meter. An identification tag is supplied with specific flow station measurement information, as required.

### ACCURACY AND REPEATABILITY

The accuracy of the flow element is within  $\pm 0.75\%$  with a repeatability of  $\pm 0.1\%$  and turndown ratio of 17:1 in the corresponding and appropriate range of Reynolds' Numbers. Certified, independent test data is available from NIST laboratories in similar line sizes as well as in liquids and gases.

### APPLICABLE FLUIDS

Liquids and gases.

### COMPONENTS

All sensors are furnished with 1/4 in. instrument ball valves, threaded weld fitting, threaded ball valve, threaded cage nipple, threaded compression fitting, and ID tag as standard equipment. Integral 3-valve or 5 valve transmitter mount manifold and integral RTD temperature sensor are available as options.



### FEATURES

- No separation effects on the low (static) pressure
- Turndown ratio of 17:1
- No vacuum effects
- No vortex generation
- Very high repeatability
- Accuracy of  $\pm 0.75\%$  uncalibrated
- Low drag coefficient

## METER SPECIFICATIONS

Name	Specification
Probe Construction	316 Stainless steel
Head	"Y" type, brass 1/8 in. FNPT
Instrument Valves	1/4 in. SAE flare brass ball type
Retract Assembly	Wet tap
ID Tag	Polycarbonate
Temperature Maximum *	120° F (49° C)
Pressure Maximum *	75 PSIG (517 kPa)

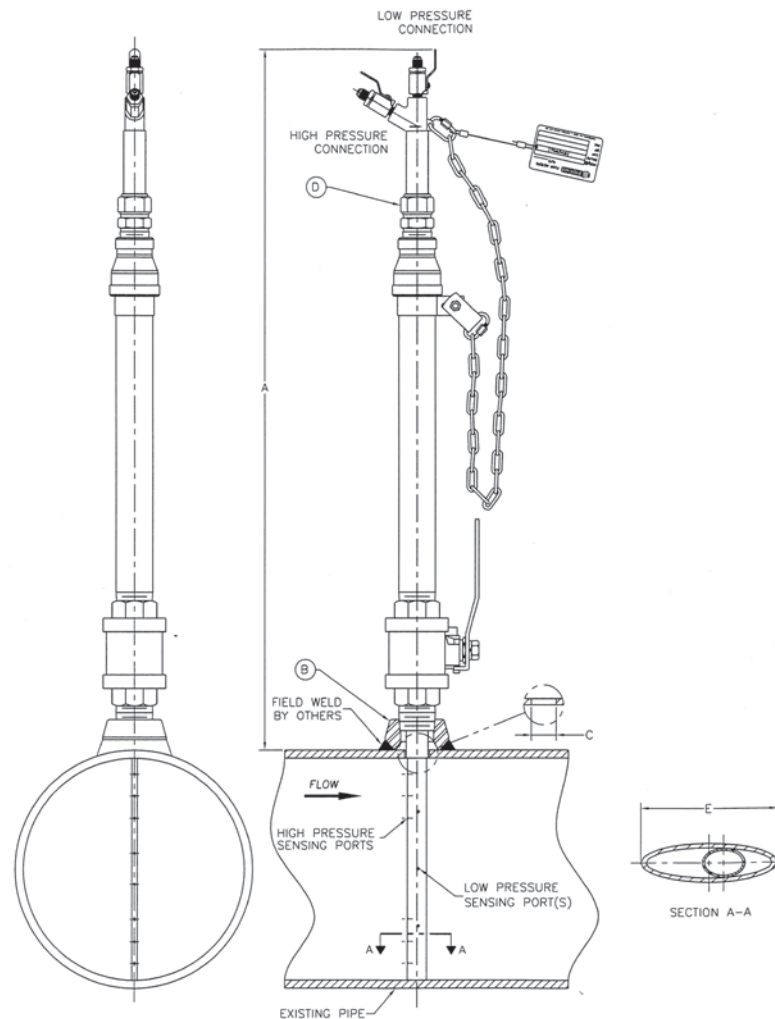
\* For higher pressure and temperature application please consult factory

## PIPE SIZE SPECIFICATIONS

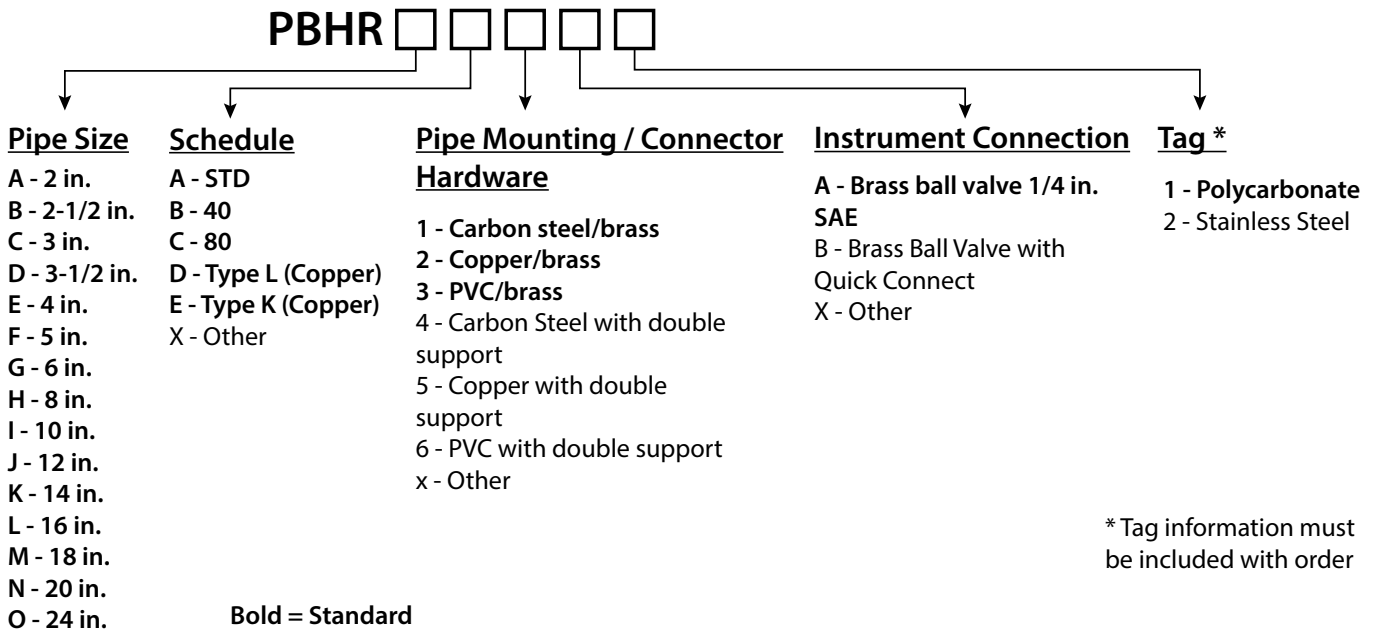
BHR Pipe Size	ELLIPSE size	Sensor Connection	Pipe Mounting	Isolating Valve
2...5 in.	1/2 in.	1/2 in. Brass compression with SS ferrule	3/4 in. 3000# CS thread-o-let	3/4 in. Bronze ball valve
6...12 in.	7/8 in.	1 in. CS compression with SS ferrule	1-1/4 in. 3000# CS thread-o-let	1-1/4 in. Bronze ball valve
14...24 in.	1-1/4 in.	1-1/4 in. Brass compression with SS ferrule	1-1/2 in. 3000# CS thread-o-let	1-1/2 in. Bronze ball valve

**DIMENSIONS**

Size	Model	A Height in. (mm)	B NPT in. (mm)	C DIA in. (mm)	D DIA in. (mm)	E Ellipse in. (mm)
2 in.	PBHRAXXX	12 (304.80)	0.75 (19.05)	0.625 (15.875)	0.5 (12.70)	0.5 (12.70)
2-1/2 in.	PBHRBXXX	12.5 (317.50)	0.75 (19.05)	0.625 (15.875)	0.5 (12.70)	0.5 (12.70)
3 in.	PBHRCXXX	13 (330.20)	0.75 (19.05)	0.625 (15.875)	0.5 (12.70)	0.5 (12.70)
3-1/2 in.	PBHRDXXX	13.5 (342.90)	0.75 (19.05)	0.625 (15.875)	0.5 (12.70)	0.5 (12.70)
4 in.	PBHEXXX	14 (355.60)	0.75 (19.05)	0.625 (15.875)	0.5 (12.70)	0.5 (12.70)
5 in.	PBHFXXX	15 (381.00)	0.75 (19.05)	0.625 (15.875)	0.5 (12.70)	0.5 (12.70)
6 in.	PBHGXXX	23.5 (596.90)	1.25 (31.75)	1.125 (28.575)	1.0 (25.4)	0.875 (22.225)
8 in.	PBHRHXXX	25.5 (647.70)	1.25 (31.75)	1.125 (28.575)	1.0 (25.4)	0.875 (22.225)
10 in.	PBHRIXXX	27.375 (695.325)	1.25 (31.75)	1.125 (28.575)	1.0 (25.4)	0.875 (22.225)
12 in.	PBHRJXXX	27.375 (695.325)	1.25 (31.75)	1.125 (28.575)	1.0 (25.4)	0.875 (22.225)
14 in.	PBHRKXXX	31.625 (803.275)	1.5 (38.10)	1.375 (34.925)	1.25 (31.75)	1.25 (31.75)
16 in.	PBHLXXX	33.625 (854.075)	1.5 (38.10)	1.375 (34.925)	1.25 (31.75)	1.25 (31.75)
18 in.	PBHRMXXX	35.625 (904.875)	1.5 (38.10)	1.375 (34.925)	1.25 (31.75)	1.25 (31.75)
20 in.	PBHRNXXX	37.625 (955.675)	1.5 (38.10)	1.375 (34.925)	1.25 (31.75)	1.25 (31.75)
24 in.	PBHROXXX	41.625 (1057.28)	1.5 (38.10)	1.375 (34.925)	1.25 (31.75)	1.25 (31.75)



**PART NUMBER MATRIX**



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## DESCRIPTION

The Ellipse<sup>®</sup> Annular Regular Flow Meter is a multi-ported, self-averaging differential pressure flow element for liquid and gas applications. The Ellipse flow meter is designed with a series of ports facing the upstream velocity pressures and flow sensing ports strategically located ahead of the trailing edge flow separation.

## COMPONENTS

All sensors are furnished with 1/2 in. (12 mm) instrument valves, flanged mounting hardware (with the proper ratings), and ID tag as standard equipment. Available options include integral 3-valve or 5-valve transmitter mount manifold and integral RTD temperature sensor.

## FEATURES

- Patented elliptical design
- Single point pipe entry for DP, temperature and static pressure
- No dampening software required
- Low pressure loss (typically 3% of DP in a 12 in. (304 mm) line) due to the patented aerodynamic profile
- NIST traceable calibration, optional independent labs
- Accuracy:  $\pm 0.75\%$  of reading, repeatability:  $\pm 0.1\%$  of reading
- Turndown Ratio: 17:1; no vacuum effects
- No moving part construction provides long, trouble-free service life
- True static pressure measurement rather than a calculated value
- Overcomes loss of accuracy caused by fluid separation at the sensor body

## CONFIGURATION

The flow element has a two-piece construction: an elliptical shape and two 100% independent flow sensing chambers. This construction prevents signal degradation and mixing, and does not require dampening hardware or software. The impact velocity sensing holes (high pressure) are located along the leading edge and the true static sensing holes (low pressure) are on the exterior probe side. This does not generate any vortices or vacuum effects that impinge on the static pressure measurement sensing area and has a drag coefficient of 0.32 or less. Each flow sensor is complete with instrument shutoff valves with provisions to accept a transmitter or direct indicating meter. An identification tag is supplied with specific flow station measurement information, as required.



## MAXIMUM ALLOWABLE DP (INCHES OF WATER COLUMN)

Pipe Size in. (mm)	Single Support Probe Size (in.)		Double Support Probe Size (in.)	
	7/8	1-1/4	7/8	1-1/4
2 (50.80)	880	—	2380	—
2-1/2 (63.50)	525	—	1558	—
3 (76.20)	396	—	1283	—
3-1/2 (88.90)	283	—	1117	—
4 (101.60)	197	—	980	—
5 (127.00)	153	—	757	—
6 (152.40)	126	—	669	—
8 (203.20)	114	360	512	—
10 (254.80)	100	240	315	960
12 (304.80)	87	175	250	700
14 (355.60)	53	147	195	585
16 (406.40)	—	113	—	450
18 (457.20)	—	90	—	360
20 (508.00)	—	74	—	295
24 (609.60)	—	68	—	270
26 (660.40)	—	50	—	215
30 (762.00)	—	34	—	155
32 (812.80)	—	—	—	—
36 (914.40)	—	—	—	—
42 (1066.80)	—	—	—	—

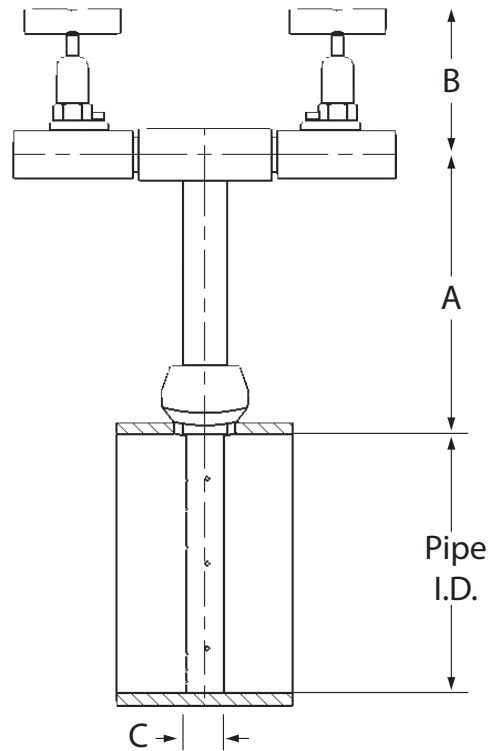
## SPECIFICATIONS

<b>Applications</b>	Liquids and gases
<b>Pipe Size</b>	2...72 in. (50...1830 mm)
<b>Pressure</b>	800 PSI (5515 kPa) max.
<b>Temperature</b>	800° F (426° C) max.
<b>Accuracy</b>	±0.75% of reading
<b>Repeatability</b>	±0.1%
<b>Turndown Ratio</b>	17:1 with no vacuum effect
<b>Reynolds Number</b>	>75,000: Maintains most accurate flow measurements <75,000: Consult factory for estimated results
<b>Resonance</b>	If greater than 0.8, use double support

## STANDARD COMPONENTS

Component	Specifications
Head	T-type
Connection	316 SS 1/4 in. or 1/2 in. FNPT
Compression Fitting	CS 3000 lb. with SS ferrule
Weld Fitting	CS 3000 lb. – ASTM A105
Instrument Valves	2 per sensor, 316/316L SS Ellipse – 1/4 in. CS
ID Tag	316 SS with wire

## DIMENSIONS



	Probe Length		Probe Width
	A	B	C
<b>ARO</b>	4.19 in. (106.38 mm)	2.25 in. (57.15 mm)	0.50 in. (12.70 mm)
<b>AR</b>	6.63 in. (168.28 mm)	3.13 in. (79.38 mm)	0.87 in. (22.10 mm)
<b>AR1</b>	6.63 in. (168.28 mm)	3.13 in. (79.38 mm)	1.25 in. (31.75 mm)

**PART NUMBER CONSTRUCTION**

**Ellipse®** Annular Regular  
1/2 in. DIAMETER

PAR0 -

<b><u>PIPE SIZE</u></b>								
2 in.	A							
2-1/2 in.	B							
3 in.	C							
3-1/2 in.	D							
4 in.	E							
5 in.	F							
<b><u>SCHEDULE</u></b>								
STD	A							
20	B							
30	C							
40	D							
60	E							
80	F							
100	G							
120	H							
140	I							
160	J							
XH	K							
XXH	L							
5S	M							
10S	N							
40S	O							
80S	P							
<b><u>PIPE ORIENTATION</u></b>								
Horizontal	A							
Vertical	B							
<b><u>PROBE MATERIAL</u></b>								
316/316L SS						1		
Monel®						2		
Inconel®						3		
Hastelloy®						4		
Other						X		
<b><u>INSTRUMENT CONNECTION</u></b>								
1/4 in. NPT							A	
<b><u>CONNECTION</u></b>								
SS Compression Fitting w/SS Ferrule								A
<b><u>PIPE MOUNTING</u></b>								
A105 CS 3000#								1
316/316L SS 3000#								2
316/316L SS 150# Coupling								3
A105 CS 3000# w/Double Support								4
316/316L SS 150# Coupling w/Double Support								5
316/316L SS 3000# w/Double Support								6
Not Required								Z
<b><u>INSTRUMENT VALVE</u></b>								
1/4 in. Needle CS								A
1/4 in. Needle SS								B
Not Required								Z

"CF" - Consult Factory

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

Transmitter mount not available for Model AR0. Please see Model AR

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)

Ellipse® Annular Regular  
7/8 in. DIAMETER

PAR -

**PIPE SIZE**

2 in.	A
2-1/2 in.	B
3 in.	C
3-1/2 in.	D
4 in.	E
5 in.	F
6 in.	G
8 in.	H
10 in.	I
12 in.	J
14 in.	K
16 in.	L
18 in.	M
20 in.	N
24 in.	O
30 in.	P
36 in.	Q

**SCHEDULE**

STD	A
20	B
30	C
40	D
60	E
80	F
100	G
120	H
140	I
160	J
XH	K
XXH	L
5S	M
10S	N
40S	O
80S	P

**PIPE ORIENTATION**

Horizontal	A
Vertical	B

**PROBE MATERIAL**

316/316L SS	1
Monel®	2
Inconel®	3
Hastelloy®	4
Other	X

**INSTRUMENT CONNECTION**

1/2 in. NPT	A
1/2 in. Socket	B
TT3 (Integral 3-Valve Trans Mount - Max Temp 225° F)	C
TT5 (Integral 5-Valve Trans Mount - Max Temp 225° F)	D
(RTD is not available with Integral 5-Valve Manifold. If RTD is required, select "E" Transmitter Flange Connection and the appropriate manifold valve under the Instrument Valve section below.)	
Transmitter Flange Connection	E

**CONNECTION**

CS Compression Fitting w/SS Ferrule	A
SS Compression Fitting w/SS Ferrule	B

**PIPE MOUNTING**

A105 CS 3000#	1
316/316L SS 3000#	2
316/316L SS 150# Coupling	3
A105 CS 3000# w/Double Support	4
316/316L SS 150# Coupling w/Double Support	5
316/316L SS 3000# w/Double Support	6
Not Required	Z

**INSTRUMENT VALVE**

1/4 in. Needle CS	A
1/4 in. Needle SS	B
Not Required	Z
ONLY AVAILABLE WITH OPTION "E" UNDER INSTRUMENT CONNECTION	
Fig x Fig 3-Valve Manifold CS - Max Temp 225° F	E
Fig x Fig 3-Valve Manifold SS - Max Temp 225° F	F
Fig x Fig 5-Valve Manifold CS - Max Temp 225° F	G
Fig x Fig 5-Valve Manifold SS - Max Temp 225° F	H
Customer Supplied Valve Manifold	I

**RTD (Max Temp 480° F, consult factory for higher temp options)**

100 Ohm RTD 3-Wire w/Explosion Proof Head	1
100 Ohm RTD 3-Wire, Integral w/Aluminum Head	2
Not Required	Z

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)



Ellipse® Annular Regular  
1-1/4 in. DIAMETER

PAR1 -

<b>PIPE SIZE</b>									
12 in.	J								
14 in.	K								
16 in.	L								
18 in.	M								
20 in.	N								
24 in.	O								
30 in.	P								
36 in.	Q								
42 in.	R								
48 in.	S								
60 in.	T								
72 in.	U								
<b>SCHEDULE</b>									
STD	A								
20	B								
30	C								
40	D								
60	E								
80	F								
100	G								
120	H								
140	I								
160	J								
XH	K								
XXH	L								
5S	M								
10S	N								
40S	O								
80S	P								
<b>PIPE ORIENTATION</b>									
Horizontal	A								
Vertical	B								
<b>PROBE MATERIAL</b>									
316/316L SS	1								
Monel®	2								
Inconel®	3								
Hastelloy®	4								
Other	X								
<b>INSTRUMENT CONNECTION</b>									
1/2 in. NPT	A								
1/2 in. Socket	B								
TT3 (Integral 3-Valve Trans Mount - Max Temp 225° F)	C								
TT5 (Integral 5-Valve Trans Mount - Max Temp 225° F)	D								
(RTD is not available with Integral 5-Valve Manifold. If RTD is required, select "E" Transmitter Flange Connection and the appropriate manifold valve under the Instrument Valve section below.)									
Transmitter Flange Connection	E								
<b>CONNECTION</b>									
CS Compression Fitting w/SS Ferrule	A								
SS Compression Fitting w/SS Ferrule	B								
<b>PIPE MOUNTING</b>									
A105 CS 3000#	1								
316/316L SS 3000#	2								
316/316L SS 150# Coupling	3								
A105 CS 3000# w/Double Support	4								
316/316L SS 150# Coupling w/Double Support	5								
316/316L SS 3000# w/Double Support	6								
Not Required	Z								
<b>INSTRUMENT VALVE</b>									
1/4 in. Needle CS	A								
1/4 in. Needle SS	B								
Not Required	Z								
ONLY AVAILABLE WITH OPTION "E" UNDER INSTRUMENT CONNECTION									
Fig x Fig 3-Valve Manifold CS - Max Temp 225° F	E								
Fig x Fig 3-Valve Manifold SS - Max Temp 225° F	F								
Fig x Fig 5-Valve Manifold CS - Max Temp 225° F	G								
Fig x Fig 5-Valve Manifold SS - Max Temp 225° F	H								
Customer Supplied Valve Manifold	I								
<b>RTD (Max Temp 480° F. consult factory for higher temp options)</b>									
100 Ohm RTD 3-Wire w/Explosion Proof Head	1								
100 Ohm RTD 3-Wire, Integral w/Aluminum Head	2								
Not Required	Z								

Stainless Steel ID Tag supplied as standard.  
Tag information must be included with order.

NOTE: Make sure that DP and Resonance are within acceptable limits. (See chart in the Ellipse Brochure)

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### DESCRIPTION

The BIN is a highly reliable averaging pitot tube which generates a pressure differential between its upstream (stagnation) ports and its downstream (static) ports that is proportional to the flow rate squared. It can be used to measure liquid or air in pipe sizes 2...24 in. An opposite support is supplied standard on pipe sizes 8 in. and larger.

### FEATURES

- Accuracy  $\pm 3\%$
- Easy low-cost installation - ideal for retrofits
- Very low pressure drop
- Bi-directional flow measurement capability

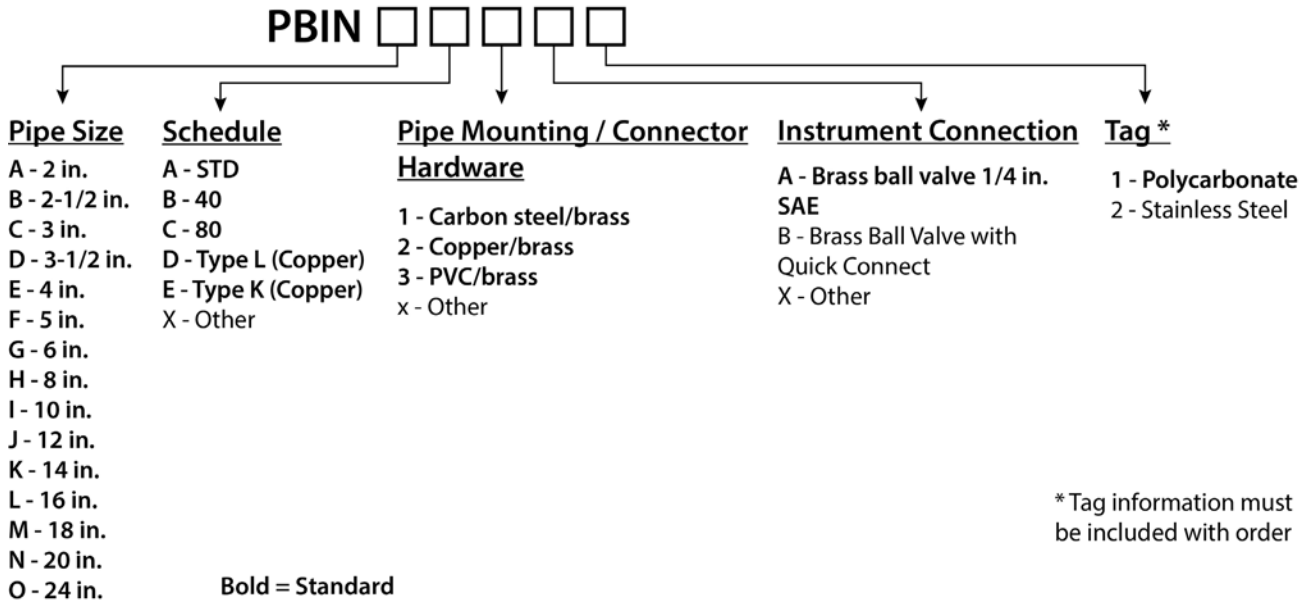
### SPECIFICATIONS

Name	Specification
Probe Construction	316 Stainless steel
Head	"Y" type, brass 1/8 in. FNPT
Pipe Mounting	3000# CS thread-o-let
Instrument Valves	1/4 in. SAE flare brass ball type
ID Tag	Polycarbonate
Temperature Maximum *	250° F (120° C)
Pressure Maximum *	400 PSIG (2760 kPa)

\* For higher pressure and temperature application please consult factory

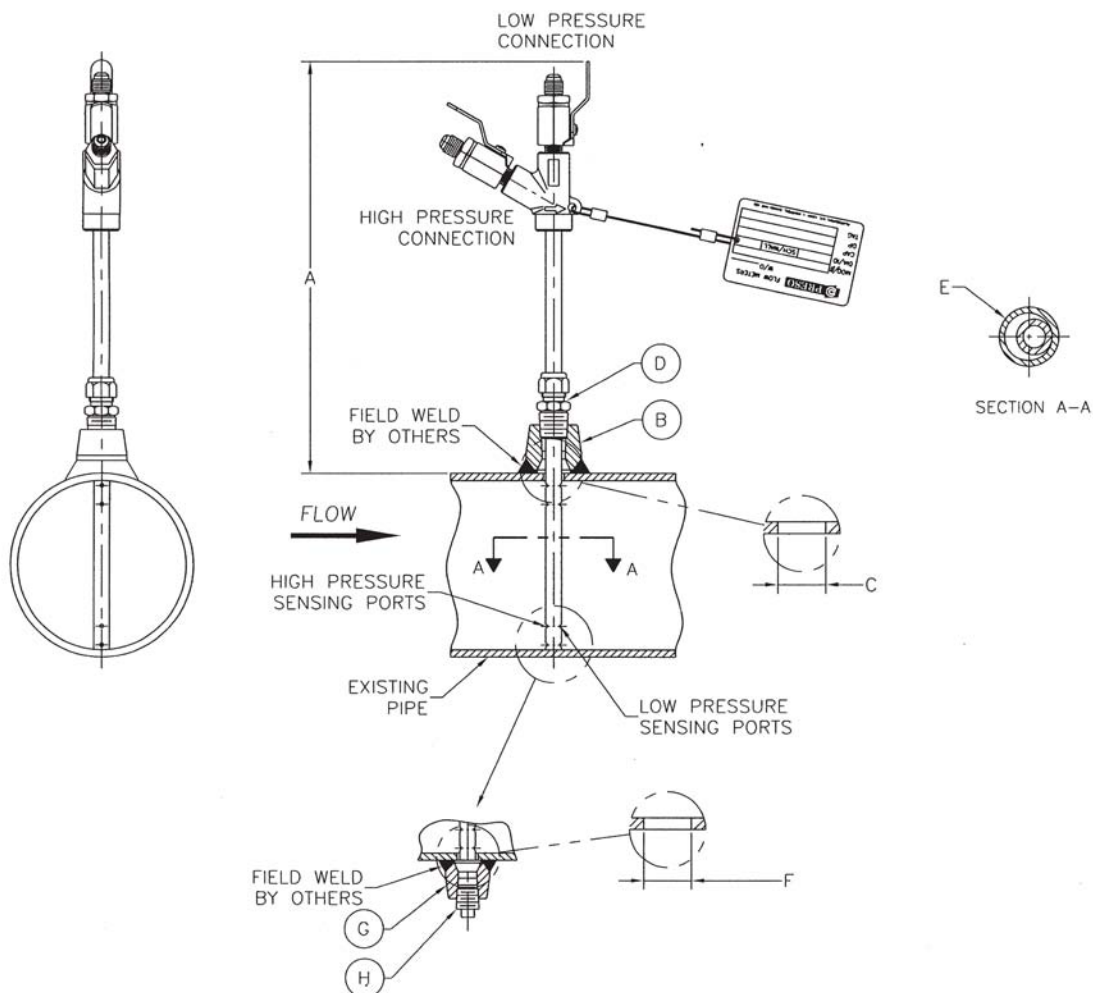


**MODEL SELECTOR**



**SUBMITTAL DATA**

Size	Model	A Height in. (mm)	B NPT in. (mm)	C DIM in. (mm)	D OD in. (mm)	E NPT in. (mm)	F NPT in. (mm)	App. Weight lbs (kg)
2 in.	PBINAXXXX	8.25 (209.55)	0.25 (6.35)	0.625 (15.80)	0.3125 (7.90)	—	—	1 (0.45)
2-1/2 in.	PBINBXXXX	8.25 (209.55)	0.25 (6.35)	0.625 (15.80)	0.3125 (7.90)	—	—	1 (0.45)
3 in.	PBINCXXXX	8 (203.20)	0.25 (6.35)	0.625 (15.80)	0.3125 (7.90)	—	—	1 (0.45)
3-1/2 in.	PBINDXXXX	8.25 (209.55)	0.25 (6.35)	0.625 (15.80)	0.3125 (7.90)	—	—	1 (0.45)
4 in.	PBINEXXXX	8.25 (209.55)	0.25 (6.35)	0.625 (15.80)	0.3125 (7.90)	—	—	1 (0.45)
5 in.	PBINFXXXX	8.75 (222.25)	0.375 (9.50)	0.625 (15.80)	0.375 (9.50)	—	—	1.25 (0.57)
6 in.	PBINGXXXX	8.75 (222.25)	0.375 (9.50)	1.125 (28.50)	0.375 (9.50)	—	—	1.25 (0.57)
8 in.	PBINHXXXX	8.38 (212.90)	0.375 (9.50)	1.125 (28.50)	0.375 (9.50)	0.25 (6.35)	0.25 (6.35)	1.5 (0.68)
10 in.	PBINIXXXX	8.38 (212.90)	0.375 (9.50)	1.125 (28.50)	0.375 (9.50)	0.25 (6.35)	0.25 (6.35)	1.5 (0.68)
12 in.	PBINJXXXX	9.38 (238.30)	0.5 (12.70)	1.125 (28.50)	0.5 (12.70)	0.375 (9.50)	0.375 (9.50)	2 (0.91)
14 in.	PBINKXXXX	10.25 (260.35)	1 (25.40)	1.375 (34.90)	1 (25.40)	1 (25.40)	1 (25.40)	4.25 (1.93)
16 in.	PBINLXXXX	10.38 (263.65)	1 (25.40)	1.375 (34.90)	1 (25.40)	1 (25.40)	1 (25.40)	4.25 (1.93)
18 in.	PBINMXXXX	10.38 (263.65)	1 (25.40)	1.375 (34.90)	1 (25.40)	1 (25.40)	1 (25.40)	4.5 (2.05)
20 in.	PBINNXXXX	10.25 (260.35)	1 (25.40)	1.375 (34.90)	1 (25.40)	1 (25.40)	1 (25.40)	4.5 (2.05)
24 in.	PBINOXXXX	10.25 (260.35)	1 (25.40)	1.375 (34.90)	1 (25.40)	1 (25.40)	1 (25.40)	4.5 (2.05)



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