- Superior Low-Flow Performance
- Error Free Installation
- PVC, Polypropylene, Brass, or 316 Stainless Steel
- Maximum Pressure

PVC	150 PSI @ 70°F
Polypropylene	175 PSI @ 70°F
Brass, 316 SS	150 PSI @ 70°F

- Maximum Temperature

PVC/Polypropylene	130°F
Brass/Stainless Steel	200°F

- Flow Range

	1/2"	3/4"	1"	1 1/2"	2"
Minimum	.28	.5	.8	1.9	3.1
Maximum	28	50	80	190	314

SPECIAL FEATURES

Excellent Low Flow Capabilities.
Using sapphire bearings and design elements to reduce friction the Hays IP Meter gives excellent low flow monitoring.

Installs in a Wide Range of Pipe Sizes.
A depth adjustment system allows the probe to be set for installation in a range of pipe sizes from 1/2" to 2". This preset depth insures error - free installation for optimal results.

Signal can Interface Without Signal Conditioning.
Square wave signal can interface with many programmable controllers and computer cards without signal conditioning.

Signal sent Through Unshielded Cable Hundreds of Feet.
Solid State Hall Effect Sensor is used to detect passage of six rotor blades. This eliminates magnetic drag and produces a square wave signal which can be sent up to 2000 feet over unshielded cable without a transmitter.

Field Repairable.
If damaged by dropping or other impact, the bearings and rotor can be purchased separately or a rebuilt IP kit containing rotor, bearings and replacement O-rings. This replacement is both simple and easy with a small screw driver.

TYPICAL APPLICATIONS

- **Chemical Proportioning**
- **Flow Rate Monitoring**
- **Water Treatment Control**

ORDERING OPTIONS

Probe Body:

Brass
Stainless
PVC
Polypropylene

HOW TO ORDER

Specify: model, body option, pipe size Example: IP81B 1"

Model	Pipe Size	Options
IP 81	1/2" - 2"	B - Brass S - Stainless Steel P - PVC PP - Poly Pro (Consult Factory)

SPECIFICATIONS

Materials:

Probe body: Brass, Type 316 Stainless Steel, PVC or Polypropylene
Rotor: Kynar
Shaft: Tungsten Carbide
Bearings: Ruby Ring, Sapphire End Stone, set in 316 Stainless Steel
Installation Fitting: Brass, 316 Stainless Steel, PVC or Polypropylene
Power: 6-24 VDC, 10 mA
Signal: Square Wave, Current Sinking Output, 20mA Maximum
Cable: #22 AWG 3-Conductor, 18' Standard, 2,000' Max. to Control

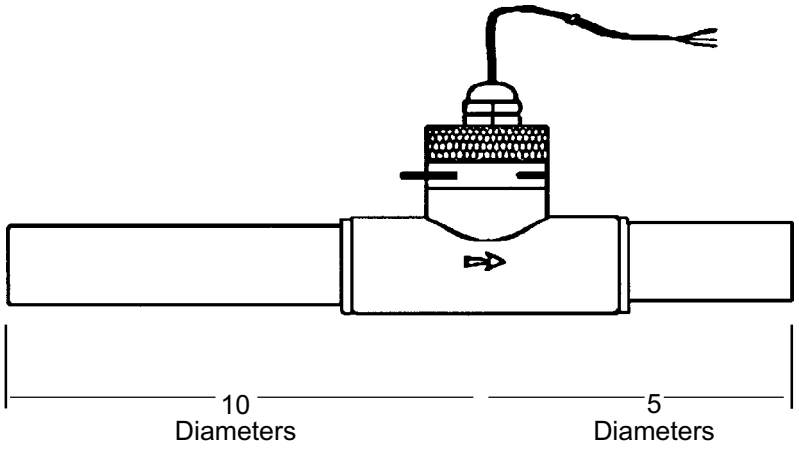
Accuracy: ± 1% of Full Scale
Maximum Working Pressure: Brass, 316 SS 250 PSI - PVC, Poly Pro 150 PSI at 70ºF
Maximum Temperature: Brass, 316 SS 200ºF - PVC, Poly Pro 130ºF

Flow Range (GPM):	1/2"	3/4"	1"	1 1/2"	2"
Minimum	.28	.5	.8	1.9	3.1
Maximum	28	50	80	190	314

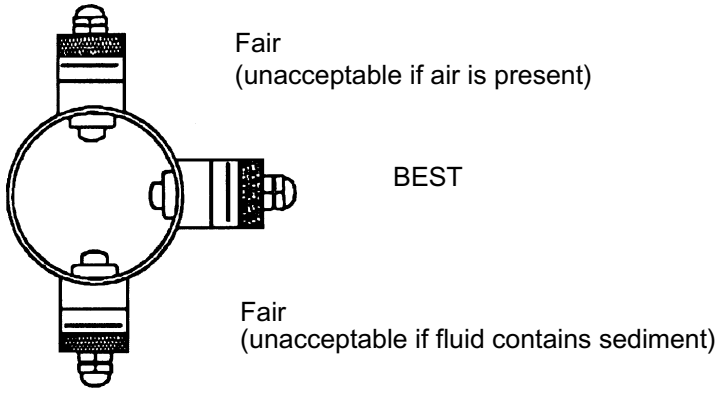
K-Factor: Indicated on Meter Fitting

INSTALLATION

FITTINGS: IP 81 Insertion Meters require special fittings. The meter fitting must first be installed in the pipeline. It is strongly recommended that straight pipe of at least 10 pipe diameters upstream and 5 pipe diameters downstream of the meter be utilized for optimum performance. Inadequate straight pipe or any change in pipe diameter can result in significant inaccuracy. Typically the meter will read high. A PVC fitting is usually installed by solvent welding. The stainless steel and brass meter fittings have male pipe threads, requiring the appropriate female threaded fittings.



METER INSTALLATION: After the meter fitting is installed in the pipeline, the meter can be installed in the fitting. Press the meter into the fitting as far as possible. Retain the meter with the u-clip which can be installed from either side. Slide u-clip in as far as it will go. It may be necessary to rotate probe slightly to start u-clip into the slots.



CAUTION: NEVER REMOVE U-CLIP RETAINER WHEN PIPE IS PRESSURIZED. ALWAYS REMOVE PRESSURE FROM PIPE BEFORE ATTEMPTING REMOVAL OF METER. REMOVAL UNDER PRESSURE MAY RESULT IN DAMAGE OR SERIOUS INJURY.

INSTALLATION (cont'd)

METER CONNECTION: Unless the meter is supplied preconnected to a meter mounted FT400 flow indicator, three leads must be connected. The red wire to 6-24 VDC positive, the black wire to DC negative and the white wire to signal.

K-FACTOR: When the IP 81 meter is ordered with its fitting, the meter is factory calibrated in the fitting. A K-Factor is indicated on the side of the fitting and represents the actual number of pulses per gallon the meter produced during the flow test. This number when entered into the flow indicator provides the correct read out. If using a pulse rate divider, the K-factor is the starting point for calculating the divider number. Refer to K-Factor chart in this chapter.

MAINTENANCE AND REPAIR:

Rotor and Sensor - It is very unusual for a rotor or sensor to require replacement in normal use.

Rotor Replacement is required if rotor assembly has been damaged or if shaft is worn after long service. If bearings have been damaged they must also be replaced. Replacement of rotor and bearings is simple and can be accomplished at site of meter installation. Contact factory for rotor repair kit.

Sensor Replacement The primary cause of sensor failure is overvoltage or incorrect polarity when sensor leads are connected.

To replace sensor, leave meter in the fitting to prevent the meter from turning. Loosen the cable strain relief, unthread the meter cap (knurled portion of the meter body) with a strap wrench. Remove the sensor capsule by pulling the cable. The new sensor can then be installed. It is important to orient the sensor cable properly. The visible line on the face of the sensor capsule should be installed approximately parallel to the rotor slot which is also parallel to the centerline of the pipe. To hold sensor in position, apply a few drops of thread locking compound or fast setting adhesive to the sensor capsule. When adhesive has set, replace the meter cap. Tighten the meter cap very tight with a strap wrench to prevent it from backing out while installing or removing the meter. Finally, tighten the strain relief around the cable.

TX80 - Insertion Turbine Meter

Sensor

Hall Effect Sensor	12 VDC current sinking pulse

Materials

Sensor Body	Polypro, Brass, or 316 SS
Rotor	Polypro, Kynar opt.
Shaft	Nickel-bound tungsten carbide,ceramic opt.
Bearings	Ruby ring, sapphire endstone

Pipe Size

TX81	1/2" to 3", Tee fittings
TX82	4" to 8", Saddle fittings, weldolets

Maximum Pressure

Polypro	175 PSI at 75º
Brass	250 PSI
316 SS	500 PSI

Maximum Temperature 130º F at 0 PSI (Polypro)
200º F (Brass, SS)

Flow Range (GPM)

	TX81						TX82		
	1/2"	3/4"	1"	1-1/2"	2"	3"	4"	6"	8"
Min.	0.28	0.5	0.8	1.9	3.1	6.9	12	27	47
Max.	28	50	80	190	314	691	1200	2700	4700

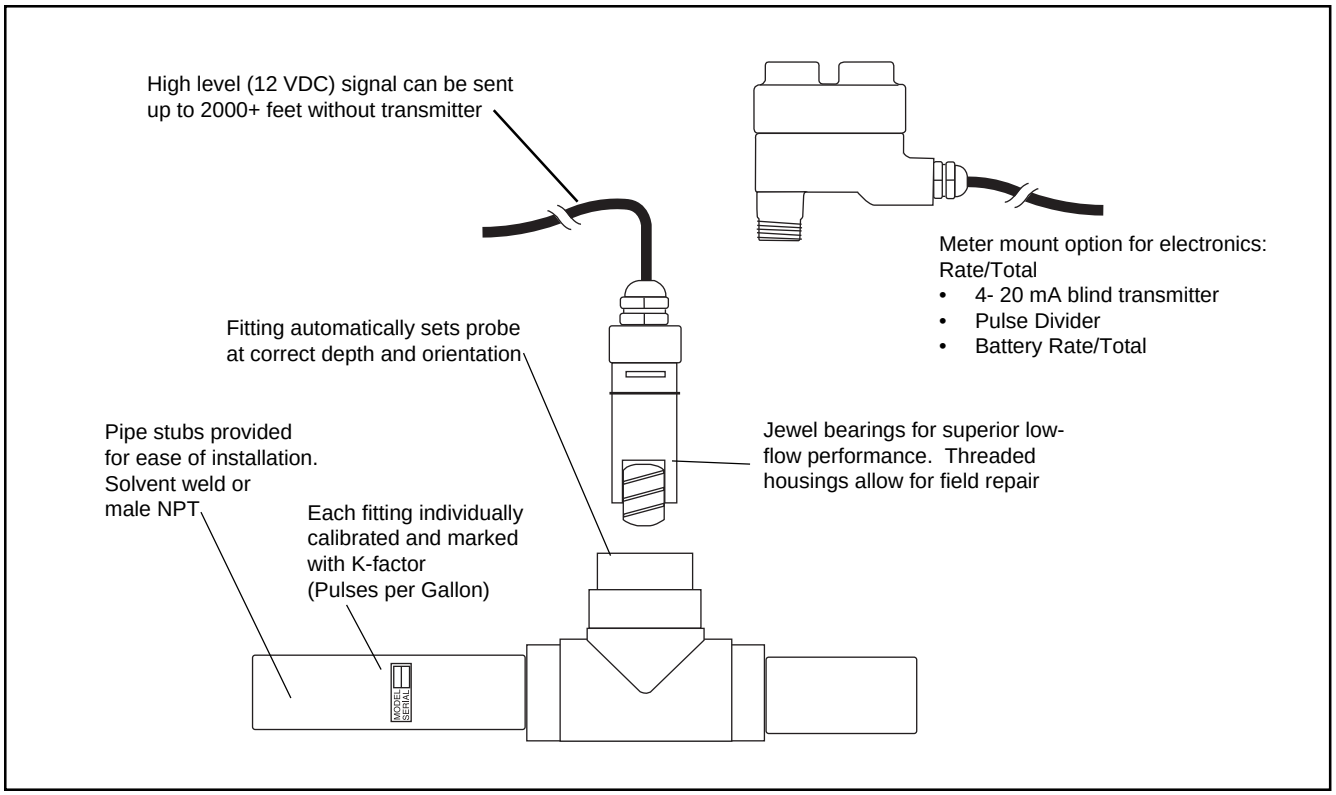
GENERAL INFORMATION

The TX80 Series are turbine-type insertion meters de-signed for use in pipe sizes 1/2" to 8". High-quality jewel bearings and nickel-bound tungsten carbide shaft are used in both the TX81, for pipe sizes 1/2" to 3", and the TX82, for pipe sizes 4" to 8". Bodies are machined from solid rod for maximum precision. Low-flow performance is superior. The rotation of the rotor is detected by a non-drag Hall-effect sensor. Output is a pulse-type square wave, which can be sent long distances (up to 2,000 feet) without a transmitter. This signal can be con-nected directly to Hays controls, as well as PLC's, counters, and computer cards. Battery operation using the FT96M battery-operated Flow Computer is also avail-able as an option.

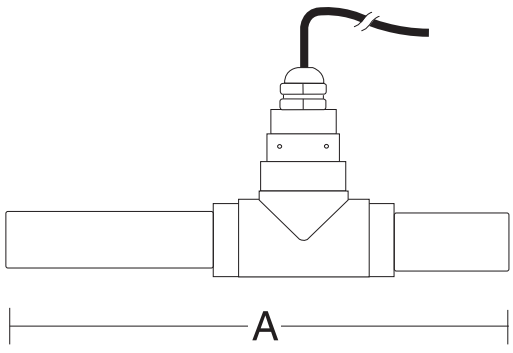
TX80 meters are ideal for chemical propor-tioning applications. For rate and total display, as well as pump pacing, the FT400 flow indicator can be mounted directly on the TX80 Series, or remotely on a wall or panel.

The TX80 Series require special fittings, since they are not depth-adjustable, installation in the fitting ensures correct depth placement in the pipe. Fittings are avail-able in PVC, brass, and stainless steel. Sensors are avail-able in brass, 316 stainless steel, and polypropylene.

SPECIFICATIONS



Note: For Brass, SS, and Carbon Steel, consult factory for fitting length dimensions.



Fitting Length

Size	Dim. A
1/2"	14-1/2"
3/4"	14-1/2"
1"	17-1/4"
1 1/2"	20"
2"	20"
3"	20"
4"	20"
6"	20"

How To Order

Material Code: Y = Polypro, B = Brass,
S = Stainless 316
Option Code: (See right)

TX81 _____ - _____
TX82 _____ - _____

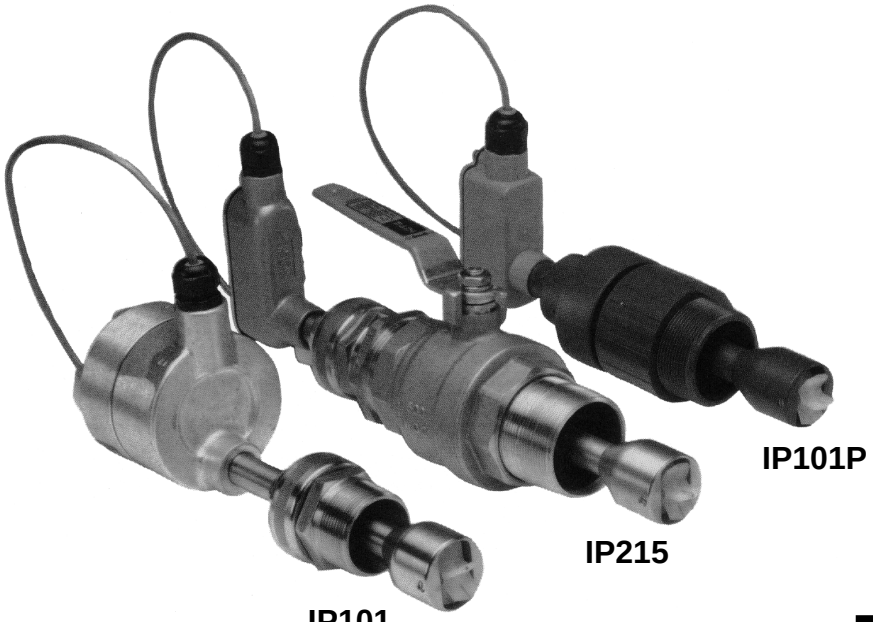
Option Codes:
05 High temp: PVDF rotor/ ceramic shaft
04 Passive pickup
06 LMI connector
07 conncetor
02 Bidirectional flow (Hall-Effect only)

- Accuracy: ±1% of Full Range
- Range: .3 — 30 fps
- Max. Working Pressure 200 psi
- MaximumTemperature

  Brass/Stainless Steel 185°

  PVC - 0 psi 140°

  150 psi 70°



IP101P

IP215

IP101
w/ FT400

SPECIAL FEATURES

Signal Sent Through Unshielded Cable Hundreds of Feet.
Solid State Hall Effect Sensor is used to detect passage of six rotor blades. This eliminates magnetic drag, and produces a square wave signal which can be sent for hundreds of feet without a transmitter, over unshielded cable.

Installs in a Wide Range of Pipe Sizes.
A depth adjustment system allows the probe to be set for installation in a wide range of pipe 1½" — 48".

Field Repairable.
If damaged by dropping or other impact , the bearings and rotor can be purchased separately or a rebuilt IP kit containing rotor, bearings and replacement O-rings. This replacement is both simple and easy with a small screw driver.

Excellent Low Flow Capabilities.
Using sapphire bearings and design elements to reduce friction, the Hays IP Meter gives excellent low flow monitoring.

Signal can Interface without Signal Conditioning.
Square wave signal can interface with many programmable controllers and computer cards without signal conditioning.

- **Chemical Proportioning**
- **Flow Rate Monitoring**
- **SCADA (Supervisory Control & Data Acquisition)**

ORDERING OPTION

- **Stainless Steel Rotor**
- **Tungsten Carbide Shaft**
- **All Stainless Steel Meter**
- **High Temp. (250°) / High Press. (500 lbs.)**

HOW TO ORDER

Model	Size	Options
IP Meter 101	(pipe 1.5" - 10")	B - Brass
IP Meter 201	(pipe 1.5" - 48")	S - Stainless Steel
		P-PVC (Consult Factory)

SPECIFICATIONS

Materials:

Probe body: Brass, Type 316 Stainless Steel, PVC

Rotor: Kynar

Shaft: Proprietary High-Nickel Alloy

Bearings: Ruby ring, Sapphire End Stone, set in 316 Stainless Steel

Installation Fitting: Brass or 316 Stainless Steel, 1½" Male NPT

Power: 6-24 VDC, 6mA

Signal: Square Wave, 11 Hz/FPS (approx.), Current Sinking Output, 20 mA Maximum

Cable: #22 AWG 3-conductor, 18' standard, 2,000' max. to control

Accuracy: +/- 1% of Full Scale

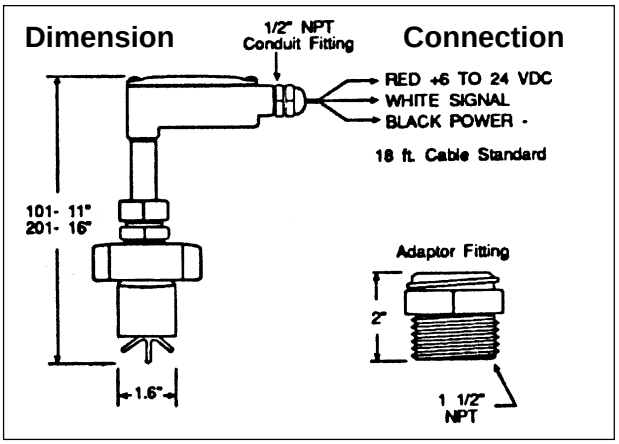
Range: 0.3 — 30 FPS

Maximum Working Pressure: 200 PSI

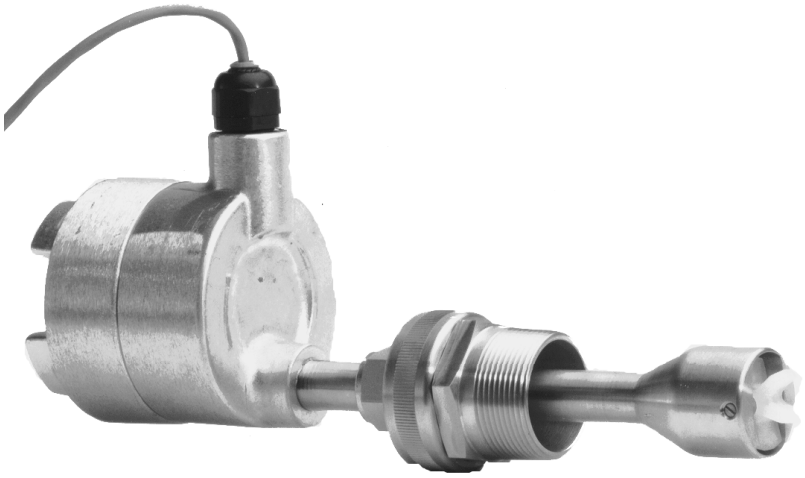
Temperature Range: Brass/Stainless Steel 185°F
PVC- O PSI 140°F
150 PSI 70°F

Shipping Weight: 101B/101S-4 lbs.,101P-2.5 lbs.
201B and 201S - 5 lbs.

Pipe Size Range: IP101B,S - 1 1/2" to 10"
IP101P - 2" to 10"
IP201B,S,P - 1 1/2" to 48"



Instruction Manual



SPECIAL FEATURES

- **INSTALLS IN A WIDE RANGE OF PIPE SIZES**
- **EXCELLENT LOW-FLOW PERFORMANCE**
- **FIELD REPAIRABLE**

Sapphire bearings and precision molded rotor contribute to the exceptional low-flow performance and linearity of this insertion meter. Threaded bearing housings also allow easy field repair if the rotor or bearings become damaged.

A solid-state Hall-effect sensor is used to detect the passage of the six rotor blades. This eliminates magnetic drag, and produces a square wave signal which can be sent for hundreds of feet without a transmittter, over upshielded cable. This signal interfaces with many programmable controllers and computer cards without signal conditioning. The Hays FT500 provides rate, total, high/low flow relays, and a scaled pulse output. The CX30 can be used for pump pacing.

Installation fittings are standard 1½" male NPT for brass and stainless steel. Installation fittings are standard 2" male NPT for PVC. A depth adjustment system allows the probe to be set for installation in a wide range of piping. Iron, nylon coated, brass, plastic and stainless steel fittings are available from Hays. (For applications requiring installation in a pressurized pipe, without shutdown, see the IP Hot Tap specification sheet).

TYPICAL APPLICATIONS

- **Chemical Proportioning**
- **Flow rate monitoring**
- **SCADA (Supervisory Control & Data Acquisition)**

SPECIFICATIONS

Materials:

Probe body: Brass, Type 316 Stainless Steel, PVC
Rotor: Kynar
Shaft: Proprietary High-Nickel Alloy
Bearings: Ruby ring, sapphire end stone, set in 316 stainless steel
Installation Fitting: Brass or 316 stainless steel, 1½" Male NPT
Power: 6-24 VDC, 6mA

ORDERING OPTIONS

- **STAINLESS STEEL ROTOR**
- **TUNGSTEN CARBIDE SHAFT**
- **ALL STAINLESS STEEL METER**
- **HIGH TEMP. (250°F) / HIGH PRESS. (500 LBS.)**

Signal: Square Wave, 11 Hz/FPS (approx.), Current Sinking Ouput, 20 mA Maximum
Cable: #22 AWG 3-Conductor, 18' Standard, 2,000' Max. to Control
Accuracy: +/- 1% of Full Scale
Range: 0.3 — 30 FPS
Maximum Working Pressure: 200 PSI
Temperature Range: Brass/Stainless Steel 185°F
PVC - O PSI 140°F
150 PSI 70°F
Shipping Weight: 101B/101S - 4 lbs.
101P - 2.5 lbs.
201B and 201S - 5 lbs.

Pipe Size Range: IP101B,S - 1 1/2" to 10"
IP101P - 2" to 10"
IP201B,S,P -1 1/2" to 48"

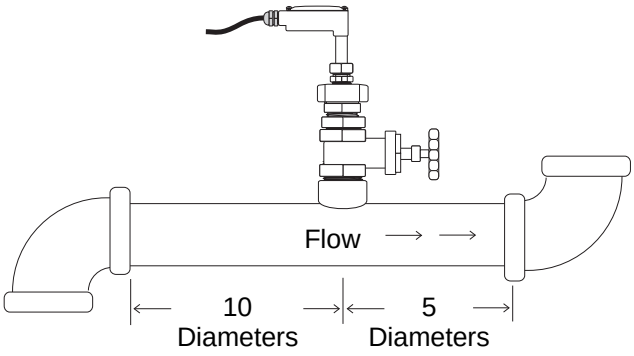
INSTALLATION

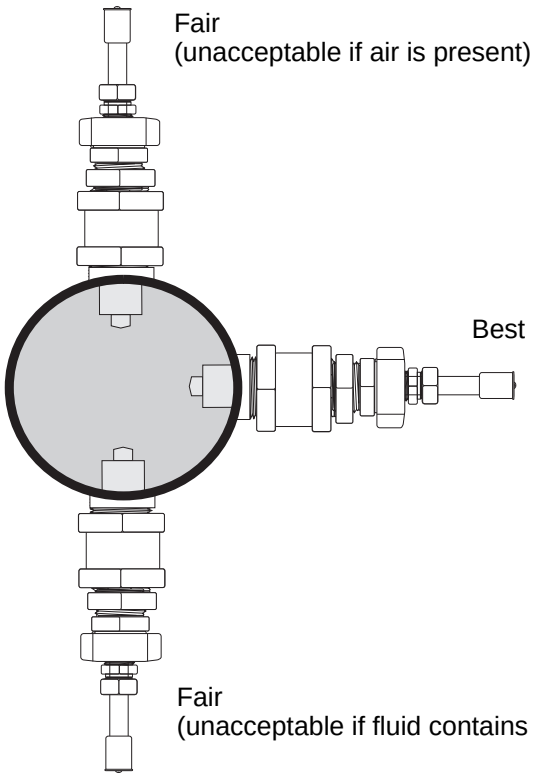
1. Piping Requirements. The IP meter can be installed in any size pipe from 1½" to 48". For best results, there should be at least ten diameters of straight pipe upstream of the meter, and five diameters downstream.

2. Fittings. All of the IP meters except the Hot Tap unit are supplied with a 1½" male NPT adaptor fitting which provides a 1½" female NPT thread, including saddles, tee, and weldolets. Tees are available from Hays for pipe sizes ½" to 2" and saddles are available for sizes 3" to 36".

3. Orientation. Vertical and horizontal installations are both acceptable. Horizontal installation provides a slightly better low flow performance and avoids the possible problem of trapped air at the top of the pipe. Installation on the bottom of the pipe is acceptable, but less desirable if sediment collection is a possibility.

4. Environmental. IP meters are designed to perform in damp environments, and to tolerate splash. However, direct burial or immersion are not recommended. The cable strain relief is threaded into a 1/2" conduit hub, allowing liquid-tight conduit connection if it is desired.





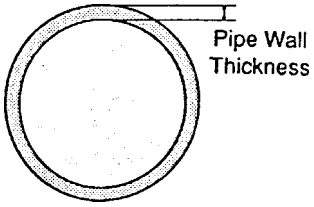
5. Adaptor Installation. After the pipe fitting is in place, remove the threaded adaptor from the IP meter. Apply a thread sealant (tape or paste type) to the adaptor. Next, thread the adaptor into the pipe fitting and tighten securely.

6. Meter Installation. Slide the meter through the adaptor fitting. Engage the locking collar threads and turn until the collar stops, about one turn.

7. Depth Setting. It is important for accuracy that the meter be inserted the correct distance into the pipe. To set the correct depth, follow these steps:

A. From the chart below, find Dimension “C” for the size of pipe. Subtract pipe wall thickness to get dimension “D”.

B. Using a ruler or tape, measure from the pipe to the underside of the meter junction box (see diagram).



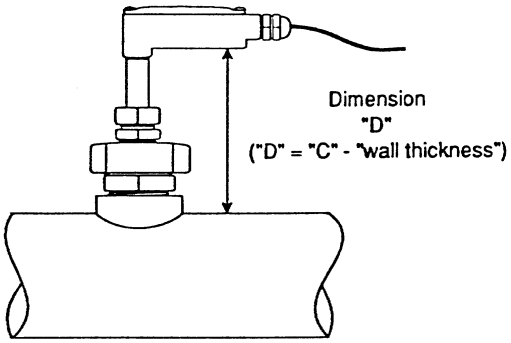


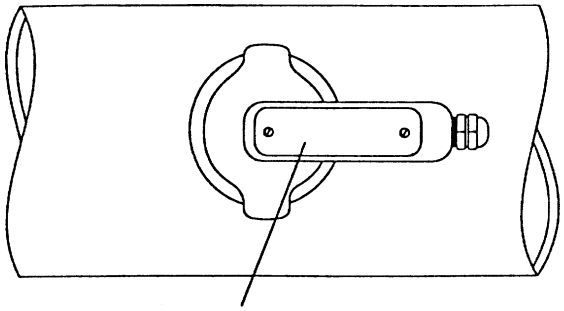
Table 1. Pipe Wall Thickness

Nom. Pipe Size	Sch. 40	Sch. 80	Class 52 Ductile Iron
1.5"	0.145	0.200	--
2"	0.154	0.218	--
2.5"	0.203	0.276	--
3"	0.216	0.300	0.28
4"	0.237	0.337	0.29
5"	0.258	0.375	--
6"	0.280	0.432	0.31
8"	0.322	0.500	0.33
10"	0.365	0.593	0.35
12"	0.406	0.687	0.37
14"	0.437	0.750	0.39
16"	0.500	0.843	0.40
18"	0.562	0.937	0.41
20"	0.593	1.031	0.42
22"	--	1.125	--
24"	0.687	1.218	--
30"	--	--	--
36"	0.750	--	--

Table 2. Dimension “C”

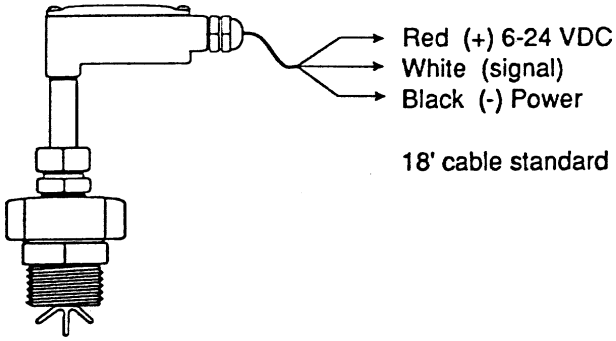
Nom. Pipe	Dim. “C” IP101B,S	Dim. “C” IP101P,PP	Dim. “C” IP201B,S	Dim. “C” IP201P,PP	Dim. “C” IP115B,S	Dim. “C” IP115P,PP	Dim. “C” IP215B,S	Dim. “C” IP215P,PP
1.5"	8.745	9.745	11.745	12.745	12.745	13.745	19.995	20.995
2"	8.66	9.66	11.66	12.66	12.66	13.66	19.91	20.91
2.5"	8.575	9.575	11.575	12.575	12.575	13.575	19.825	20.825
3"	8.49	9.49	11.49	12.49	12.49	13.49	19.74	20.74
4"	8.32	9.32	11.32	12.32	12.32	13.32	19.57	20.57
5"	8.15	9.15	11.15	12.15	12.15	13.15	19.4	20.4
6"	7.98	8.98	10.98	11.98	11.98	12.98	19.23	20.23
8"	7.64	8.64	10.64	11.64	11.64	12.64	18.89	19.89
10"	7.3	8.3	10.3	11.3	11.3	12.3	18.55	19.55
12"	*	*	9.96	10.96	*	*	18.21	19.21
14"	*	*	9.62	10.62	*	*	17.87	18.87
16"	*	*	9.28	10.28	*	*	17.53	18.53
18"	*	*	8.94	9.94	*	*	17.19	18.19
20"	*	*	8.6	9.6	*	*	16.85	17.85
22"	*	*	8.26	9.26	*	*	16.51	17.51
24"	*	*	7.92	8.92	*	*	16.17	17.17
30"	*	*	6.9	7.9	*	*	15.15	16.15
36"	*	*	5.88	6.88	*	*	14.13	15.13
42"	*	*			*	*	13.11	14.11

* Not Recommended



Junction box must be parallel to pipe.

8. Signal Connection. IP meters are supplied with 18 ft. of 3-conductor, #22 unshielded cable. The cable color is coded to help in connection. (See diagram below).



9. Calibration. The IP meter is calibrated by entering a number into the control connected to the meter. This number, called the K-Factor, is the number of pulses the meter sends per gallon of fluid passing through the pipe. The K-Factor for a particular pipe size can be read from the chart "K-Factors for Various Pipe Sizes" For maximum accuracy, particularly if there is less straight pipe than is recommended, the meter can be calibrated in its actual installation by counting the pulses corresponding to a measured amount of liquid in a calibrated container. If the IP meter is being used with the Hays FT500 flow computer, the pulse count can be determined by setting the K-Factor to 1.00 This will cause the totalizer display to read the actual pulse count.

OPERATION

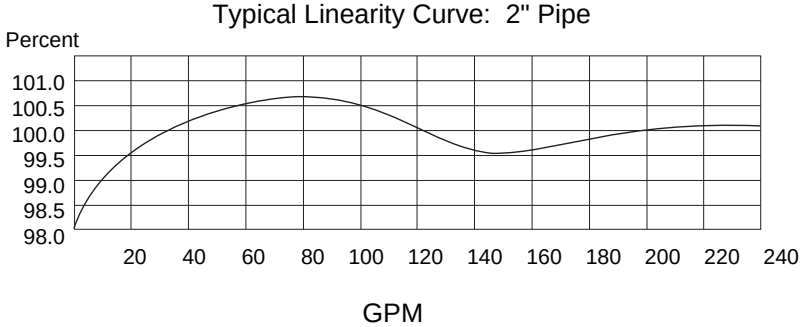
1. Theory. Inside the pipe, the rotor spins in the flow stream at a specific depth set by following the instructions above. As it spins, a small magnet in each rotor blade passes by a Hall effect sensor buried inside the meter body. This solid-state device is sensitive to magnetic fields, and switches every time a magnet passes. The result is a series of square-wave pulses which can be converted by remote electronics into rate readout or other types of information. Unlike meters which generate a tiny voltage as the blades of the rotor pass, the IP meter switches a relatively high voltage (typically 12 VDC), which results in a strong signal that is not sensitive to interference.

In principle, an insertion meter measures the velocity of flow at one point in the pipe, and from this the total flow can be determined. The calibration factors, or “K-Factors” provided in this manual are based on flow studies conducted on a variety of pipes in a laboratory. The assumption behind these numbers is that the straight pipe recommendations above are followed, that the fluid in the pipe has the same viscosity and density as water, and that the depth has been properly set. In small pipe, especially 3" and below, the depth setting is fairly critical, and should be done with extra care. For example, in a 2" pipe, a difference of 1/32" could cause the K-Factor to vary by 5%.

Moving fluid in a pipe doesn't all flow at the same velocity. Toward the center of the pipe, the flow is faster than it is near the pipe wall, where friction becomes a factor. As flow rate increases the relationship between speeds at different points, called the “velocity profile,” changes also. This can result in non-linearity, which means that a K-Factor which is correct for one flow rate may be high or low for another. The depth setting recommendations for the meter have been chosen through testing to minimize non-linearity. A typical linearity curve for the meter is shown below.

2. Flow Range. The meters are designed to operate at fluid velocities of 0.3 to 30 feet per second. In a 2" pipe for example, this corresponds roughly to 3 to 300 GPM. The excellent low-flow capability is made possible by the use of jewel bearings and other design elements which reduce friction. Due to the specialized low-flow design, continuous operation near the top of the flow range will result in a shortened life for the rotor shaft. If problems with continuous high flow are encountered or anticipated, contact HAYS for recommendations on special shaft materials.

Typical Linearity Curve: 2" Pipe



MAINTENANCE AND REPAIR

CAUTION! Never attempt to remove the IP meter when there is pressure in the pipe. Always check for pressure in the pipe before removing the meter. Loosen the locking collar slowly to allow any trapped pressure to escape. Failure to do so could result in the meter being thrown from the pipe, resulting in serious injury or damage!

1. Rotor Replacement. If damaged, the rotor can easily be replaced in the field. If it has been damaged by dropping or other type of impact, the bearings will probably need to be replaced. If replacement is due only to normal wear of the shaft, the bearings will probably still be usable. The rotor may be purchased separately, or a rebuild kit containing rotor, bearings and replacement O-rings, may be purchased.

The only tool required for replacement is a small screwdriver. Follow these steps:

A. Back the threaded bearing housing out until they come clear of the rotor shaft. If the bearings are being replaced also, thread them completely out.

B. Remove the rotor from the meter. It helps to shift the rotor fully to one side of the slot, then angle one shaft end up and out of the slot, then repeat this process for the other end.

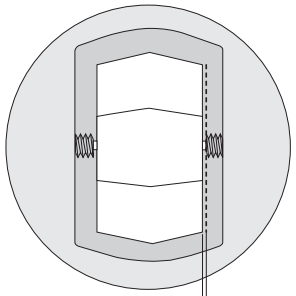
C. If the bearings are being replaced, start the new bearings into their holes and screw them until they are almost into the slot.

D. Start the replacement rotor in. Carefully slide one end of the shaft into the hole in one bearing, until it bottoms. Then screw the other bearing in a turn or two, and start the other end of the shaft into it. Now screw the first bearing in a turn or two. Alternate between bearings in this way, checking amount of end play each time. Be careful not to bottom the bearings against the shaft ends. There is a flat sapphire at the end of the bearing housing. Jamming this jewel against the end of the shaft by screwing the bearing housing in too far will usually result in damage to the jewel.

E. Make final adjustment. Screw in one bearing and then the other by small amounts, checking the amount of rotor play after each adjustment to avoid bottoming. The bearings are properly adjusted when the rotor is equally spaced from the sides of the slot, with a small amount of side-to-side play (about .010", or the thickness of an ordinary business card).

F. Blow lightly to be sure that the rotor turns freely. It should spin easily and slowly and smoothly coast to a stop.

2. Troubleshooting. If the IP meter quits or does not operate on initial installation, see the troubleshooting chart. The internal installation, see the troubleshooting chart. The internal electronic components are not designed for field repair. If the meter signal is lost for any reason other then a loose connection, contact your distributor or Hays for return and repair.



Flow in gallons per minute various velocities: Sched. 40 pipe.

Nominal Pipe Size	Feet per Second 0.3	0.5	1.0	2.0	5.0	10.0	20.0	30.0
1½"	1.9	3.2	6.3	12.7	31.7	63.5	127	190
2"	3.1	5.2	10.5	20.9	52.3	105	209	314
2½"	4.5	7.5	14.9	29.8	74.6	149	298	448
3"	6.9	11.5	23.0	46.1	115	230	461	691
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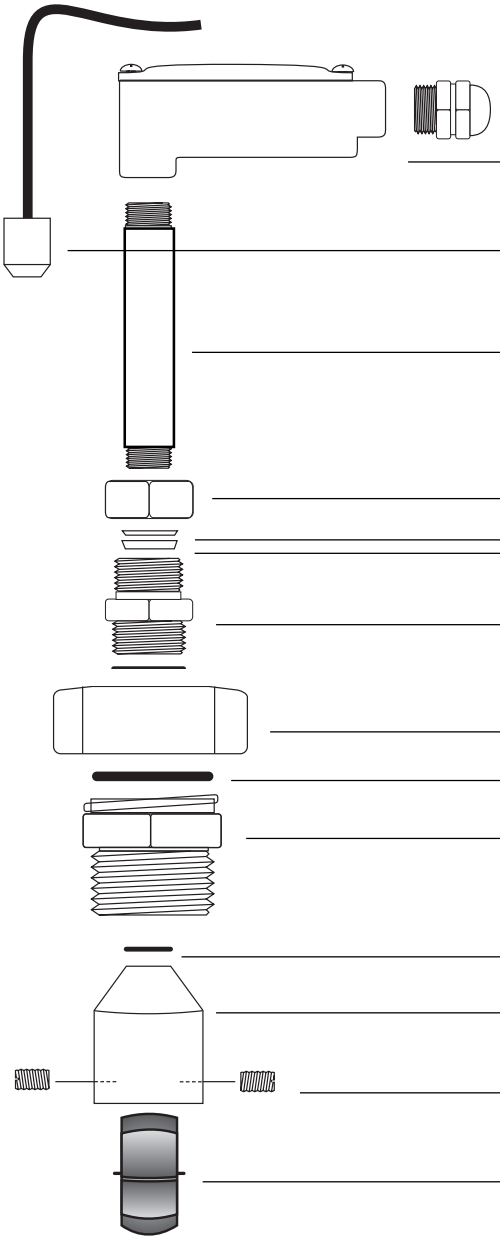
5"	18.7	31.2	62.4	125	312	624	1,247	1,871
6"	27.0	45.0	90.0	180	450	900	1,801	2,701
8"	46.8	78.0	156	312	780	1,559	3,119	4,678
10"	73.7	123	246	492	1,229	2,458	4,916	7,373
12"	105	174	349	698	1,744	3,489	6,978	10,466
14"	127	211	422	844	2,109	4,218	8,435	12,653
16"	165	275	551	1,102	2,754	5,508	11,016	16,524
18"	209	349	697	1,394	3,486	6,972	13,944	20,916
20"	260	433	867	1,733	4,333	8,665	17,330	25,995
24"	376	627	1,253	2,506	6,266	12,532	25,064	37,596
36"	874	1,457	2,914	5,827	14,569	29,137	58,274	87,412
38"	1,060	1,767	3,535	7,070	17,675	35,349	70,698	106,047

K-Factor Chart

Nominal Pipe Size	PVC Steel Sch. 40	Sch. 80	Stainless Steel Schedule 5S	10S	40S	80S	Copper Tubing Type K	Type L	Copper Pipe	Ductile Iron Class 52
1.5	82.60	95.16	68.34	75.68	82.60	95.16	97.62	94.53	83.64	
2	50.12	56.96	42.49	46.02	50.12	56.96	55.80	55.80	50.36	
2.5	35.12	39.67	29.17	30.83	35.12	39.67	36.11	35.23	34.25	
3	28.92	32.37	24.49	25.61	28.92	32.37	32.21	31.39	29.03	25.93
4	16.79	18.59	14.49	15.00	16.79	18.59	18.12	17.85	17.01	15.28
5	10.69	11.75	9.53	9.71	10.51	11.75	11.79	11.46	10.62	
6	7.40	8.20	6.63	6.74	7.40	8.20	8.26	7.97	7.26	6.90
8	4.27	4.68	3.85	3.92	4.27	4.68	4.73		4.25	3.86
10	2.14	2.35	1.96	1.98	2.14	2.26				1.99
12	1.51	1.66	1.39	1.40	1.49					1.39
14	1.25	1.38	1.15							1.02
16	0.96	1.05	0.88							0.78
18	0.76	0.83	0.69							0.62
20	0.61	0.67	0.56							0.50
22	0.44	0.46								
24	0.42									
30	0.25									
36	0.18									
38	0.16									

IP Parts List



#07655 (Strain Relief)
#16560 (Junction Box)

#11015 (Sensor Capsule w/ 18' of 3 conductor cable)
#14130 (Brass Tube - IP101B)
#15130 (Stainless Tube - IP101S)
#14131 (Brass Tube - IP201B)
#15131 (Stainless Tube - IP201S)

Compression Fitting Nut (comes with compression fitting)
#16525 (Compression Fitting Back Ferrule)
#16520 (Compression Fitting Front Ferrule)
#14200 (Compression Fitting - Brass)
#15065 (Compression Fitting - Stainless)

#16445 (Locking Collar)
#16438 (O-Ring)*
#14180 (Brass Adaptor Fitting)
#15060 (Stainless Adaptor Fitting)

#16436 (O-Ring)
#14220 (Brass Paddlewheel Housing)
#15220 (Stainless Paddlewheel Housing)
#16430 (Jewel Bearing Assembly - 2 req'd)*

#11130 (Kynar Rotor)*
#15075 (Stainless Rotor)*

**Denotes Rotor Repair Kit*

NOTE: For PVC parts, please consult factory.

NOTES

IP 215

SPECIAL FEATURES

No Shutdown or Loss of Fluid. Rotor is contained in a small housing attached to a tube, which passes through a gate valve as it leaves this pipe from 2" to 48".

Installs in a Wide Range of Pipe Sizes. Hot Tap IP Meter can be installed in any pipe from 2" to 48".

Stronger Signal Eliminates Interference. Unlike meters which generate a tiny voltage as the blades of the rotor pass, Hays Hot Tap IP Meter switches a relatively high voltage (12VDC), which results in a strong signal that is not sensitive to interference.

Field Repairable. If damaged by dropping or other impact, the bearings and rotor can be purchased separate or a rebuilt kit containing rotor, bearings and replacement O-rings. This replacement is both simple and easy with a small screw driver.

Signal Sent Through Unshielded Cable Hundreds of Feet Solid State Hall-Effect Sensor Issued to Detect Passage of Six Rotor Blades. This eliminates magnetic drag, and produces a square wave signal which can be sent for hundreds of feet without a transmitter, over unshielded cable.

Excellent Low Flow Capabilities. Using sapphire bearings and design elements to reduce friction. The Hays Hot Tap IP Meter gives excellent low flow monitoring.

TYPICAL APPLICATIONS

- **Chemical Proportioning**
- **Flow Rate Monitoring**
- **SCADA**
  (Supervisory Control and Data Acquisition)

HOW TO ORDER

Specify: Model and material of construction

Ordering Options
- **Stainless Steel Rotor**
- **Tungsten Carbide Shaft**
- **All Stainless Steel Meter**

Example: Hot Tap IP Meter in Brass.

Order:	
	P-PVC (Consult Factory)
	B-Brass
IP 215 Hot Tap IP Meter	S-Stainless Steel

IP215B-Hot Tap IP Meter/Brass

Instruction Manual

The IP Series are insertion meters which use a small rotor with jewel bearings to determine the rate of flow in a pipe. Rotation of the rotor is detected by means of a Hall-effect sensor in the meter body, that is isolated from the fluid. The rotor is contained in a small housing attached to a tube, which passes through a gate valve as it leaves the pipe. This allows the unit to be installed or withdrawn from the pipe without shutdown or loss of fluid. The initial installation is done with any standard “hot tap” drilling machine which can adapt to the 2" NPT pipe thread on the gate valve. A condolet on the end of the tube allows for easy splicing of cable to the unit if more than the standard 18 feet is required. Depth setting in the pipe is accomplished by measuring from the outside of this condolet. An instrument-type compression fitting holds the insertion depth once it is set.

FEATURES

- **Installs in a Wide Range of Pipe Sizes**
- **Excellent Low-Flow Performance**
- **Field repairable**

TYPICAL APPLICATIONS

- **Chemical Proportioning**
- **Flow Rate Monitoring**
- **SCADA (Supervisory Control and Data Acquisition)**

Ordering Options:

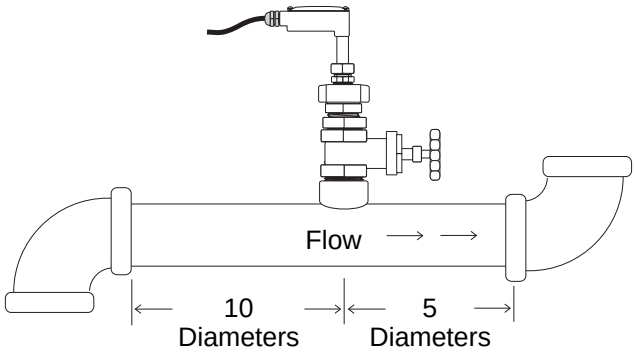
- **Stainless Steel Rotor**
- **Tungsten Carbide Shaft**
- **All Stainless Steel Meter**

SPECIFICATIONS

Materials:
Probe Body: Brass, Type 316 Stainless Steel, PVC
Rotor: Kynar
Rotor: Proprietary High-Nickel Alloy, Tungsten Carbide
Bearings: Sapphire
Valve: Cast Bronze or PVC or Stainless Steel T316
Fitting: Brass Nipple, 2" Male NPT
Power: 6-24 VDC, 10mA Maximum
Signal: Squarewave, Current Sinking
Cable: #21 AWG 3-Conductor; 18' Standard, 2,000' Max. to Control
Accuracy * : +/- 1% of Full Scale
Pipe Size Range: 2" to 48"
Range: 0.3 - 30 FPS
Maximum Working Pressure: 200 PSI
Temperature Range: Brass/SS: 33ºF -185ºF
PVC: 0 PSI -140º F / 150 PSI -70ºF
Shipping Weight: IP 115 - 11 lbs., IP 215 - 12 lbs.,
***** Laboratory accuracy, installed accuracy affected by piping variables. Consult Hays.

INSTALLATION

1. Piping Requirements. The IP meter can be installed in any size pipe from 2" to 48". For best results, there should be at least ten diameters of straight pipe upstream of the meter, and five diameters downstream.

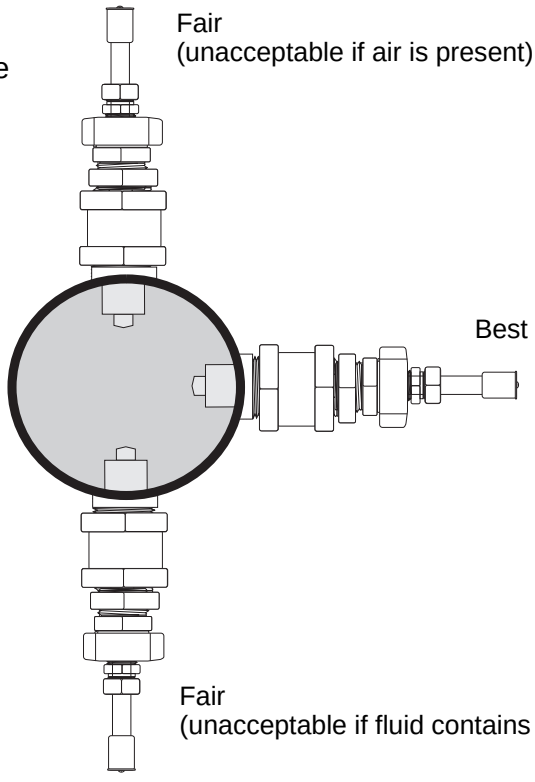


2. Fittings. The Hot Tap unit is supplied with a 2" male NPT adaptor fitting. This can be installed in any fitting which provides a 2" female NPT thread, including saddles, tees, and weldolets. Tees are available from Hays for pipe sizes 2" to 4" and saddles are available for sizes 3" to 36".

3. Orientation. Vertical and horizontal installations are both acceptable. Horizontal installation provides a slightly better low flow performance and avoids the possible problem of trapped air at the top of the pipe. Installation on the bottom of the pipe is acceptable, but less desirable if sediment collection is a possibility.

4. Environmental. IP meters are designed to perform in damp environments, and to tolerate splash. However, direct burial or immersion are not recommended. The cable strain relief is threaded into a 1/2" conduit hub, allowing liquid-tight conduit connection if it is desired.

5. Valve Installation. After the pipe fitting (saddle, tee or weldolet) is in place, remove the meter from the valve and carefully set it aside. Apply a thread sealant to the 2" nipple extending from the valve, and thread it into the pipe fitting. Tighten securely.

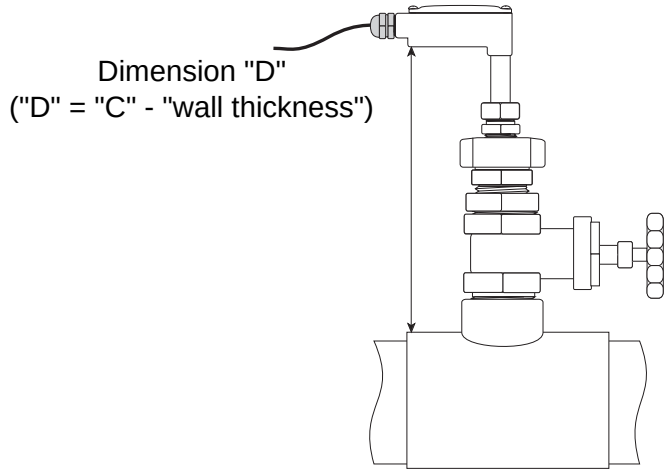


6. Pipe Tapping. Any of the standard hot-tap machines which have 2" capability can be used. This includes Mueller, Transmate and Ford machines. Thread the 2" male adaptor of the tapping machine onto the valve. Open the valve fully. Following the instructions of the tapping machine manufacturer, drill the pipe with a 1¾" or 1⅞" cutter or drill bit. When finished, retract the cutter and close the valve. Then remove the tapping machine. With the meter pulled back as far as it will go into its threaded fitting, replace the meter on the valve and tighten.

7. Depth Setting. It is important for accuracy that the meter be inserted the correct distance into the pipe. To set the correct depth, follow these steps:

A. From the chart below, find Dimension “C” for the size of pipe. Subtract pipe wall thickness to get dimension “D”.

B. Using a ruler or tape, measure from the pipe to the underside of the meter junction box (see diagram).

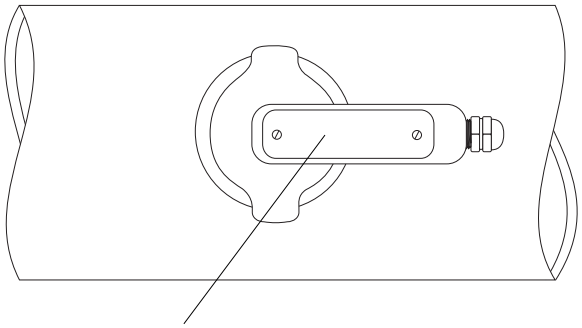


Pipe Wall Thickness Chart

Nominal Pipe Size	Schedule 40	Schedule 80	Class 52 Ductile Iron
1½"	0.145	0.200	—
2"	0.154	0.218	—
2½"	0.203	0.276	—
3"	0.216	0.300	0.28
4"	0.237	0.337	0.29
5"	0.258	0.375	—
6"	0.280	0.432	0.31
8"	0.322	0.500	0.33
10"	0.365	0.593	0.35
12"	0.406	0.687	0.37
14"	0.437	0.750	0.39
16"	0.500	0.843	0.40
18"	0.562	0.937	0.41
20"	0.593	1.031	0.42
22"	—	1.125	—
24"	0.687	1.218	—
30"	—	—	—
36"	0.750	—	—

Nominal Pipe Size	Dimension “C”
2"	19.9
2½"	19.8
3"	19.7
4"	19.6
5"	19.4
6"	19.2
8"	18.9
10"	18.6
12"	18.2
14"	17.9
16"	17.5
18"	17.2
20"	16.9
22"	16.5
24"	16.2
30"	15.2
36"	14.1

C. Loosen the compression fitting and slide the meter up or down until it measures the same as dimension “D”. Line the junction box up with the centerline of the pipe, as shown at right.

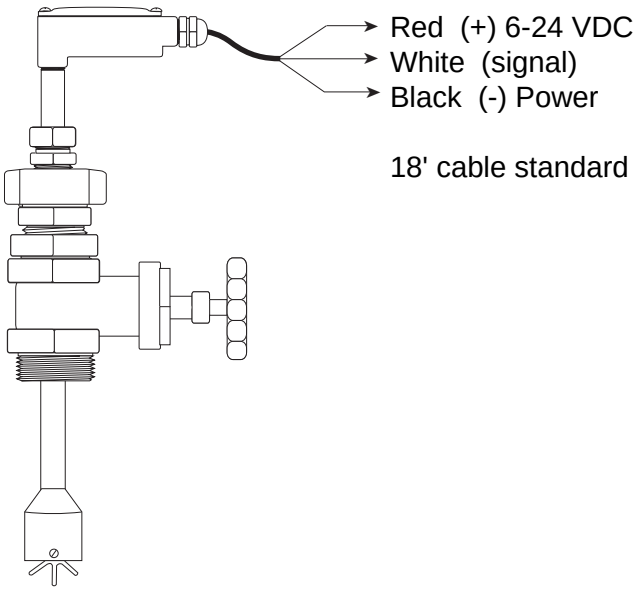


Junction box must be parallel to pipe.

D. Retighten the compression fitting.

8. Signal connection. IP meters are supplied with 18 ft. of 3-conductor, #22 unshielded cable. This cable is color coded to help in connection. (See diagram below)

9. Calibration. The IP meter is calibrated by entering a number into the control connected to the meter. This number, called the K-Factor, is the number of pulses the meter sends per gallon of fluid passing through the pipe. The K-Factor for a particular pipe size can be read from the chart “K-Factors for Various Pipe Sizes.” For maximum accuracy, particularly if there is less straight pipe than is recommended, the meter can be calibrated in its actual installation by counting the pulses corresponding to a measured amount of liquid. This requires the ability to catch the liquid in a calibrated container. If the IP meter is being used with the HAYS FT500 flow computer, the pulse count can be determined by setting the K-Factor to 1.00. This will cause the totalizer display to read the actual pulse count.



OPERATION

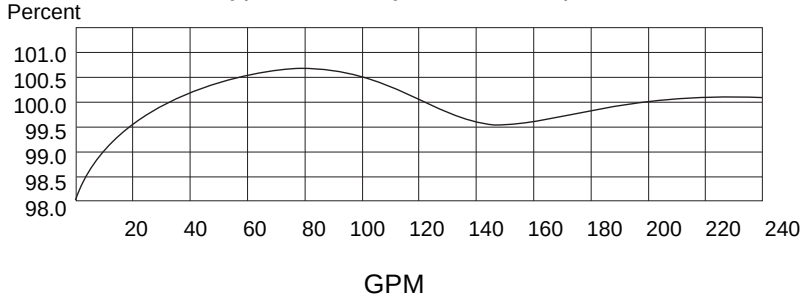
1. Theory. Inside the pipe, the rotor spins in the flow stream at a specific depth set by following the instructions above. As it spins, a small magnet in each rotor blade passes by a Hall effect sensor buried inside the meter body. This solid-state device is sensitive to magnetic fields, and switches every time a magnet passes. The result is a series of square-wave pulses which can be converted by remote electronics into rate readout or other types of information. Unlike meters which generate a tiny voltage as the blades of the rotor pass, the IP meter switches a relatively high voltage (typically 12 VDC), which results in a strong signal that is not sensitive to interference.

In principle, an insertion meter measures the velocity of flow at one point in the pipe, and from this the total flow can be determined. The calibration factors, or “K-Factors” provided in this manual are based on flow studies conducted on a variety of pipes in a laboratory. The assumption behind these numbers is that the straight pipe recommendations above are followed, that the fluid in the pipe has the same viscosity and density as water, and that the depth has been properly set. In small pipe, especially 3" and below, the depth setting is fairly critical, and should be done with extra care. For example, in a 2" pipe, a difference of 1/32" could cause the K-factor to vary by 5%.

Moving fluid in a pipe doesn’t all flow at the same velocity. Toward the center of the pipe, the flow is faster than it is near the pipe wall, where friction becomes a factor. As flow rate increases the relationship between speeds at different points, called the “velocity profile,” changes also. This can result in non-linearity, which means that a K-factor which is correct for one flow rate may be high or low for another. The depth setting recommendations for the meter have been chosen through testing to minimize non-linearity. A typical linearity curve for the meter is shown below.

2. Flow Range. The meters are designed to operate at fluid velocities of 0.3 to 30 feet per second. In a 2" pipe for example, this corresponds roughly to 3 to 300 GPM. The excellent low-flow capability is made possible by the use of jewel bearings and other design elements which reduce friction. Due to the specialized low-flow design, continuous operation near the top of the flow range will result in a shortened life for the rotor shaft. If problems with continuous high flow are encountered or anticipated, contact HAYS for recommendations on special shaft materials.

Typical Linearity Curve: 2" Pipe



MAINTENANCE AND REPAIR

CAUTION! Never attempt to remove the IP meter when there is pressure in the pipe. Always check for pressure in the pipe before removing the meter. Loosen the locking collar slowly to allow any trapped pressure to escape. Failure to do so could result in the meter being thrown from the pipe, resulting in serious injury or damage!

1. Rotor Replacement. If damaged, the rotor can easily be replaced in the field. If it has been damaged by dropping or other type of impact, the bearings will probably need to be replaced. If replacement is due only to normal wear of the shaft, the bearings will probably still be usable. The rotor may be purchased separately, or a rebuild kit containing rotor, bearings and replacement O-rings, may be purchased.

The only tool required for replacement is a small screwdriver. Follow these steps:

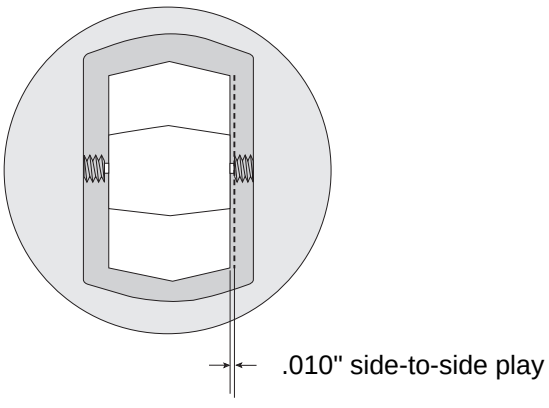
A. Back the threaded bearing housings out until they come clear of the rotor shaft. If the bearings are being replaced also, thread them completely out.

B. Remove the rotor from the meter. It helps to shift the rotor fully to one side of the slot, then angle one shaft end up and out of the slot, then repeat this process for the other end.

C. If the bearings are being replaced, start the new bearings into their holes and screw them in until they are almost into the slot.

D. Start the replacement rotor in. Carefully slide one end of the shaft into the hole in one bearing, until it bottoms. Then screw the other bearing in a turn or two, and start the other end of the shaft into it. Now screw the first bearing in a turn or two. Alternate between bearings in this way, checking amount of end play each time. Be careful not to bottom the bearings against the shaft ends. There is a flat sapphire at the end of the bearing housing. Jamming this jewel against the end of the shaft by screwing the bearing housing in too far will usually result in damage to the jewel.

E. Make final adjustment. Screw in one bearing and then the other by small amounts, checking the amount of rotor play after each adjustment to avoid bottoming. The bearings are properly adjusted when the rotor is equally spaced from the sides of the slot, with a small amount of side-to-side play (about .010",or the thickness of an ordinary business card).



F. Blow lightly to be sure that the rotor turns freely. It should spin easily and slowly and smoothly coast to a stop.

2. Troubleshooting. If the IP meter quits or does not operate on initial installation, see the trouble-shooting chart. The internal electronic components are not designed for field repair. If the meter signal is lost for any reason other than a loose connection, contact your distributor or HAYS for return and repair.

Flow in gallons per minute various velocities: Sched. 40 pipe.

Nominal Pipe Size	Ft/Sec 0.3	0.5	1.0	2.0	5.0	10.0	20.0	30.0
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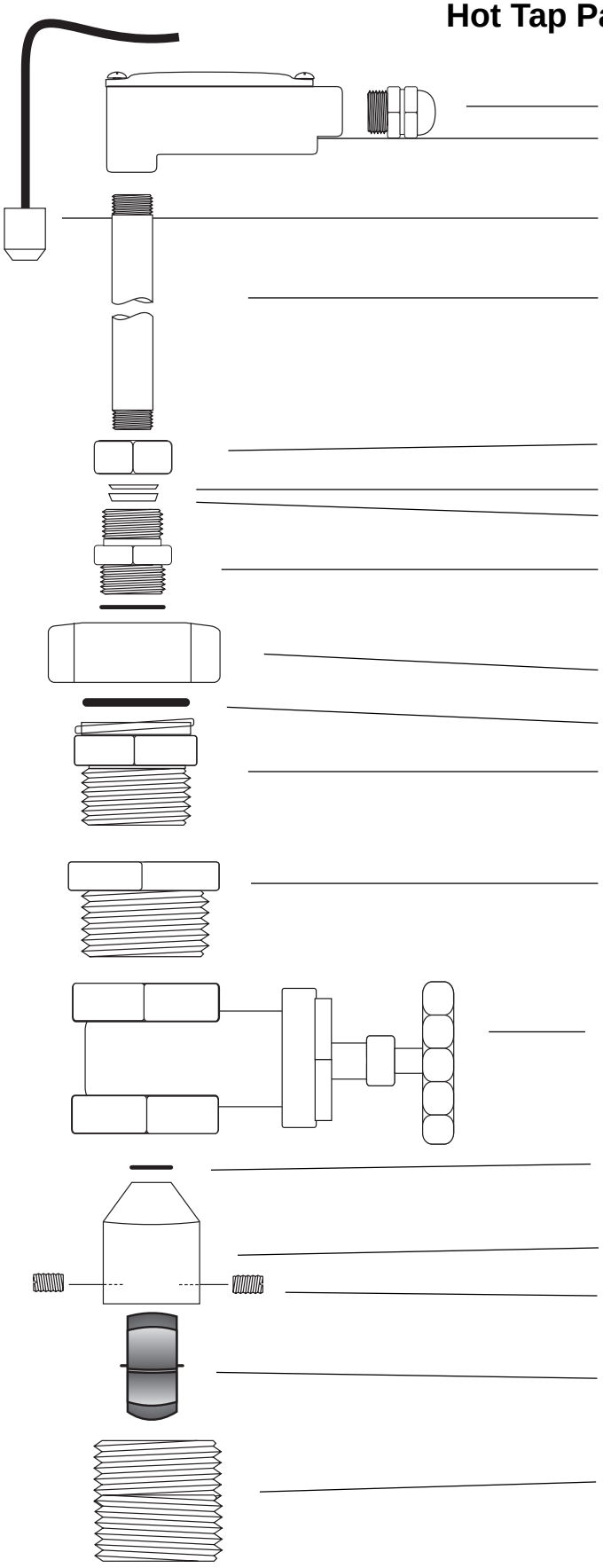
Hot Tap Parts List



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#15070 (Stainless Locking Collar)
#16438 (O-Ring)*****
#14180 (Brass Adaptor Fitting)
#15060 (Stainless Adaptor Fitting)

#14175 (Brass 1½" X 2" Bushing)
#15175 (Stainless 1½" X 2" Bushing)

#14125 (Brass Valve)
#15200 (PVC Valve)
#15175 (Stainless Valve)

#16436 (O-Ring)

#14220 (Brass Rotor Housing)
#15220 (Stainless Rotor Housing)
#16430 (Jewel Bearing Assembly--2 req'd)*****

#11130 (Kynar Rotor)*****
#15075 (Stainless Rotor)*****

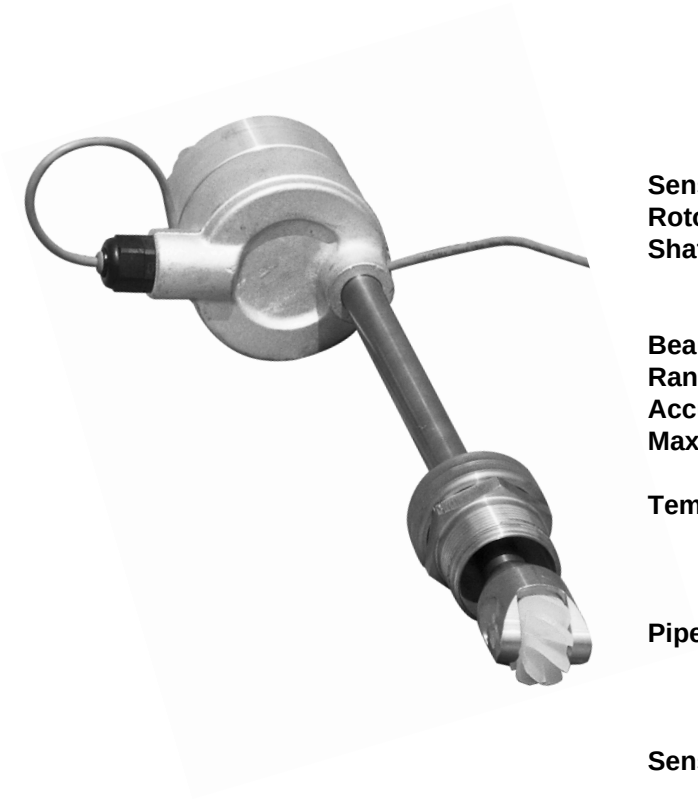
#14210 (Brass 2" Close Nipple)
#15100 (Stainless 2" Close Nipple)

Denotes Rotor Repair Kit

NOTE: For PVC parts, consult factory.

Problem	Probable Cause	To Check	To Repair
No signal after installation	Insufficient flow	See "Ft./Sec.-GPM· conversion chart. Minimum flow should be above 0.3 ft./sec.	Contact Hays
	Bad connection to control electronics	Check connections at control. Check polarity; red (+), black (-), white (signal).	Re-connect if necessary
	Incompatible control	If control is not made by Hays, check to see if it: 1) Provides 12 VDC power; 2) Accepts current-sinking inputs, or 3) Accepts at least 300 Hz input frequency.	Contact Hays
	Damaged or missing rotor	Remove meter and check visually for free-spinning.	Obtain new rotor and replace
Inaccurate metering	Improper insertion depth	Go through depth setting section again. Remove meter and measure. Look for possible flow disturbance.	Set again to correct depth
	Not enough straight pipe between meter and flow disturbance	See recommendations, measure.	Move away from flow disturbance or field calibrate.
	Wrong K-factor setting in control	Check control and K-factor chart.	Reset K-Factor in control
	Damaged rotor	Remove and examine for damage and for free-spinning.	Replace rotor.

The IP Series are insertion meters which use a small rotor with jewel bearings to determine the rate of flow in a pipe. Rotation of the rotor is detected by means of a Hall-effect sensor in the meter body, isolated from the fluid. The rotor is contained in a small housing attached to a tube, which passes through a gate valve as it leaves the pipe. This allows the unit to be installed or withdrawn from the pipe without shutdown or loss of fluid. The initial installation is done with any standard "hot tap" drilling machine which can adapt to the 2" NPT pipe thread on the gate valve. A condolet on the end of the tube allows for easy splicing of cable to the unit if more than the standard 18 feet is required. Depth setting in the pipe is accomplished by measuring from the outside of the pipe to the underside of this condolet. An instrument-type compression fitting holds the insertion depth once it is set.



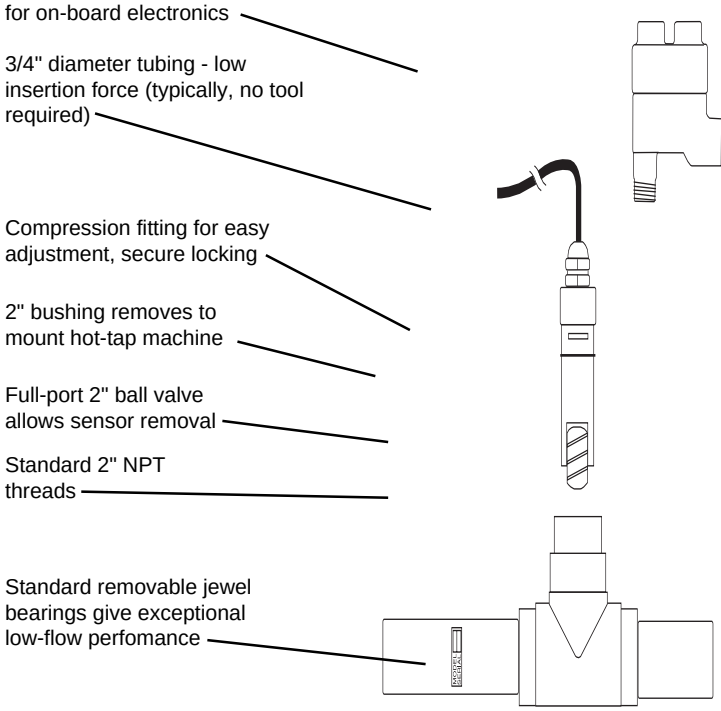
Sensor body	Brass, 316 SS
Rotor	Polypro PVDF optional
Shaft	Nickel-bound tungsten carbide, zirconia ceramic optional
Bearings	Ruby
Range	0.2 – 30 fps (0.06-9 M/s)
Accuracy	± 1% FS
Maximum Pressure	200 psi (13 bar)
Temperature	
Standard	185° F (85°C)
High-Temp	250° F (121°C)
Pipe Size	
TX101	2"-10" (50 - 250mm)
TX201	10"- 48" (250 - 1200mm)
Sensor/Signal	Hall Effect (NPN) Current sinking pulse, 20 mA max.
Cable	#22 AWG 3-con, 18' (6m)
Maximum Cable Run	2,000' (650m)

GENERAL INFORMATION

Sapphire bearings and a non-drag pickoff give these adjustable insertion turbine flow sensors a wide flow range and long life. A Hall-effect device detects the passage of miniature magnets in the eight rotor blades. The resulting square-wave signal can be sent for hun-dreds of feet without a transmitter, over unshielded cable. This signal can be connected directly to many PLC's and other controls without any additional elec-tronics. Installation fittings are standard 1-1/2" NPT. A depth adjustment system allows two basic sizes to cover pipe sizes from 2" to 48". Fittings such as saddles and weldolets may be purchased locally.

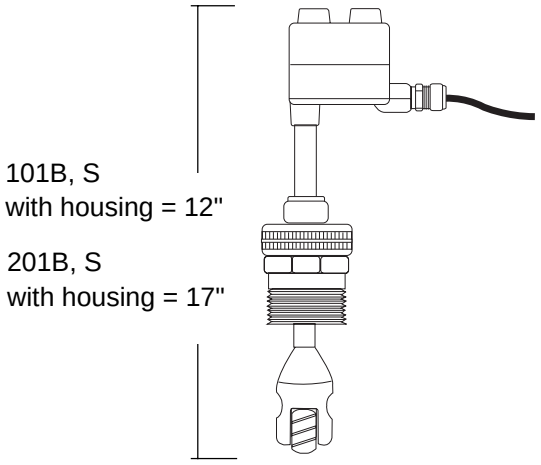
A modular system of electronics can be installed di-rectly on the flow sensor, in a splashproof cast hous-ing. The FT400 provides digital rate and total display, as well as programmable pulse and optional 4-20 mA analog outputs.

SPECIFICATIONS



	Min. GPM	Max. GPM
2"	2	300
3"	5	700
4"	8	1,100
6"	18	2,500
8"	30	4,500
10"	50	7,000
12"	70	10,000
16"	110	16,000
24"	250	35,000

DIMENSIONS



How To Order

Material Code: B = Brass,
S = Stainless 316
Option Code: (See right)

TX101 _____ - _____
TX201 _____ - _____

Options:
04 Passive pickup
03 Bidirectional flow (Hall-Effect only)
06 LMI pump connector
07 Control connector
05 High temp: PVDF rotor/ceramic shaft
10 High pressure
40 Submersible

NOTES