Smart Sensors

THORNTON

Leading Pure Water Analytics

- pH and ORP
- Pure Water pH
- High Performance Dissolved Oxygen
- Long Life Dissolved Oxygen
- Impeller & Paddlewheel Flow
- PFA & Insertion Vortex Flow
- Tank Level, Pressure, Vacuum, Temp
- Smart Signal Adapters

770MAX pH, ORP, Dissolved Oxygen, Flow, Pressure, Level & Temperature Sensors

METTLER TOLEDO

Thornton offers detachable sensors with an electrical connector directly on the electrode body to allow flexible and low cost electrode replacement, separate from the preamplifier. A variety of housings, including retractable models are available.

Measuring electrode: Glass pH, platinum ORP
Reference electrode: Silver-silver chloride with double junction or equivalent
Temperature compensator: Pt1000 included in all pH sensors; not in ORP sensors
pH range: 0-14 except 2-12 for 52 000 512
Maximum flow: 10 ft/s (3 m/s)
Maximum cable lengths: 300 ft (91 m) patch cord, 33 ft. (10 m) preamp cable

770MAX Detachable pH and ORP Sensors

A complete pH or ORP installation requires **1** an electrode, **2** a housing and **3** a preamp from each of the tables below. In addition, each installation requires a patch cord and instrument. Double lines divide groups of compatible electrodes and housings.

Electrode (1)

Application	Rating	Fitting / Material / Connection	Part No. Ref. No.
pH, general purpose, low cost	30psi (2 bar) at 60 °C & 75psi (5 bar) at 45 °C	PG13.5 / polysulfone & glass / VP	**52 000 512** 4010-120-Pt1000
pH, general purpose high pressure	See housing limits	PG13.5 / glass / VP	**52 002 146** 4250-120-Pt1000
pH, general purpose & moderately pure waters**	100 °C 36psi (2.5 bar)	PG13.5 / glass / VP	**52 001 419** 3200-120-Pt1000
pH, HF-Resistant	See housing limits	PG13.5 / glass/ VP	**52 005 353** 4252-120-Pt1000-VP
ORP, general purpose & moderately pure water	0-100 °C 36psi (2.5 bar)	PG13.5 / glass & Pt / S8	**10 505 3339** Pt4805-DPA-S8-120
ORP, general purpose, high pressure	See housing limits	PG13.5 / glass & Pt / S8	**10 505 3288** Pt4805-DXK-S8-120
pH, general purpose high chemical resistance	0-100 °C 100psi (7 bar) at 65 °C 50psi (3.5 bar) at 100 °C	1" NPT insertion or 1" NPT submersion / PVDF & glass / VP	**41 453 3102** 4501-VP-Pt1000-SG
pH, Retractable	See housing limits	PG 13.5 retractable / Glass / VP	**52 002 147** 4250-225-Pt1000
ORP, Retractable	See housing limits	PG 13.5 retractable / Glass & Pt / S8	**10 505 3255** Pt4805-DXK-S8-225

Housing (2)

Connection / Material / Rating	Part No.
3/4"NPT insertion or submersion*** / CPVC / 100psi (7 bar) at 80 °C	**53 300 021**
3/4"NPT insertion or submersion*** / PVDF / 100psi (7 bar) at 110 °C	**52 401 520**
1" weld tee / PVC / 50psi (3.5 bar) at 60 °C	**41 722 3001**
user's 1-1/2" tee and reducing bushing for insertion, or 1" coupling & pipe for submersion	**none required**
Retractable 1-1/2" NPT / CPVC / 75psi (5 bar), 80 °C	**1000-40**
Retractable 1-1/2" NPT / PVDF / 75psi (5 bar), 100 °C	**1000-41**
Retractable 1" NPT / 316SS / 100psi (7 bar), 100 °C	**1000-42**

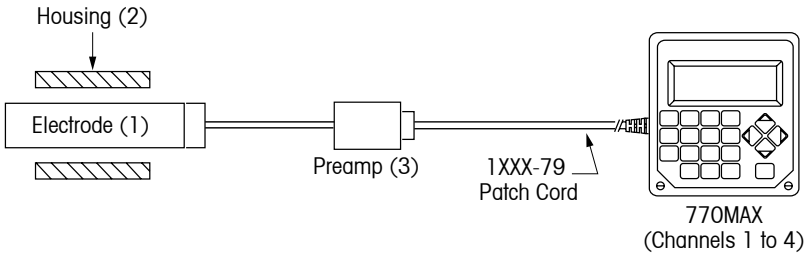
** For use with moderately pure waters (conductivity 5-50 µS/cm) use 53 300 021 housing in 3/4" NPT earth-grounded metal pipe tee with flow <100 mL/min and discharge to open drain. For higher purity and/or higher accuracy in pure water see the pHure Sensor™, pages 4-5.

*** For insertion in plastic pipe, use 3/4 x 1" reducing bushing and 1" pipe tee. For submersion w/plastic pipe, use 3/4 x 1" reducing coupling and 1" pipe.

Preamp (3)

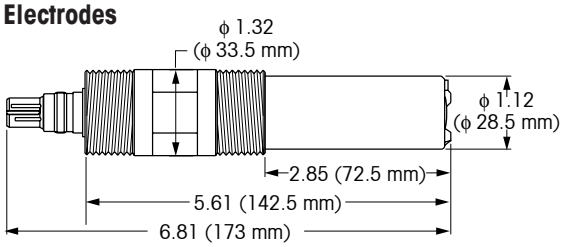
Connector	Cable Length	Part No.
	pH	
VP	3 ft (1 m)	**1200-21**
VP	10 ft (3 m)	**1200-22**
VP	16 ft (5 m)	**1200-23**
VP	33 ft (10 m)	**1200-24**
	ORP	
AS9	3 ft (1 m)	**1200-25**
AS9	10 ft (3 m)	**1200-26**
A59	16 ft (5 m)	**1200-27**
A59	33 ft (10 m)	**1200-28**

AS9 preamp connector mates with S8 electrode connector.



* For an overview of Smart Sensors, see the last page.

Electrodes



41 453 3102 Electrode

10 505 3339
10 505 3288

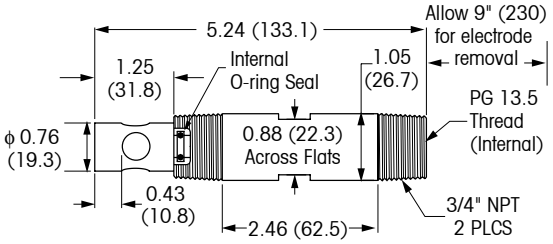
52 000 512

52 001 419
52 002 146

41 453 3102

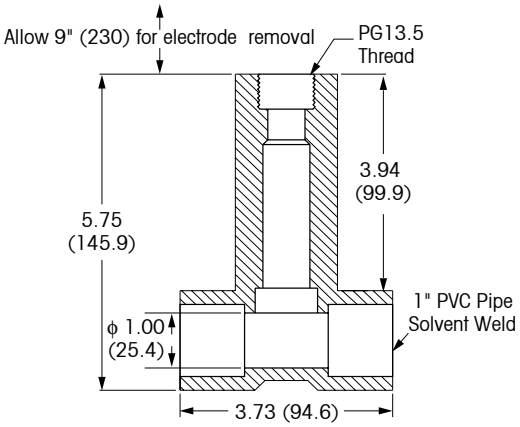
52 002 147

Housings



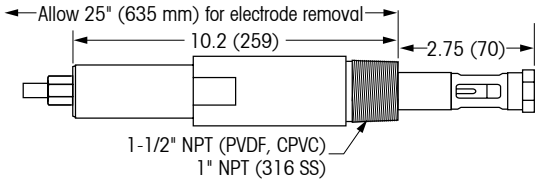
53 300 021 & 52 401 520

53 300 021



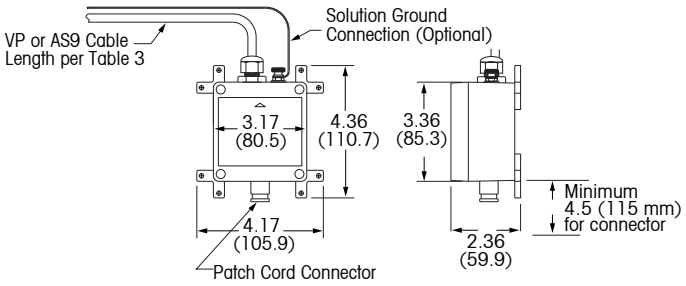
41 722 3001

41 722 3001



1000-4X

1000-41



1200-2X

1200-21

Dimensions: inches (mm)

Applications for pure water pH measurement

- Reverse osmosis - pH adjustment of clean recycle water or between membranes in two pass systems to optimize rejection rates
- Power plant cycle chemistry - monitoring and controlling pH levels to comply with guidelines and minimize corrosion and scaling

Background
pH measurement in low conductivity waters requires special precautions. It must be made on a side-stream sample in a closed, metal, flow-through chamber with low flowrate and discharge to open drain. This assures a sample uncontaminated by carbon dioxide from the air, minimal, constant sample pressure at the reference electrode and electrical shielding to promote stability. The sample line should be short and small in diameter to minimize sample delays and to minimize waste of pure water. Additional stability is obtained with a dual high impedance measuring circuit that includes a solution ground.

Key to pure water pH measurements has been the use of a flowing junction type of reference electrode which forces electrolyte through the reference junction to provide the same conditions in various samples. The flowing junction produces nearly the same potential in pure water as in the much more conductive calibrating buffer solutions. However, a flowing junction requires some form of electrolyte reservoir that can make installation, service and calibration more cumbersome and increases cost.

Description
The Mettler-Toledo Thornton pHure Sensor™ uses a special internally-pressurized gel electrolyte reference electrode to produce similar results to a flowing junction but with much more convenient installation and maintenance. The electrode also includes a low resistance pH glass membrane, an integral, fast-responding RTD, and VP connection. The mating preamplifier provides a dual high input impedance measuring circuit with solution ground to maximize stability. The flow housing provides a controlled flow path with minimum volume to encourage power plant corrosion particles to flush through instead of accumulating as with a large flow bowl.

All components of the pHure Sensor™ have been optimized for performance and value and conform to ASTM Standard D5128. Various lengths of preamp cable and patch cord (ordered separately) are available to provide flexibility in locating the preamp.

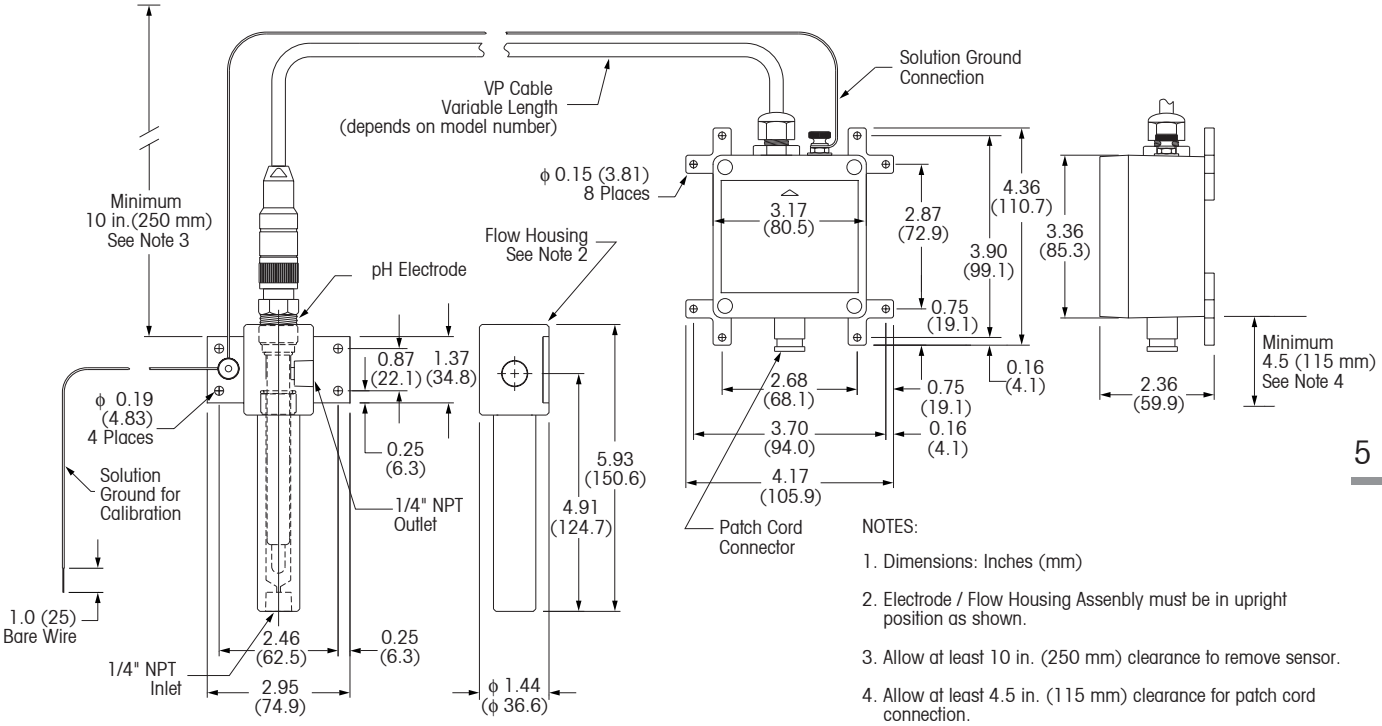
Specifications

Wetted materials: 316 SS, glass, silicone rubber
Process connections: 1/4" NPTF in/out
Flow housing volume: 5 mL with electrode in place
Maximum pressure: atmospheric pressure for optimum stability; operational 0-35 psig (0-2.5 bar); can safely withstand 100 psig (7 bar)
Sample temperature: 32 - 176 °F (0 - 80 °C), short term to 212 °F (100 °C)
Sample pH: 1 - 11
Sample flowrate: 50 - 150 mL/min
Sample conductivity: >0.8 µS/cm for highest accuracy
Preamplifier enclosure: ABS, sealed
Preamp connections: VP cable to sensor, included, length dependent on part number; standard patch cord to instrument, ordered separately.
Components included: 52 002 447 combination pH electrode, 02385 flow housing & 1200-2X preamp with VP cable. Order patch cord separately.

Description	Part No.
pHure Sensor™ with 3 ft (1 m) VP cable	**333-211**
pHure Sensor™ with 10 ft (3 m) VP cable	**333-212**
pHure Sensor™ with 16 ft (5 m) VP cable	**333-213**
pHure Sensor™ with 33 ft (10 m) VP cable	**333-214**
Replacement combination electrode with RTD	**52 002 447**

pHure Sensor ™ Features

pHure Sensor ™ Dimensions



NOTES:

1. Dimensions: Inches (mm)
2. Electrode / Flow Housing Assenbly must be in upright position as shown.
3. Allow at least 10 in. (250 mm) clearance to remove sensor.
4. Allow at least 4.5 in. (115 mm) clearance for patch cord connection.
5. Orient preamplifier box with VP cable at top. Mouting feet are removable.

Thornton's High Performance ppb-level dissolved oxygen measurement capability excels in the most demanding applications. Inherent in its design is a precise zero and a highly accurate response over the entire range of measurement. This allows it to perform well at any level as well as providing very fast response to changes from one level to another.

The polarographic probe uses a gas-permeable membrane through which oxygen passes to produce an electrochemical reaction and current flow in direct proportion. The membrane is stainless steel mesh-reinforced Teflon for exceptional durability. Behind that membrane is the platinum cathode where oxygen reacts to produce the measurement signal. The cathode is surrounded by a guard electrode which prevents stray oxygen from the sides of the membrane or inside of the probe from adding to the signal. The guard ring is the key to the very rapid downscale response. The electrochemical reaction is completed at the silver cathode.

Full temperature compensation accounts for effects on both membrane permeability and solubility of oxygen in water.

Features

- Very fast response
- High accuracy
- Low maintenance with drop-in modular membrane
- Excellent long-term stability

Applications

Power plant cycle chemistry monitoring of DO enables control of oxygen scavenger with phosphate, caustic or all-volatile treatment. With oxygenated treatment it can be used to regulate oxygen feed. Compliance with cycle chemistry guidelines and specifications for DO can be assured with this very accurate and responsive measuring system. Cycling plants can benefit from its rapid downscale response, assuring real-time reporting of even the fastest deoxygenation during startup.

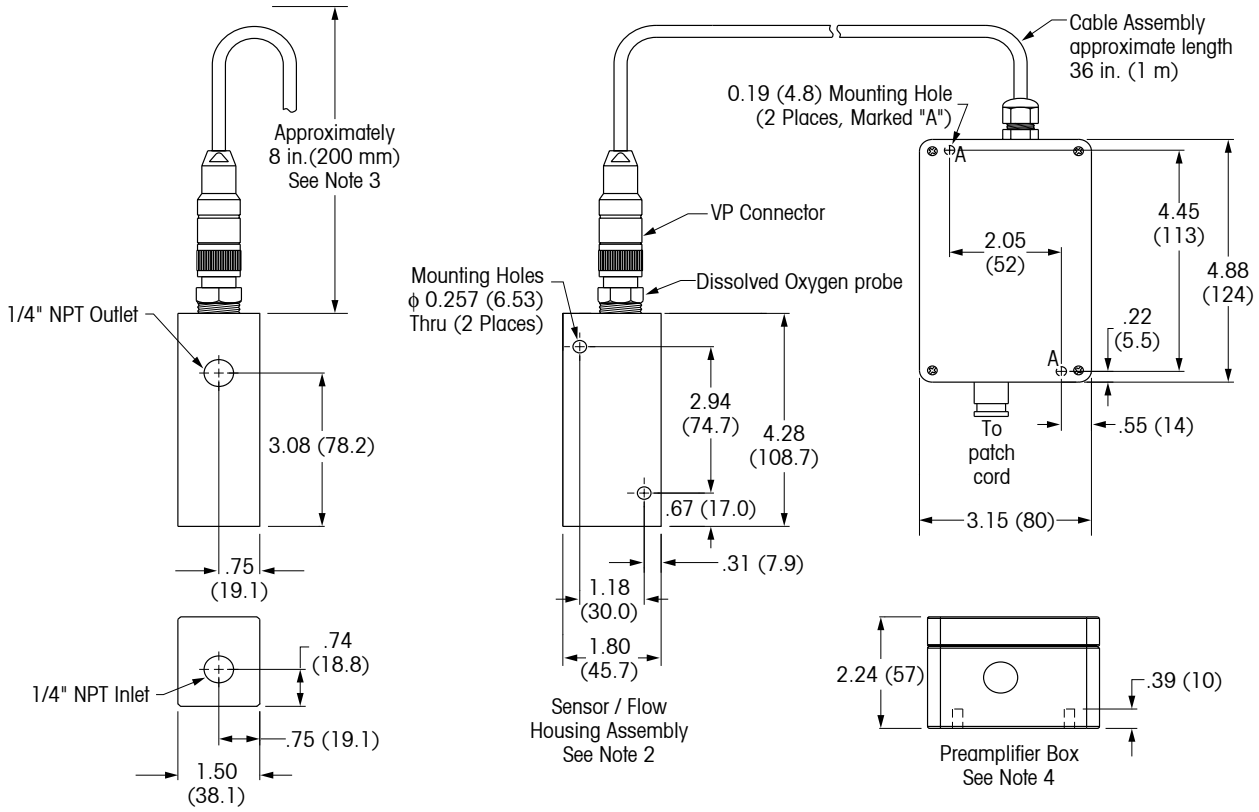
A 770MAX can be used as a compact portable meter to verify or calibrate panel-mounted instruments. A single 770MAX can measure specific and cation conductivity, pH, dissolved oxygen and sample temperature and provide simultaneous RS232 or analog outputs for all of them.

Semiconductor ultrapure water for some processes requires low DO levels to prevent oxidation of wafer surfaces between stages. The 770MAX can provide a solid ppb-level DO measurement plus simultaneous measurements of resistivity and flow in the same instrument.

Pure water treatment systems with deaerators to produce water for the above applications can be reliably monitored with this sensor. The additional measurement channels are available for all of the other 770MAX parameters.

Sample flowrate: 50 - 1000 mL/min
Sample temperature: 0 - 60 °C (32 - 140 °F) for temperature compensation; can tolerate 100 °C
Sample pressure: 0 - 5 bar (72 psig)
Sample connections: 1/4" NPT
Wetted materials: Polyacetal flow housing, polyphenylene sulfide probe body, Teflon membrane reinforced with stainless steel and silicone rubber, Viton and silicone rubber o-rings.
Cable length: Probe to preamp, 3 ft (1 m); preamp to instrument, 1 to 300 ft (0.3 to 91 m) with patch cord ordered separately
Weight: 1 kg (2 lb) with flow housing
Response time: 98% response in 90 seconds
Operating range: 0 - 10,000 ppb (µg/L)
System accuracy: ± 1% of reading or 1 ppb, whichever is greater; ± 0.5 °C
Spare parts: Replacement electrolyte included

Description	Part No.
DO Probe, preamp & flow housing	**357-210**
Maintenance kit (electrolyte and 4 membranes)	**52 200 024**
Polarization module (for portable use)	**52 200 893**



Notes:

1. Dimensions: inches (mm)
2. Sensor/Flow housing assembly must be in upright position as shown.
3. Allow approximately 8 in. (200 mm) clearance to remove sensor.
4. Orient preamplifier box with VP cable at the top.

Thornton's long-life dissolved oxygen measurement capability uses an industry-proven sensor design with major improvements in longevity. An especially durable membrane and controlled internal electrochemistry allow many years of operation with no internal maintenance.

Self-polarized electrodes minimize upsets from power interruption. Full temperature compensation accounts for effects on both membrane permeability and solubility of oxygen in water.

Features

- Very low maintenance
- Excellent long-term stability
- Industry-proven sensor technology
- No interference from hydrogen in stator cooling applications.

Applications

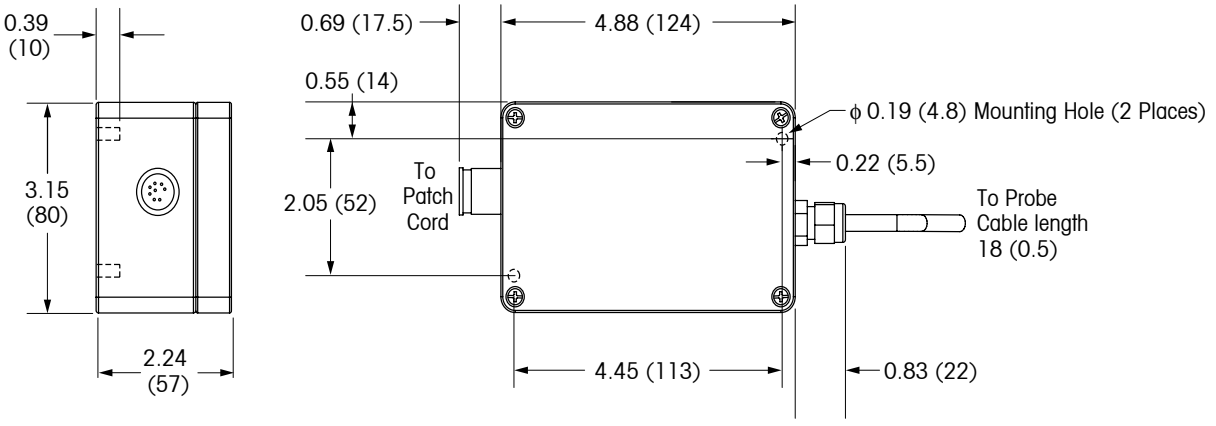
Power plant cycle chemistry monitoring of DO enables control of oxygen scavenger with phosphate, caustic or all-volatile treatment. With oxygenated treatment it can be used to regulate oxygen feed. Compliance with cycle chemistry guidelines and specifications for DO can be assured with this reliable, long-term measuring system.

Semiconductor ultrapure water for some processes requires low DO levels to prevent oxidation of wafer surfaces between stages. The 770MAX can provide solid ppb-level DO measurements plus simultaneous measurements of other key water quality parameters in the same instrument.

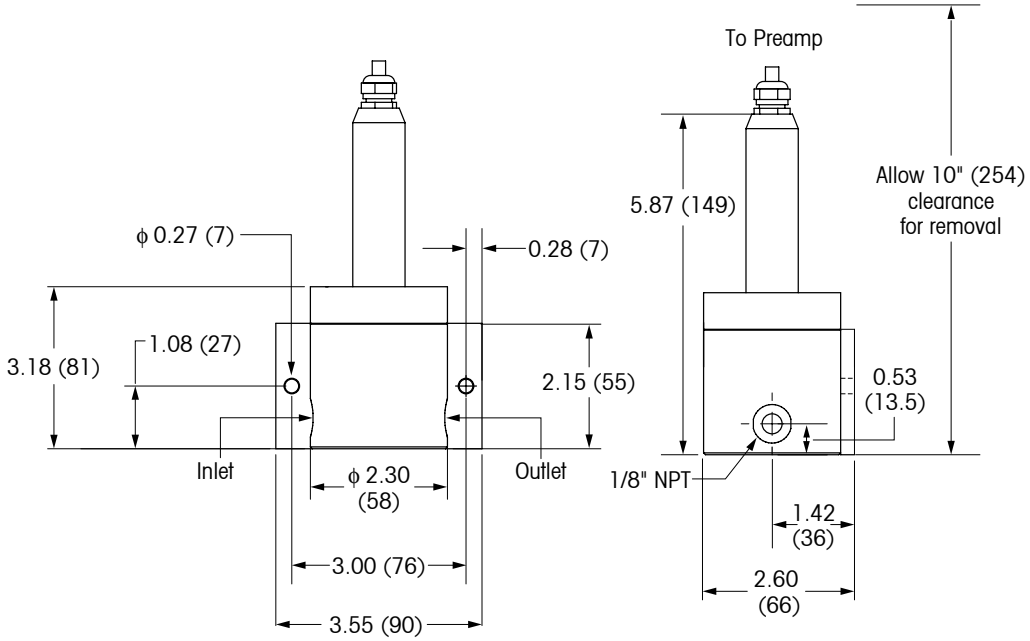
Pure water treatment systems with deaerators to produce water for the above applications can be reliably monitored with the 770MAX.

Sample flowrate:	50 - 2000 mL/min
Sample temperature:	5 - 50 °C (41 - 122 °F)
Sample pressure:	Normal operation, atmospheric; can withstand 3 bar (45 psig)
Sample connections:	1/8" NPT
Wetted materials:	Polyacetal flow chamber, 316 stainless steel and polyacetal probe, HDPE membrane
Cable length:	Probe to preamp, 1.5 ft (0.5 m); preamp to instrument, 5 to 200 ft (1.6 to 61 m) with patch cord ordered separately
Weight:	1.5 kg (3 lb) with flow chamber
Response time:	Within range, 20 seconds for 90% response; from air calibration, dependent on air exposure time
Operating range:	0 - 10,000 ppb (µg/L) with auto-ranging
System accuracy:	± 2% reading or 1 ppb, whichever is greater; ± 0.5 °C
Spare parts:	Maintenance kit of 7 membranes, and replacement electrolyte, Part No. 91008 included.

Description	Part No.
ppb DO Probe & flow chamber	**357-110**



Orient preamp box with probe cable at top.



Dimensions: inches (mm)

Flow sensors are available in models to work with any of the four Smart inputs or with either of the two pulse flow inputs of a 770MAX instrument. For greatest convenience, Smart models are normally used. However, if all four Smart inputs are needed for other measurements then the pulse inputs may help to reduce the number of instruments required in a system. Pulse input sensors require screw terminal wiring, manual setup and entry of calibration data. An external power supply which can power two pulse input sensors is required with pulse input models, as noted.

770MAX Forward-Swept Impeller Flow Sensors with Fittings

Provide low cost non-magnetic flow measurement, with installation fitting included.

Mounting fitting: Included with insertion sensor (flow-thru and socket union type sensors do not require fitting), wetted parts as noted.

Straight pipe requirements: 10 x diameter upstream and 5 x diameter downstream.

Electrical connections: Smart models have 1.5 ft (0.5 m) cable and smart connector and use patch cords up to 300 ft (91 m). Pulse input models have 20 ft (6.1 m) cables and may be extended up to 2,000 ft (610 m) using 20 gauge, shielded cable: 2-conductors for socket tee models, 3-conductors for other models.

Power supply: One external 12 VDC isolated power supply 1000-65 is required for one or two pulse input sensors. One kit 1000-67 is required for each 1-1/2″ and larger pulse input sensor.

Accuracy: ± 1% FS over operating range

Repeatability: ± 0.5% FS over operating range

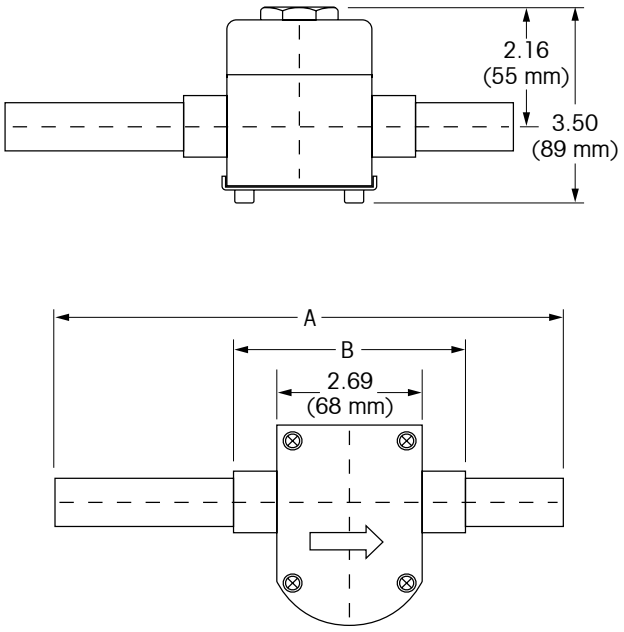
Pipe Size of Included Fitting	Wetted Materials	Flow Range	Pressure at Temperature PSIG (bar)	Pressure at Temperature °F (°C)	Ref. No	Pulse Input Part No.	Smart Input Part No.
1/2″ flow-thru/pipe	PVC, Viton, ceramic, Tefzel	0.2-5.8 GPM			410200-0022	**33349**	**335-531**
3/4″ flow-thru/pipe	PVC, Viton, ceramic, Tefzel	0.4-13 GPM	350 (24)	78 (23) &	411200-0022	**33350**	**335-731**
1/2″ flow-thru/pipe	PVC, Viton, ceramic, Tefzel	0.7-15 GPM	75 (5.2)	140 (60)	400200-0022	**33176**	**335-511**
3/4″ flow-thru/pipe	PVC, Viton, ceramic, Tefzel	1.7-33 GPM			401200-0022	**33177**	**335-711**
1″ flow-thru/pipe	PVC, Viton, ceramic, Tefzel	2.2-45 GPM			402200-0022	**33175**	**335-111**
1-1/2″ Socket tee	PVC tee, PPS, Nylon, tungsten carbide, EPDM	1-30 ft/s			228PV1505-1211	**33142**	**335-911**
2″ Socket tee	PVC tee, PPS, Nylon, tungsten carbide, EPDM	1-30 ft/s			228PV2005-1211	**33143**	**335-211**
3″ Socket tee	PVC tee, PPS, Nylon, tungsten carbide, EPDM	1-30 ft/s	100 (7)	68 (20) &	228PV3005-1211	**33144**	**335-311**
4″ Socket tee	PVC tee, PPS, Nylon, tungsten carbide, EPDM	1-30 ft/s	40 (2.8)	140 (60)	228PV4005-1211	**33145**	**335-411**
4″ saddle type, see below	PVC, PPS, Nylon, ceramic, EPDM	1-30 ft/s			220PVS0005-1211	**33273**	**335-451**
6″ saddle type, see below	PVC, PPS, Nylon, ceramic, EPDM	1-30 ft/s			220PVS0005-1211	**33273**	**335-651**
1/2″ Socket union	PVDF, Viton, ceramic, Tefzel	1-20 GPM	275 (19)	65 (18) &	400500-0022	**33172**	**335-521**
3/4″ Socket union	PVDF, Viton, ceramic, Tefzel	1.74-34 GPM	140 (10)	220 (104)	401500-0022	**33174**	**335-721**
1″ Socket union	PVDF, Viton, ceramic, Tefzel	2.8-56 GPM			402500-0022	**33171**	**335-121**
1-1/2″ to 6″ Repl. Sensor for PVC Pipe, fitting not included*		1-30 ft/s	NA	NA	813107-1211	**33191**	**335-041**
1-1/2″ to 6″ Repl. Sensor for PVDF Pipe, fitting not included*		1-30 ft/s	NA	NA	813003-0022	**33192**	**335-051**
4″ Insert Sensor for SS pipe		0.5-30 ft/s	400 (28)	100 (38) &	220SS0000-1211	**33418**	**335-461**
6″ Insert Sensor for SS pipe		0.5-30 ft/s	325 (22)	300 (149)	220SS0000-1211	**33418**	**335-661**

* Requires field configuration for pipe size.

Mounting Saddles

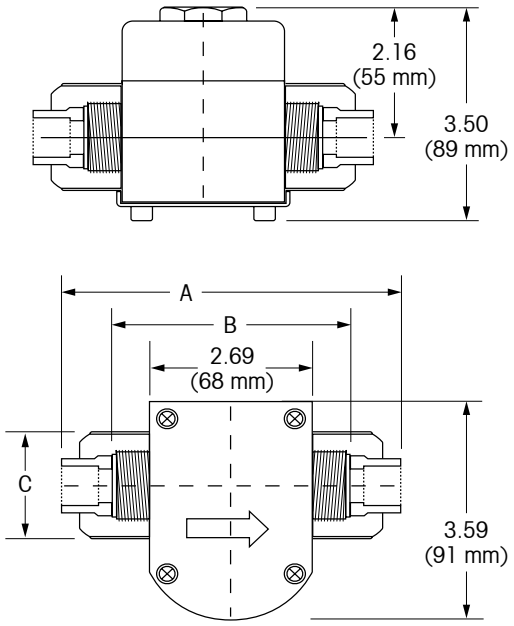
Pipe Size	Wetted Materials	Ref. No	Pulse Input Part No.	Smart Input Part No.
4″ used w/33273	Polypropylene, Viton	26235-01	**17523**	**17523**
6″ used w/33273	Polypropylene, Viton	26234-01	**17524**	**17524**

PVC Flow-thru/Pipe



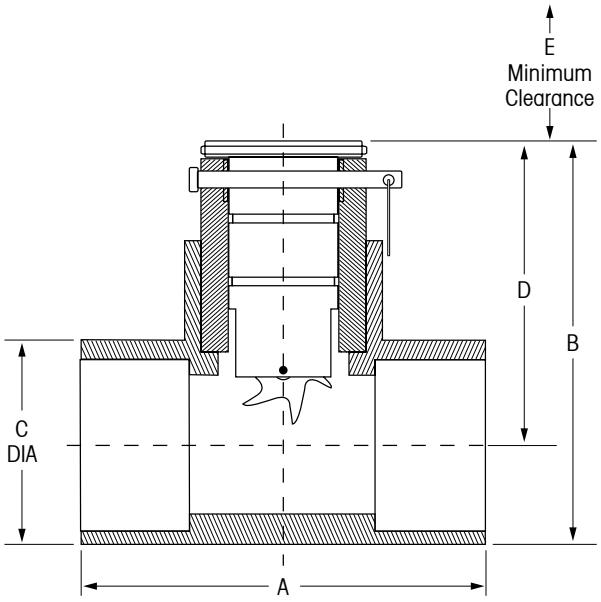
PVC Size	1/2″	3/4″	1″
A	8.83″ (224 mm)	10.69″ (272 mm)	13.15″ (334 mm)
B	4.08″ (104 mm)	4.69″ (119 mm)	5.40″ (137 mm)

PVDF Socket Union



PVDF Size	1/2″	3/4″	1″
A	5.58″ (142 mm)	6.12″ (155 mm)	1.85″ (47 mm)
B	3.54″ (90 mm)	3.92″ (100 mm)	2.24″ (57 mm)
C	1.85″ (47 mm)	4.32 (110 mm)	2.52″ (64 mm)

PVC Socket Tee



PVC Size	1.5″	2″	3″	4″
A	5.0″ (127 mm)	.63″ (143 mm)	6.50″ (165 mm)	7.38″ (187 mm)
B	5.16″ (131 mm)	5.64″ (143 mm)	6.83″ (173 mm)	7.83″ (199 mm)
C	2.38″ (60 mm)	2.88″ (73 mm)	4.23″ (107 mm)	5.38″ (137 mm)
D	3.97″ (101 mm)	4.20″ (107 mm)	4.68″ (119 mm)	5.1″ (130 mm)
E	5.0″ (127 mm)	5.0″ (127 mm)	5.0″ (127 mm)	5.0″ (127mm)

770MAX Flat Paddlewheel Flow Sensors

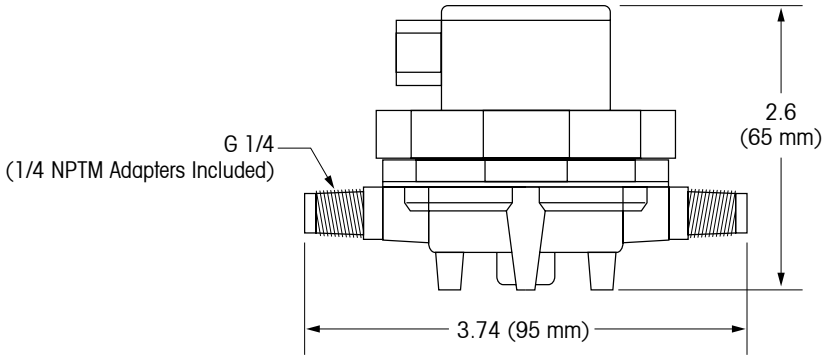
Provide low cost flow measurement and high pressure/temperature models.

Mounting fitting: Must be obtained separately except for 1/4" NPT models.
Straight pipe requirements: 10-50 x diameter upstream and 5 x diameter downstream.
Electrical connections: Smart models have 1.5 ft (0.5 m) cable and smart connector and use patch cords up to 300 ft (91 m). Pulse input models have 25 ft (7.6 m) cables and may be extended up to 200 ft (61 m) for magnetic type and 1,000 ft (305 m) for Hall effect type, using 2-conductor, 22 gauge, shielded cable.
Linearity: 1% FS
Repeatability: ± 0.5% FS, except ± 0.25% FS for 1/4" NPT models
Certification: CE rated, certificate of accuracy included where indicated.

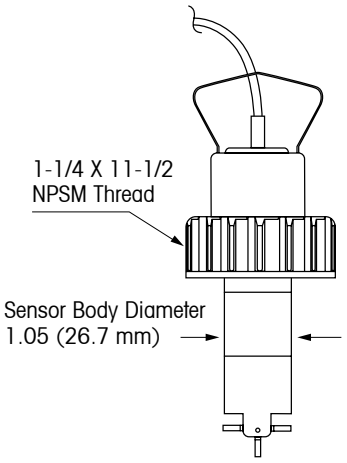
Pipe Size	Wetted Materials	Cert. Incl.	Flow Ranges	Pressure at Temperature PSIG (bar)	°F (°C)	Ref No.	Pulse Input Part No.	Smart Input Part No.
Hall Effect								
0.5 - 4″	Polypropylene, titanium, PVDF	Y	0.3-20 ft/s (0.1-6 m/s)	180 (12.4) 25 (1.7)	68 (20) & 194 (90)	3-2536-P0	**33298**	**334-210***
5 - 8″	Polypropylene, titanium, PVDF	N				3-2536-P1	**33299**	**334-211***
10″ & Up	Polypropylene, titanium, PVDF	N				3-2536-P2	**33300**	**334-212***
0.5 - 4″	PVDF, Hastelloy C	Y		200 (13.8) 25 (1.7)	68 (20) & 212 (100)	3-2536-V0	**33301**	**334-213***
5 - 8″	PVDF, Hastelloy C	N				3-2536-V1	**33302**	**334-214***
1.5 - 36″	316SS, PEEK, CD4MCu, 1.5″ NPT Hot Tap	N		250 (17.2)	180 (82)	3-2540-3	**33304**	**334-216***
1.5 - 24″	316SS, PEEK, CD4MCu, 1.5″ NPT Hot Tap	N				3-2540-1	**33305**	**334-217***
Magnetic								
1/4″ NPTM	PVDF, Viton, Teflon	N	0.13-0.74 GPM 0.5-2.8 LPM	80 (5.5) 45 (3.1)	-20 (-30) & 248 (120)	3-2507.100-2V	**33282**	**334-405**
1/4″ NPTM	PVDF, Viton, Teflon	N	0.3-1.6 GPM 1.3-6 LPM			3-2507.100-4V	**33285**	**334-406**
1/4″ NPTM	PVDF, Viton, Teflon	N	0.8-3.2 GPM 3.0-12 LPM			3-2507.100-6V	**33287**	**334-407**
0.5 - 4″	Polypropylene, titanium, PVDF	Y	1-20 ft/s (0.3-6 m/s)	180 (12.4) 25 (1.7)	68 (20) & 194 (90)	P51530-P0	**NA**	**334-203***
5 - 8″	Polypropylene, titanium, PVDF	N				P51530-P1	**NA**	**334-204***
0.5 - 4″	PVDF, Hastelloy C	Y		200 (13.8) 25 (1.7)	68 (20) & 212 (100)	P51530-V0	**NA**	**334-205***
0.5 - 4″	PVDF	Y				P51530-T0	**NA**	**334-201***
5 - 8″	PVDF	N				P51530-T1	**NA**	**334-202***
0.5 - 1″	316SS, CD4Mcu, Fluoroloy B	N	1-20 ft/s (0.3-6 m/s)	1500 (103)	300 (149)	P525-1	**NA**	**334-303***
1.25 - 12″	316SS, CD4Mcu, Fluoroloy B	N				P525-2	**NA**	**334-302***

* Specify pipe material, size, and schedule or inside diameter to enable Smart calibration.

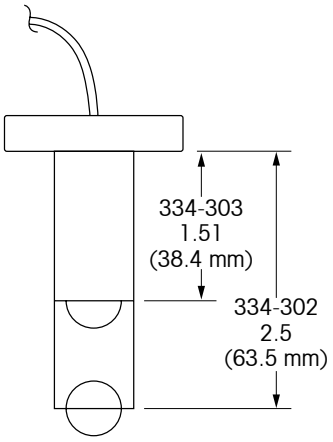
1/4" NPTM Flow-thru



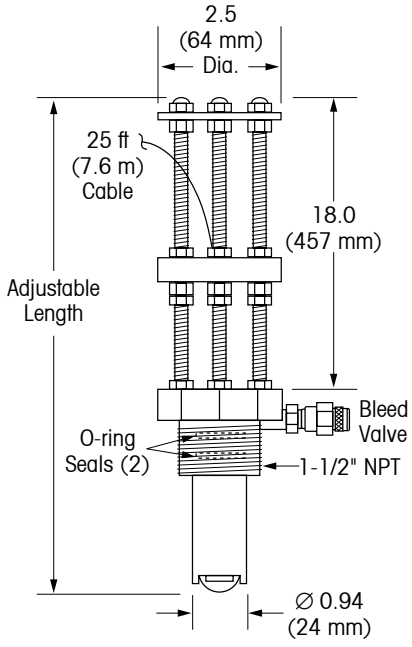
0.5 - 8" Plastic



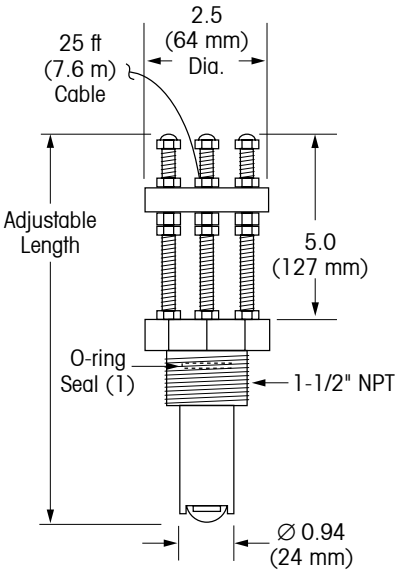
Metal



Hot Tap & Large Pipe



33304 & 334-216



33305 & 334-217

Dimensions: inches (mm)

Vortex Flow Sensors

Accurate flow measurement with no metal parts and no moving parts in a variety of connection types and sizes.

Straight pipe requirement: 10 x diameter upstream and 5 x diameter downstream.
Pressure / Temperature: PVC:150 psi (10 bar) @ 70 °F (21 °C), 93 psi (6.5 bar) @ 100 °F (38 °C). PVDF:150 psi (10 bar) @ 70 °F (21 °C), 130 psi (9 bar) @ 150 °F (65 °C); 203 °F (95 °C) max.
Viscosity: For liquids more viscous than water, consult Thornton.
Accuracy: ±1% of full scale
Enclosure: NEMA 4X
Electrical connections: 1/2" NPTF port with screw terminal wiring. Wiring may be run up to 1,000 ft. (305 m) with 3-conductor, 20 gauge, shielded cable, such as Belden 9364.
Power supply: One external 12 VDC isolated power supply 1000-65 is required for one or two pulse input sensors. One kit 1000-67 is required for each pulse input sensor.
Certification: CSA and CE, Certificate of Calibration included.

Flow Range GPM (LPM)	Size	Length in.	Length (mm)	Pulse Input* Part No.	Smart Input Part No.
PVC - NPTM Threaded Connection					
0.6-5 (2.3-19)	1/4″	5.25″	(133)	**33308**	**336-101**
1.3-15 (5-57)	1/2″	7.13″	(181)	**33309**	**336-102**
2.1-25 (8-95)	3/4″	7.63″	(194)	**33310**	**336-103**
4.2-50 (16-189)	1″	8.03″	(204)	**33311**	**336-104**
8.3-100 (31-378)	1-1/2″	8.37″	(213)	**33312**	**336-105**
16.7-200 (63-757)	2″	8.37″	(213)	**33313**	**336-106**
PVDF - Bead & Crevice Free Butt End Connection					
1.3-15 (5-57)	1/2″	4.87″	(124)	**33315**	**336-108**
2.1-25 (8-95)	3/4″	4.87″	(124)	**33316**	**336-109**
4.2-50 (16-189)	1″	5.09″	(129)	**33317**	**336-110**
8.3-100 (31-378)	1-1/2″	6.24″	(158)	**33318**	**336-111**
16.7-200 (63-757)	2″	6.77″	(172)	**33319**	**336-112**

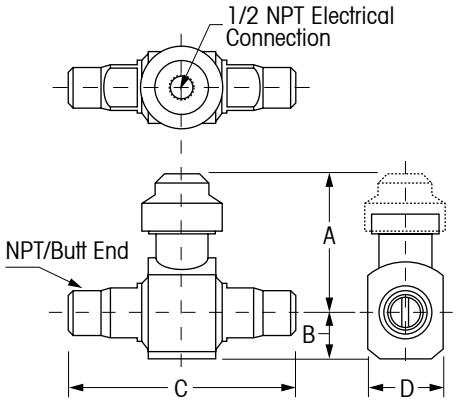
Flow Range GPM (LPM)	Size	Length in.	Length (mm)	Pulse Input* Part No.	Smart Input Part No.
PVC - Wafer Type (Connects between 150# flanges)					
1.3-15 (5-57)	1/2″	2.03″	(52)	**33320**	**336-113**
2.1-25 (8-95)	3/4″	2.03″	(52)	**33321**	**336-114**
4.2-50 (16-189)	1″	2.25″	(57)	**33322**	**336-115**
8.3-100 (31-378)	1-1/2″	2.63″	(67)	**33323**	**336-116**
16.7-200 (63-757)	2″	3.22″	(82)	**33324**	**336-117**
25-300 (95-1135)	3″	4.25″	(108)	**33325**	**336-118**
PVDF - Wafer Type (Connects between 150# flanges)					
1.3-15 (5-57)	1/2″	2.03″	(52)	**33326**	**336-119**
2.1-25 (8-95)	3/4″	2.03″	(52)	**33327**	**336-120**
4.2-50 (16-189)	1″	2.25″	(57)	**33328**	**336-121**
8.3-100 (31-378)	1-1/2″	2.63″	(67)	**33329**	**336-122**
16.7-200 (63-757)	2″	3.22″	(82)	**33330**	**336-123**
25-300 (95-1135)	3″	4.25″	(108)	**33331**	**336-124**

Flow Range GPM (LPM)	Size	Length in.	Length (mm)	Pulse Input* Part No.	Smart Input Part No.
PVC - Van Stone 150# Flanges					
25-300 (95-1135)	3″	12.00″	(305)	**33332**	**336-125**
50-600 (190-2270)	4″	12.00″	(305)	**33333**	**336-126**
PVDF - Van Stone 150# Flanges					
25-300 (95-1135)	3″	12.00″	(305)	**33334**	**336-127**
50-600 (190-2270)	4″	12.00″	(305)	**33335**	**336-128**

* Pulse input flow sensors are for 770MAX channels 5 & 6 only, do not have Smart Sensor capabilities and do not use patch cords.

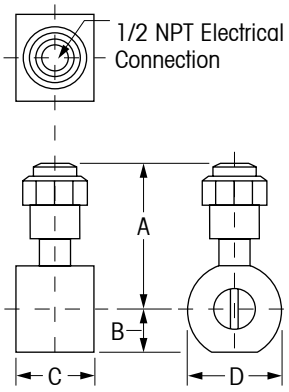
Dimensions – PVC (NPT)

Size	A	B	C	D
1/4″	3.81″ (97)	1.75″ (45)	5.25″ (133)	2.50″ (64)
1/2″	3.81″ (97)	1.75″ (45)	7.13″ (181)	2.50″ (64)
3/4″	3.81″ (97)	1.75″ (45)	7.63″ (194)	2.50″ (64)
1″	3.92″ (100)	1.75″ (45)	8.03″ (204)	2.50″ (64)
1-1/2″	3.90″ (99)	2.00″ (51)	8.37″ (213)	2.50″ (64)
2″	4.31″ (109)	2.00″ (51)	8.37″ (213)	2.50″ (64)



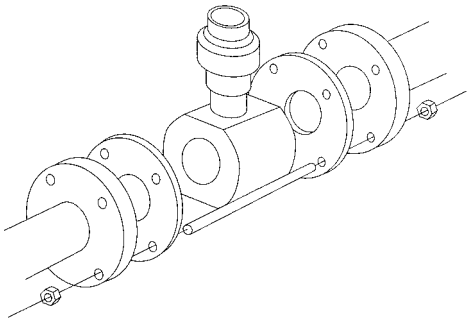
Dimensions – PVDF (Butt)

Size	A	B	C	D
1/4″	5.90″ (150)	.63″ (16)	4.87″ (124)	1.31″ (33)
1/2″	5.75″ (146)	.78″ (20)	4.87″ (124)	1.31″ (33)
3/4″	5.75″ (146)	.94″ (24)	4.87″ (124)	1.44″ (37)
1″	5.88″ (149)	1.19″ (30)	5.09″ (129)	2.00″ (51)
1-1/2″	6.21″ (158)	1.50″ (38)	6.24″ (158)	2.50″ (64)
2″	6.60″ (168)	1.88″ (48)	6.77″ (172)	3.00″ (76)



Dimensions – Wafer (ANSI 150 Standard)

Size	A	B	C	D
1/2″	5.85″ (149)	.78″ (20)	2.03″ (52)	1.75″ (44)
3/4″	5.90″ (150)	.94″ (24)	2.03″ (52)	2.13″ (54)
1″	5.69″ (145)	1.19″ (30)	2.25″ (57)	2.47″ (63)
1-1/2″	6.00″ (152)	1.50″ (38)	2.63″ (67)	3.25″ (83)
2″	6.37″ (162)	1.88″ (48)	3.22″ (82)	4.00″ (102)
3″	6.88″ (175)	2.50″ (64)	4.25″ (108)	5.24″ (133)

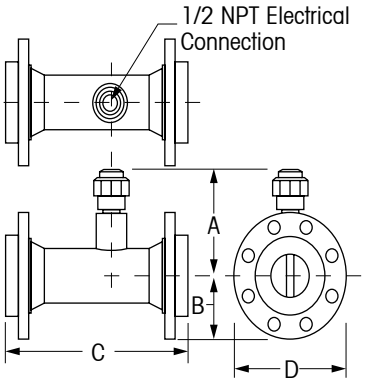


Dimensions – PVDF Van Stone Flange (ANSI 150 Standard)

Size	A	B	C	D
3″	5.72″ (145)	3.74″ (95)	12.00″ (305)	7.48″ (190)
4″	6.16″ (156)	4.51″ (115)	12.00″ (305)	9.01″ (229)

Dimensions – PVC Van Stone Flange (ANSI 150 Standard)

Size	A	B	C	D
3″	Consult Factory			
4″	6.25″ (159)	4.50″ (114)	8.00″ (203)	9.00″ (229)



Dimensions: inches (mm)

PFA Vortex Flowmeters

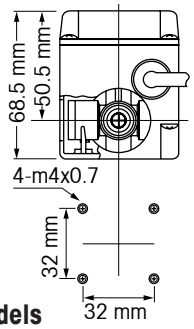
The ultimate for measuring low flow rates of ultrapure water and chemicals with molded unibody of PFA, the only wetted material, and no moving parts. For 770MAX pulse input only. Requires external power supply.

Display: 4-digit LED plus high & low alarm indicators
Connections: Straight tube ends or Flaretek
Straight tube requirements: 10 x diameter upstream and 2 x diameter downstream.
Wetted materials: PFA Perfluoroalkoxy
Temperature: 32-212 °F (0-100 °C)
Viscosity: For liquids more viscous than water, consult Thornton.
Electrical connections: 6.5 ft (2 m) cable may be extended with 22 gauge 6-conductor shielded cable up to 325 ft. (100 m) for 770MAX pulse input only.
Enclosure: NEMA 4X, IP65
Power supply: One external 12 VDC isolated power supply 1000-65 is required for one or two pulse input sensors.
Certification: CE rated, certificate of accuracy included

Size	Flow rate GPM (L/min.)	Maximum Pressure At 68°F (20°C)	At 212°F (100°C)	Part No.
Straight tube end - connections				
3/8 in.	0.1-1 (0.4-3.5)	100psig (7bar)	58psig (4bar)	**317-100**
1/2 in.	0.5-5 (2-20)	145psig (10bar)	100psig (7bar)	**317-101**
3/4 in.	2.7-19 (10-70)	100psig (76bar)	58psig (4bar)	**317-102**
1 in.	4-40 (15-150)	70psig (5bar)	43psig (3bar)	**317-103**
Male Flaretek end - connections				
3/8 in.	01-1 (0.4-3.5)	100psig (7bar)	58psig (7bar)	**317-200**
1/2 in.	0.5-5 (2-20)	145psig (10bar)	100psig (7bar)	**317-211**
3/4 in.	2.7-19 (10-70)	100psig (76bar)	58psig (4bar)	**317-222**
Female Flaretek end - connections				
3/8 in.	01-1 (0.4-3.5)	100psig (7bar)	58psig (7bar)	**317-300**
1/2 in.	0.5-5 (2-20)	145psig (10bar)	100psig (7bar)	**317-311**
3/4 in.	2.7-19 (10-70)	100psig (76bar)	58psig (4bar)	**317-322**

Straight Tube-End

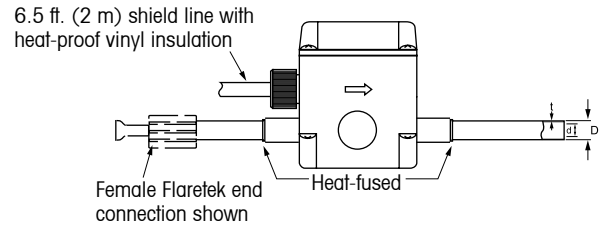
Size	Dimensions (mm)			
	D +0.30 -0.10	d +0.30 -0.10	t ± 0.15	L
3/8 in.	ϕ 9.52	ϕ 6.35	1.59	190
1/2 in.	ϕ 12.7	ϕ 9.52	1.59	190
3/4 in.	ϕ 19.05	ϕ 15.88	1.59	190
1 in.	ϕ 25.4	ϕ 22.22	1.59	190



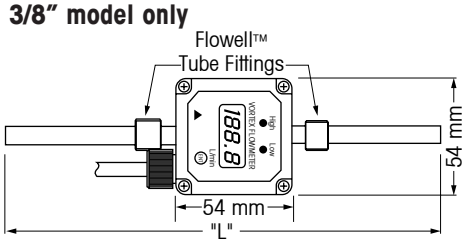
Flaretek-End

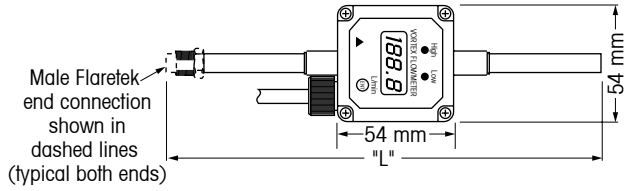
Size	Dimensions (mm)	
	L (male-ends)	L (female-ends)
3/8 in.	259	190
1/2 in.	267	190
3/4 in.	277	190

1/2", 3/4", 1" models



3/8" model only





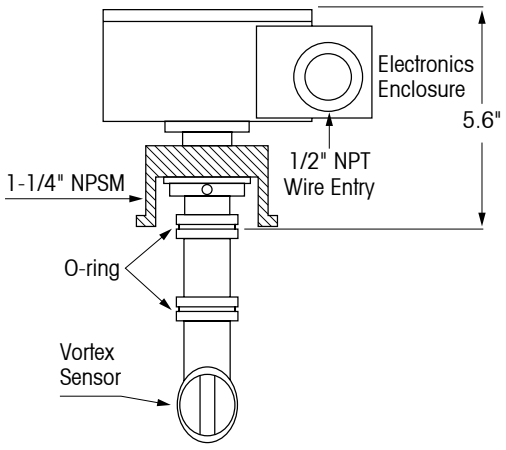
Insertion Vortex Flow Sensors

Provide direct retrofit into existing or new Signet fittings with no moving or metal parts and fewer wetted materials.

Mounting fitting: Signet, must be obtained separately
Wetted materials: PVDF, Viton; for PVC or PVDF pipe systems
Straight pipe requirements: 10 x diameter upstream and 5 x diameter downstream
Pressure / Temperature: PVDF: 200 psig (13.8 bar) at 73 °F (23 °C); 25 psig (1.7 bar) at 212 °F (100 °C). PVC: 180 psig (12.4 bar) at 73 °F (23 °C); 40 psig (2.7 bar) at 140 °F (60 °C).
Viscosity: For liquids more viscous than water, consult Thornton.
Electrical connections: Smart models have 1.5 ft (0.5 m) cable and smart connector and use patch cords up to 300 ft (91 m). Pulse models have screw terminals and are wired with 2-conductor, 22 gauge, shielded cable up to 1,000 ft (305 m).
Enclosure: NEMA 6
Power supply: One external 12 VDC isolated power supply 1000-65 is required for one or two pulse input sensors. One kit 1000-67 is required for each pulse input sensor.
Accuracy: 1% FS
Certification: CE rated, certificate of accuracy included

Specify pipe material, schedule or exact inside diameter, and existing Signet fitting when ordering.

Line Size	Flow Range GPM	Flow Range LPM	Pulse Input Part No.	Smart Input Part No.
For PVDF Signet Fitting (not included)				
1-1/4	1.2-81	4.6-307	**33358**	**338-104**
1-1/2	2-138	8-522	**33359**	**338-105**
2	3.4-224	13-848	**33360**	**338-106**
2-1/2	4.6-305	17-1, 154	**33361**	**338-107**
3	7-465	26-1, 760	**33362**	**338-108**
4	11-744	64-4, 319	**33363**	**338-109**
5	17-1, 141	65-4, 320	**33364**	**338-110**
6	25-1, 635	93-4, 640	**33365**	**338-111**
8	44-2, 940	166-11, 125	**33366**	**338-112**
For PVC Signet Fitting (not included)				
1-1/4	1.2-81	4.6-307	**33367**	**338-204**
1-1/2	2-138	8-522	**33368**	**338-205**
2	3.4-224	13-848	**33369**	**338-206**
2-1/2	4.6-305	17-1, 154	**33370**	**338-207**
3	7-465	26-1, 760	**33371**	**338-208**
4	11-744	64-4, 319	**33372**	**338-209**
5	17-1, 141	65-4, 320	**33373**	**338-210**
6	25-1, 635	93-4, 640	**33374**	**338-211**
8	44-2, 940	166-11, 125	**33375**	**338-212**



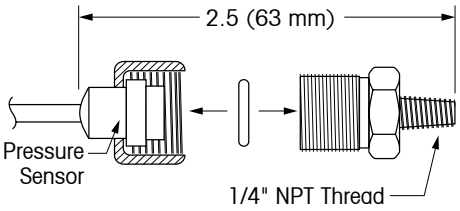
Tank Level, Pressure & Vacuum Sensors

Provide compact pressure and level sensing.

Process connection: 1/4″ NPTM
Cable: 5 ft (1.5 m), with Smart connector
Patch cord length: 150 ft (45.6 m) maximum
Accuracy: ±1% FS except 332-931 which is ±0.5% FS
Temperature range: 30 to 200 °F (-1 to 93 °C)
Temperature compensated range: 30 to 130 °F (-1 to 54 °C)
Certification: Certificate of Conformance included

Range	Wetted Material	Part No.
Tank Level		
0-6 psig (0-0.4 bar), 0-166 in (0-4.2 m)	316L SS	**332-931**
0-15 psig (0-1 bar), 0-416 in (0-10.5 m)	316L SS	**332-531**
Pressure		
0-100 psis (0-6.9 bar)	15-5 PH SS	**332-131**
0-200 psis (0-13.8 bar)	15-5 PH SS	**332-231**
0-500 psis (0-34.5 bar)	15-5 PH SS	**332-331**
0-1000 psis (0-69 bar)	15-5 PH SS	**332-431**
Vacuum		
0-15 psia (0-1 bar a)	316L SS	**332-031**

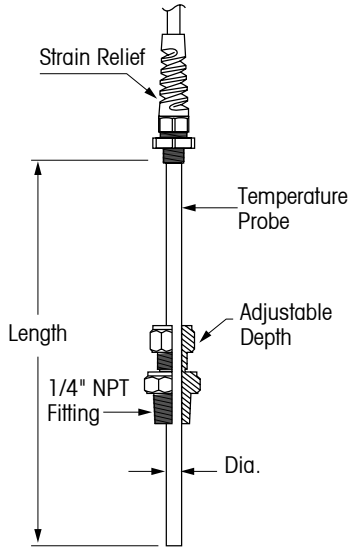
psis units identify a sealed sensor that measures gauge pressure against a constant reference of 14.7 psia. The seal protects sensitive parts of the transducer from airborne contaminants.



Temperature Sensors

Provide temperature sensing independent of conductivity or pH sensor. Penetration depth is adjustable at installation.

Process connection: 1/4″ NPTM, with 02112 Fitting
Wetted material: 316 SS
Range: -40 to 284 °F (-40 to 140 °C)
Pressure: 200 psig (14 bar)
Cable: 5 ft (1.5 m), with Smart connector
Accuracy: ±0.1°C
Certification: Certificate of Accuracy included



Description	Material	Length	Dia.	Part No.
1000 Ω Platinum RTD	316L SS	2″ (51 mm)	3/16″ (4.8 mm)	**231-321**
1000 Ω Platinum RTD	316L SS	6.8″ (173 mm)	1/4″ (6.4 mm)	**231-311**
1/4″ fitting for 231-311	Stainless Steel	-	-	**02112**

770MAX Accessories

Description	
12 VDC, 0.42 A Power Supply, required for some pulse input flow sensors, input 100-240 VAC, 1 x 2.2 x 3.8″ (25 x 55 x 96 mm) for surface mount, CE, UL, CSA.	**1000-65**
Pulse Flow Input Kit, required for some pulse input flow sensors.	**1000-67**

Patch Cord with connector at both ends, for 770MAX and Smart Sensors. Observe length limitations of pressure and level sensors.

1 ft (0.3 m) cord	**1001-79**	50 ft (15.2 m) cord	**1050-79**
5 ft (1.5 m) cord	**1005-79**	100 ft (30.5 m) cord	**1100-79**
10 ft (3 m) cord	**1010-79**	150 ft (45.6 m) cord	**1115-79**
15 ft (4.5 m) cord	**1015-79**	200 ft (61 m) cord	**1120-79**
25 ft (7.6 m) cord	**1025-79**	300 ft (91 m) cord	**1130-79**

Smart Signal Adapters

Provide an input for non-smart analog, conductivity, or frequency signals to the 770MAX. These signals can then be handled like any other channel, allowing one or more measurements to be assigned to that channel. Adapters may also be used for 770MAX accuracy verification using standards lab test equipment (if metrology protocol requires back up to the 1875 Smart Calibrator).

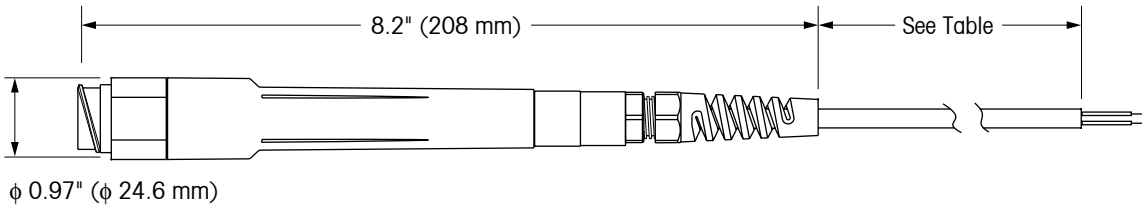
Voltage and current signals can be scaled in the 770MAX for custom ranges in 770MAX engineering units available for other sensors. For example, a special flow transmitter 4-20 mA signal may be connected to the adapter. On the 770MAX, its measurement display can be scaled in units of GPM, LPM, m^3/hr, or ft/sec. A second measurement for total flow could have units of gallons, liters or $meters^3$.

To accommodate measurement of the electrical parameters of continuous electrodeionization systems, displayed units of volts and amps are also available. Frequency signals are typically those of a pulse-type flow sensor.

Input connection: Cable with tinned lead pair (conductivity has 4-wire conductivity & 4-wire temperature input.)
Output connection: 770MAX Smart connector to interface with 1XXX-79 series patch cords
Signal requirements: Isolated from earth ground, externally powered (except 1000-68 & 1000-82)
Frequency signal: TTL, 0.5 - 4000 Hz; Amplitude - Low <2V (-5 V min), High >3V (12 V max)

Input Signal Range	Input Resistance	Cable Length	Part No.
0 - 100 mVDC	-	5 ft (1.5 m)	**1000-81**
0 - 1 VDC	-	5 ft (1.5 m)	**1000-79**
0 - 10 VDC	-	5 ft (1.5 m)	**1000-99**
4 - 20 mADC, Passive	100 ohms	5 ft (1.5 m)	**1000-90**
4-20 mADC, 24V loop power from adapter	100 ohms	5 ft (1.5 m)	**1000-68**
Conductivity Sensor & Pt1000 RTD	-	3 ft (1 m)	**1000-82**
Frequency (Flow)	-	3 ft (1 m)	**1000-83**

770MAX software version 2.4 (July 2002) or later required.



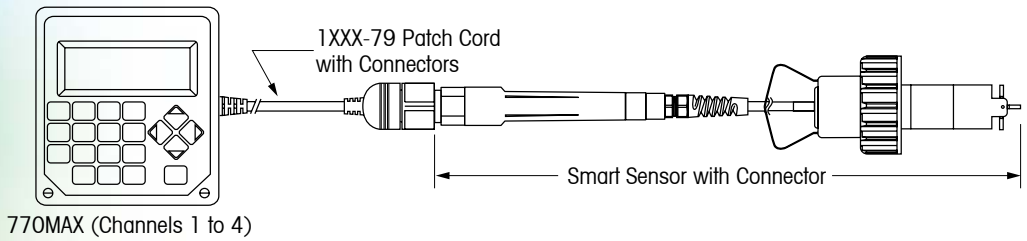
Thornton smart sensors are a key part of the 770MAX Multiparameter Analyzer/Transmitter measuring system. Sensors are available for pH, ORP, dissolved oxygen, flow, pressure, tank level and temperature as well as conductivity/resistivity (covered in separate data sheet ML0072). Each sensor includes data stored in its non-volatile memory which is communicated to the instrument as soon as it is connected. This data includes measurement identification, calibration constants, date of last calibration, serial number, etc., providing especially fast, simple and reliable startup and documentation. In addition, all wiring is conveniently handled through connectors.

Sensor Selection

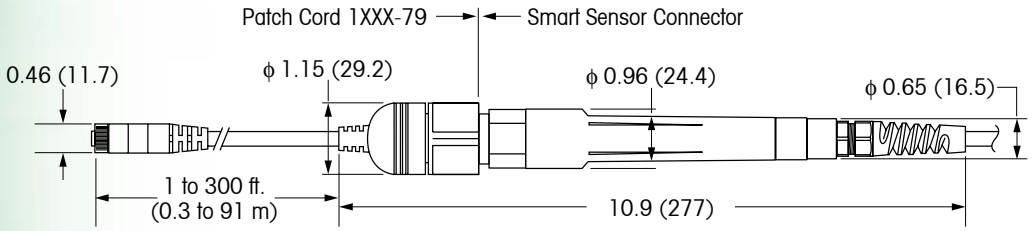
Thornton offers a variety of sensors to accommodate most applications. Use the following criteria to select the most appropriate sensor for your installation. (For sanitary sensors with Tri-Clamp connections, see data sheet ML0073.)

- Measurement range
- Pipe connection type and size
- Pressure
- Temperature and chemical compatibility including exposure to steam and/or chemical cleaning

Smart Sensor Wiring



Smart Sensor and Patch Cord Dimensions



Dimensions: inches (mm), except where noted otherwise

ISO 9001 certified

For the most current product information visit:

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