SIERRA

QuadraTherm™ 640i / 780i

THERMAL MASS FLOW METER

NEVER before possible.


SIERAR
DuoTherm

Introducing the World's Most Accurate Thermal Mass Flow Meter

From Sierra's beginning over forty years ago, Founder Dr. John G. Olin was driven by the vision of supplying industrial customers with the world's most accurate thermal mass flow meter. And, he knew it was a "sensor" game.

The development of an industrialized metal-sheathed sensor in the early 80s was Sierra's first big step, but Dr. Olin is a driven innovator, and this was only the beginning for someone who saw "Thermal Mass Flow" as his life's work. Many successful innovations followed, but in 1999 Sierra experienced a major breakthrough with the introduction of their patented no-drift DrySense™ thermal mass velocity sensor. Sierra engineers now recognized they were on the cusp of realizing Dr. Olin's vision.

Realizing the Vision

Thermal technology, by its very nature, uses the physics of heat transfer and conservation of energy in a closed system to measure mass flow rate. This means that for a thermal mass flow meter to achieve the greatest accuracy, it must solve the First Law of Thermodynamics (Heat Energy In = Heat Energy Out) for each data point.

As you can imagine, solving the First Law in a flow instrument was no easy task. By Dr. Olin's own accounting, decades of "hard-nosed dedication to excellence" by himself and Sierra's engineering team, years of testing, and his stack of yellow note pads over five feet high, jammed with his handwritten equations and designs, finally yielded the secret in the form of two revolutionary technologies—QuadraTherm™ and iTherm™, now both patented worldwide.

The QuadraTherm Sensor

Traditional thermal sensors have two sensors-—one temperature sensor and one velocity sensor, each in a separate probe. QuadraTherm (the term "Quad" meaning "four") introduces four sensors—three precision platinum temperature sensors and one patented DrySense mass velocity sensor. Performance improvements never before possible are gained as the QuadraTherm Technology isolates forced convection (the critical variable for measuring gas mass flow rate) by calculating and then eliminating unwanted heat-transfer components, like sensor stem conduction, one of the major causes of false flow readings.

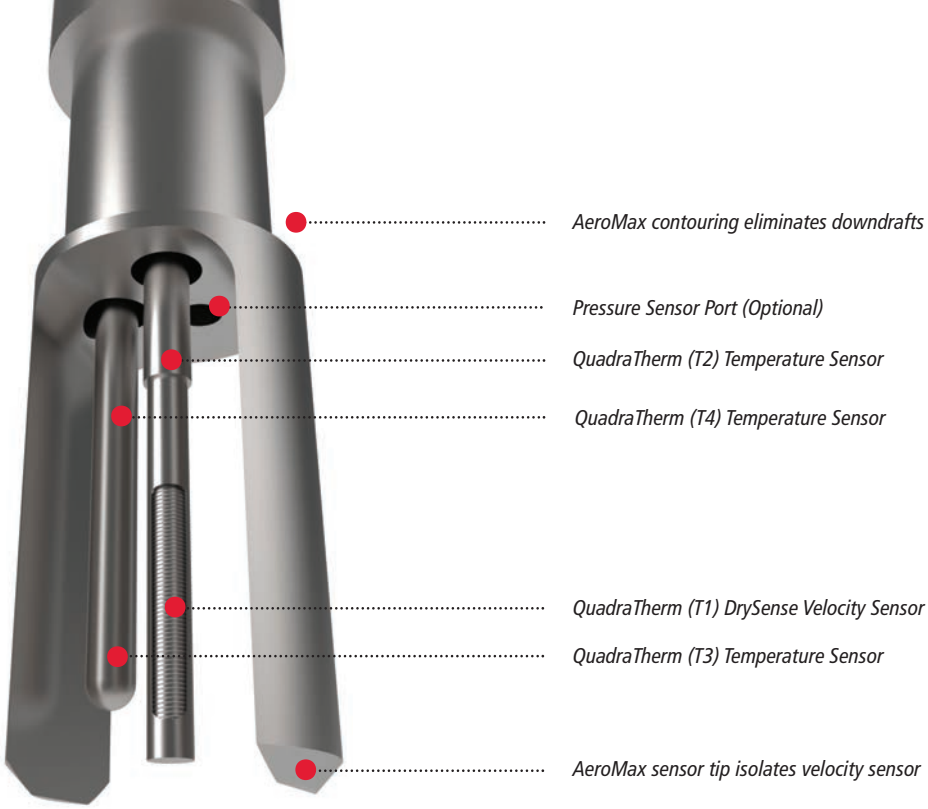
iTherm, the Brains Behind it

iTherm is the true "Brain" of the instrument and a revolutionary, living, learning algorithm set made possible by today's hyper-fast microprocessors and QuadraTherm sensor inputs. iTherm manages changes in gas flow, gas temperature and gas pressure, as well as outside temperature, via a comprehensive heat-transfer model. The result of iTherm is a proprietary, fundamentally different gas mass flow rate calculation using all pertinent variables for the most precise, stable and accurate thermal mass flow measurement possible.

QuadraTherm 640i / 780i

- Accuracy: +/- 0.5% of Reading
- Multivariable: Mass flow rate, temperature & pressure
- Revolutionary QuadraTherm™ four-sensor design
- DrySense™ no-drift sensor with lifetime warranty
- iTherm™ living, learning "Brain" manages all inputs
- Dial-A-Pipe™ : Change pipe size
- Dial-A-Gas™ : Change gas type
- iTherm Gas Library: 18 gases & mixtures (growing & improving)
- ValidCal™ Diagnostics: Assure performance
- Smart Interface Program: Computer interface software
- Foundation Fieldbus, Profibus DP, HART (pending)

- 780i inline version has built-in flow conditioning (note transparent pipe)



QuadraTherm makes it Possible.

The challenge for Dr. Olin and the Sierra engineering team was to develop a sensor that isolated forced convection, the desired source of heat loss.

In traditional thermal mass flow meters, the heated velocity sensor is inserted into the tip of a tubular probe and is surrounded by potting compounds, such as epoxy, ceramic cement, thermal grease, or alumina powder. These so-called "Wet" sensors have several weaknesses. They have an increased skin resistance which creates a "droop" in the output curve and decreased sensitivity as a consequence. They are hard to produce repeatably, which ultimately means reduced accuracy. And finally, wet sensors can create long-term measurement errors caused by aging and cracking due to differential thermal expansion between the parts of the heated velocity sensor.

QuadraTherm builds on the long-term stability of our patented no-drift DrySense velocity sensor technology. As the name implies, Sierra's velocity sensor is the only thermal sensor in the world that is truly "Dry". Our proprietary swaging process eliminates all air gaps between the heated velocity sensor and the tubular probe without the need for any potting compounds. The result is maximum sensitivity, reproducibility, immunity to cracking and shifting over time, and ultimately greatly improved accuracy. We back our DrySense Technology with a lifetime warranty.

In addition, by radically reworking the physical sensor head design, Sierra's engineering team minimized the effects of downdrafts and other interferences that cause false flow readings in traditional thermal flow meters. As Dr. Olin states, "We are trying to create a flow field for the velocity sensor where it is unaffected by anything else around it, so it can do what it was meant to do—measure the free-stream mass flow rate." Wind-tunnel testing and CFD modeling verified that we accomplished our goal.

QuadraTherm's Four-Sensor Design

Sierra's biggest breakthrough occurred when two new temperature sensors (T2 and T4—See Figure) were added to the existing two-sensor design (T3 temperature & T1 DrySense velocity) used in previous models. The two additional sensors perform real-time correction for the heat lost to the outside environment due to a phenomenon called "stem conduction." To better understand the benefits, let's look at a typical example.

Let's say the temperature of the flowing gas is higher than the outside temperature. In this case, stem conduction causes a substantial fraction (between 10% to 25%) of the electrical power supplied to the heated velocity sensor to be lost through the probe shaft to the outside environment. What happens if this is a traditional thermal mass flow meter and the outside temperature in the field application drops by a few degrees? The heat lost via stem conduction will increase and a flow measurement error will occur. QuadraTherm eliminates this source of error by first accurately measuring, and then correcting for, the heat lost via stem conduction.

And with iTherm, it Learns.

QuadraTherm's four-sensor technology provides the critical inputs for iTherm's living, learning algorithm set and gas library to accurately manage changes in gas and pipe selection, gas temperature, gas pressure, and outside temperature.

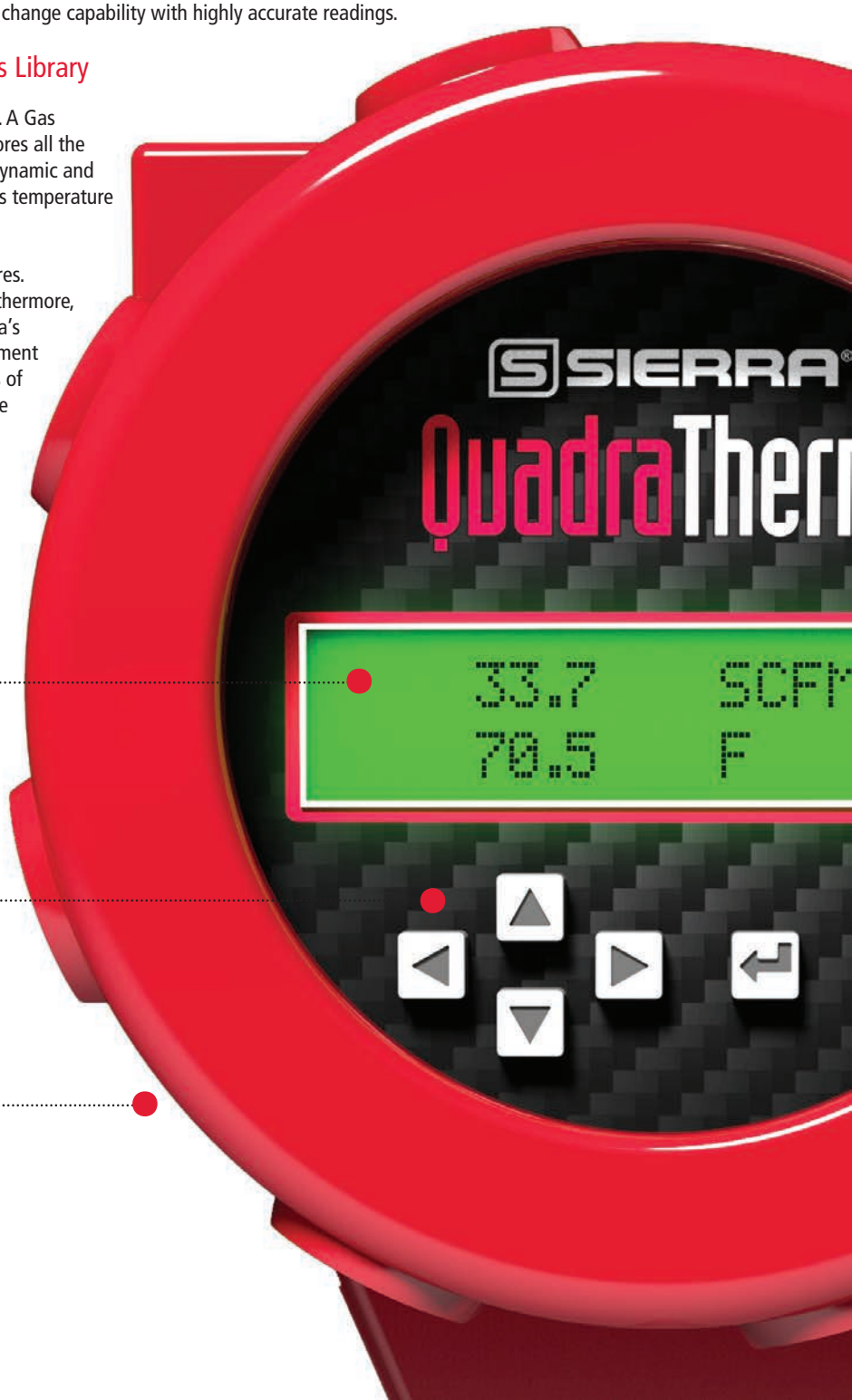
iTherm solves the First Law of Thermodynamics in a fraction of a second for each mass flow data point. It calculates stem conduction and all other unwanted heat loss components, subtracts them out, and then computes the mass flow rate from the remaining forced convection component.

And, with Dial-A-Pipe, it lets you relocate the probe to different pipe sizes and types in the field. With Dial-A-Gas, it provides gas change capability with highly accurate readings.

iTherms's Expanding Gas Library

The iTherm Gas Library stores proprietary Gas Packets. A Gas Packet is analogous to the DNA of a specific gas. It stores all the parameters needed to instantly calculate the thermodynamic and transport properties of every gas or gas mixture versus temperature and pressure.

Currently, the library has mapped 18 gases and mixtures. And it continues to grow and improve by the day. Furthermore, the millions of data points collected over time in Sierra's metrology laboratories can be used to tune the instrument for better performance and accuracy. Expect hundreds of data sets and gas and gas mixture combinations in the future that can be downloaded to your QuadraTherm meter via the internet.



Multivariable Readout: mass flow, temperature, pressure, totalizer, and alarms

Pushbutton control for Dial-A-Gas, Dial-A-Pipe, alarms, and engineering units

Explosion proof glass and enclosure

PERFORMANCE SPECIFICATIONS

Gas Measured
All inert gases and all non-condensing clean gases
Flammable gases: methane, propane, hydrogen, digester gas, natural gas
Corrosive gases compatible with 316L stainless steel
iTherm Gas Library: up to 18 gases (and growing); air is standard; Dial-A-Gas option for choice of three additional gases

Mass Velocity Range for Air
0 to 60,000 sfpm (0 to 305 smps) at 21.1°C, 1 atm

Multivariable Outputs
Mass flow rate (standard)
Temperature (standard)
Pressure (optional)
Totalized flow: totalized value is stored in non-volatile memory

Mass Flow Accuracy
780i Inline version accuracy (highest accuracy):
+/ -0.5% of reading above 50% of the full scale flow
+/- 0.5% of reading plus 0.5% of full scale below 50% of full scale flow

640i Insertion version accuracy:
+/- 0.75% of reading above 50% of the full scale flow
+/- 0.75% of reading plus 0.5% of full scale below 50% of full scale flow

iTherm Dial-A-Gas: all 640i/780i units can either be calibrated on actual gas (optional) or use iTherm Dial-A-Gas accuracies. See iTherm Dial-A-Gas Selection Chart on next page

Gas Pressure Accuracy
+/- 1.0% full scale

Gas Temperature Accuracy
+/- 1ºC (1.8°F)

Gas Pressure Ranges
30 psia (2.0 bara), 100 psia (6.7 bara), 300 psia (20.0 bara), 500 psia (33.3 bara)

Repeatability
Mass flow rate: +/- 0.15% of full scale
Gas temperature: +/- 0.5ºC (0.9ºF)
Gas pressure: +/- 0.5% of full scale

Response Time
Three seconds to achieve 63% (one time constant) of final value

Mass Flow Rate Turndown
100:1

ANALOG AND DIGITAL OUTPUTS

Output Signals
4-20 mA flow
4-20 mA temperature
4-20 mA pressure (optional)
Alarm output (contact SPST/opto relays)
User definable pulse output for totalized flow

Optional Communications Modules (pending)
MODBUS
Foundation Fieldbus
DeviceNet
Profibus DP
HART

POWER REQUIREMENTS

Input Power
100 to 240 VAC (0.4 Amps RMS at 230 VAC)
24 VDC +/- 10%, 1 Amp

OPERATING SPECIFICATIONS

Note: Maximum operating pressure must not exceed the full scale of the pressure transducer if the VTP option is ordered or damage may occur.

780i Inline Version Gas Pressure Requirements
NPT: 500 psia (33.3 bara) maximum

Flange process connections defined by the ASME B 16.5a – 1998 spec. group rating of 316L stainless steel ANSI 150 lb or 300 lb flanges (special)

316L stainless steel 150 lb flanges:
230 psia at -20ºF to 100ºF; 195 psia at 200ºF;
145 psia at 300ºF; 160 psia at 400ºF; and 145 psia at 500ºF
Equivalent DN PN16 flanges are available (see page 10 for sizes)

316L stainless steel 300 lb flanges (special):
600 psia at -20ºF to 100ºF; 505 psia at 200ºF; 455 psia at 300ºF;
415 psia at 400ºF; and 380 psia at 500ºF

640i Insertion Version Gas Pressure Requirements
Compression fittings: 500 psia (33.3 bara)
1-inch 150 lb flange (-40°F to 250°F) 185 psia (12.3 bara)
Low pressure hot tap: 150 psia (10.0 bara)
High pressure hot tap: 230 psia (15.3 bara)

Gas Temperature Requirements (all versions)
-40°F (-40°C) to 392°F (200°C)
High temperature (HT) option to 750°F (400°C) available in 640S model only

Ambient Temperature (all versions)
-40°F (-40°C) to 140°F (50°C)

PHYSICAL SPECIFICATIONS

User Interface
Local keypad with a six-button interface
Exit ⊗ Enter ↵ Four-way directional arrows ◀ ▲ ▶ ▼
RS-232 with PC software for communication and programming

Digital Display
UltraBright, backlit, LCD digital display, 2 x 16, 2 x 32 scrolling

780i Inline Version Process Connections
See page 9 and 10 for NPT, 150 lb ANSI flange and DN, PN16 sizes

640i Insertion Version Process Connections
See page 6 through 8 for insertion sizes
ANSI 1-inch - 150 lb ANSI flange (optional)
Low pressure hot tap rated to 150 psia (10.0 bara)
High pressure hot tap and retractor 230 psia (15.3 bara)

Wetted Materials
316 SS and 316L SS flow body and Pt/Ir (velocity sensor)

Leak Integrity
1 x 10^{-4} sccs of helium

Approval Agencies
FM–Explosion proof for Class I, Div I, Groups B,C,D (pending)
CE–European conformity

Enclosure
NEMA 4 (IP66), hazardous area explosion proof, flow pointer, meter information tag

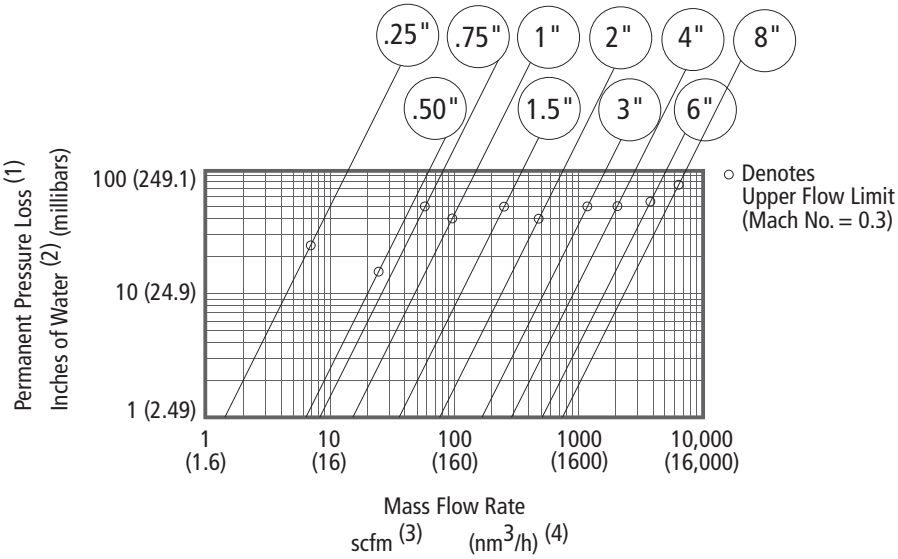
TABLE 1: iTherm Dial-A-Gas Selection Chart				
	780i Accuracy		640i Accuracy	
Gas	Actual Gas[1]	iTherm Dial-A-Gas[2]	Actual Gas[1]	iTherm Dial-A-Gas[2]
Air[3]	±0.5%	N/A	±0.75%	N/A
Argon	±0.5%	±3.0%	±0.75%	±3.0%
Carbon Dioxide	±0.5%	±3.0%	±0.75%	±3.0%
Chlorine	N/A	±3.0%	N/A	±3.0%
Digester Gas (60% CH_4, 40% CO_2)	±0.5%	±3.0%	±0.75%	±3.0%
Helium	±0.5%	±3.0%	±0.75%	±3.0%
Hydrogen	±0.5%	±3.0%	±0.75%	±3.0%
Methane	±0.5%	±3.0%	±0.75%	±3.0%
Nitrogen	±0.5%	±3.0%	±0.75%	±3.0%
Oxygen	N/A	±3.0%	N/A	±3.0%
Propane	±0.5%	±3.0%	±0.75%	±3.0%
Other[4]–Consult Factory	Special Calibration Request (SCR)	Special Calibration Request (SCR)	Special Calibration Request (SCR)	Special Calibration Request (SCR)

Notes: (1) % of reading at >50% of full scale flow; add 0.5% of full scale below 50% of full scale flow
(2) % of full scale
(3) Air is standard on the instrument and cannot be removed
(4) The iTherm Gas Library is a proprietary gas property index that is continually updated and improved

TABLE 2: 640i/780i Straight Run Requirements			
Piping Condition	Upstream 640i Insertion	Upstream 780i Inline with Flow Conditioning[1]	Downstream[2]
Single 90° Elbow or T-Piece	15D	1D	0D
Reduction (4:1)	20D	3D	0D
Expansion (4:1)	40D	3D	0D
After Control Valve	15D	3D	0D
Two 90° Elbows (in same plane)	30D	3D	0D
Two 90° Elbows (different planes)	40D	5D	0D

Notes: (1) Number of diameters (D) of straight pipe required between upstream disturbance and the flow meter
(2) Number of diameters (D) of straight pipe required downstream of the flow meter

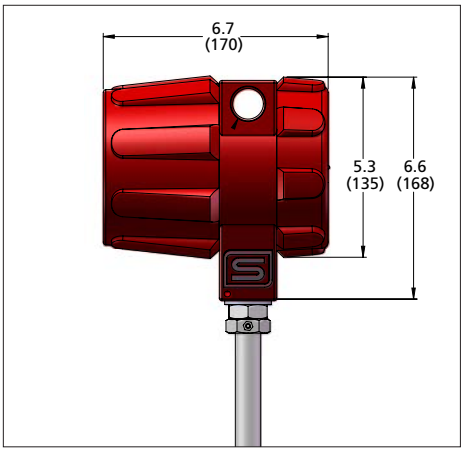
780i INLINE PRESSURE DROP



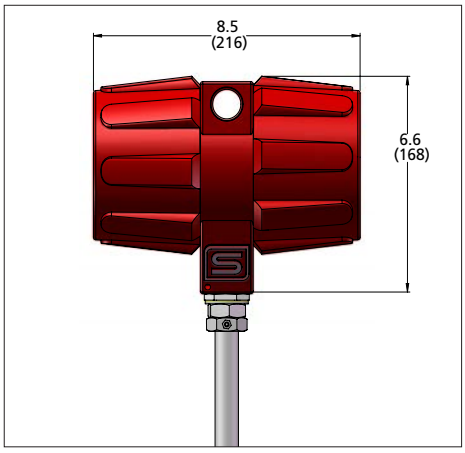
Notes: (1) For air and nitrogen at 20°C temperature and 1 atmosphere pressure
(2) 1 inch of water at 60°F = 0.0361 psi
(3) At base conditions of 21.1°C temperature and 1 atmosphere pressure
(4) At base conditions of 0°C temperature and 1 atmosphere pressure

640i INSERTION DIMENSIONAL DRAWINGS

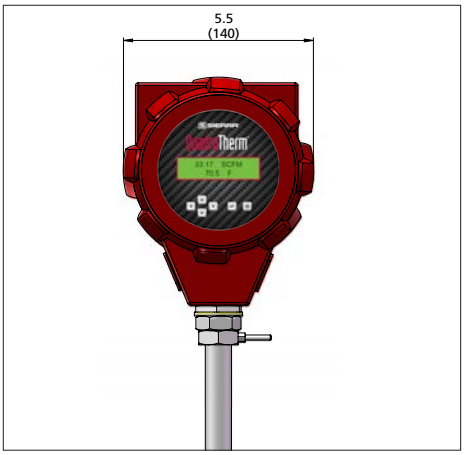
P2-DD—Side View



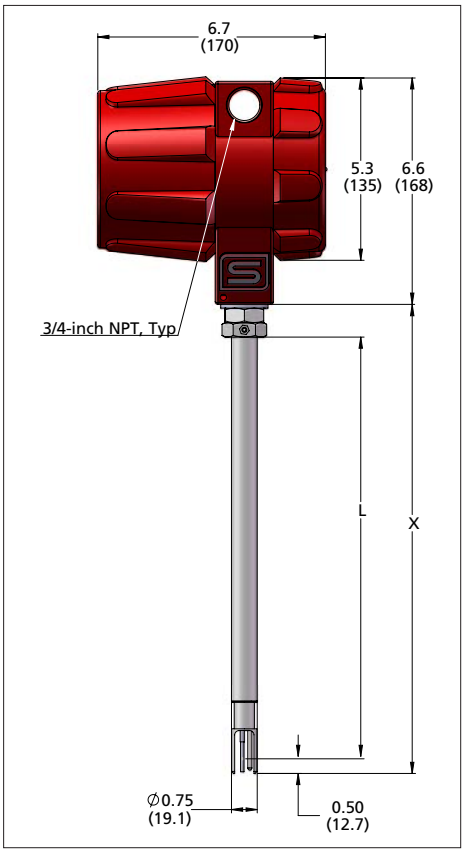
P3-DD—Side View



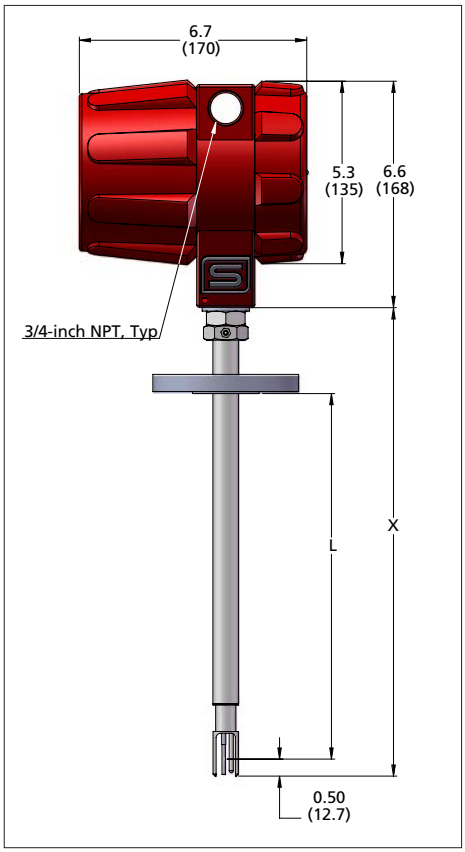
All Versions—Front View



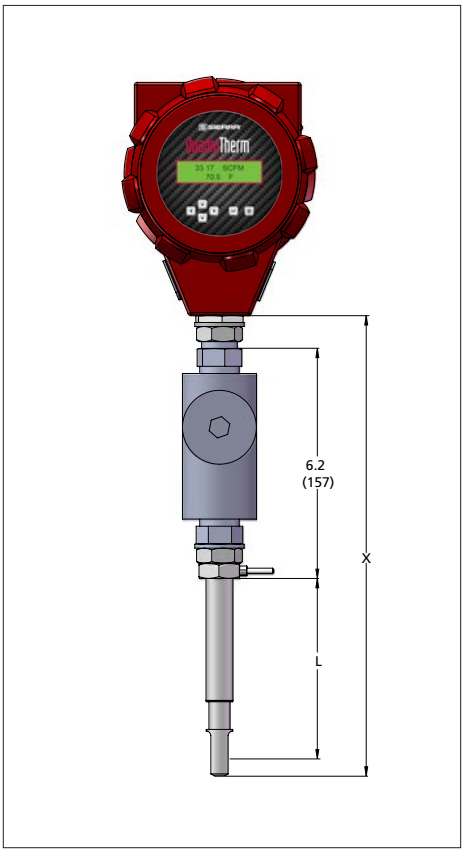
P2-DD Compression Fitting—Side View



P2-DD Flange Fitting—Side View



FM Approved Probes (pending)



Note: All dimensions in inches with (mm) in brackets; certified drawings available upon request

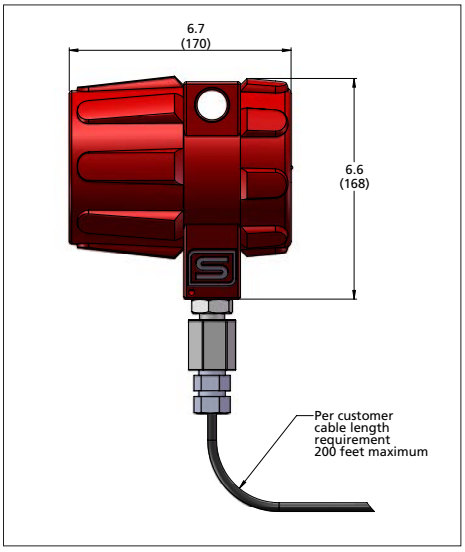
Length Chart 640i Compressions Fittings		
Code	L	X
L06	6.0 (147)	7.5 (184)
L09	9.0 (221)	10.5 (257)
L13	12.0 (294)	13.5 (331)
L18	18.0 (441)	19.5 (495)
L24	21.5 (527)	23.0 (564)
L36	35.5 (902)	37.0 (940)
L48	47.5 (1164)	49.0 (1201)

Length Chart 640i Flange Mounting		
Code	L	X
L06	4.4 (112)	7.5 (184)
L09	7.4 (188)	10.5 (257)
L13	10.4 (264)	13.5 (331)
L18	16.4 (417)	19.5 (495)
L24	19.9 (505)	23.0 (564)
L36	33.9 (861)	37.0 (940)
L48	45.9 (1166)	49.0 (1201)

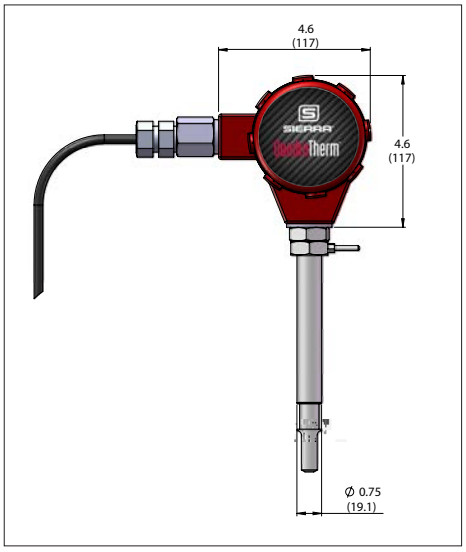
Length Chart 640i FM Version (pending)		
Code	L	X
L06	6.0 (147)	13.7 (336)
L09	9.0 (221)	16.7 (409)
L13	12.0 (294)	19.7 (483)
L18	18.0 (441)	25.7 (653)
L24	21.5 (527)	29.2 (715)
L36	35.5 (902)	43.2 (1097)
L48	47.5 (1164)	55.2 (1352)

640i INSERTION DIMENSIONAL DRAWINGS

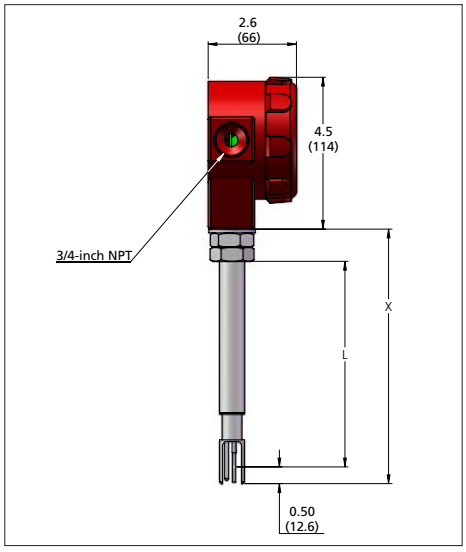
Remote Electronics—Side View



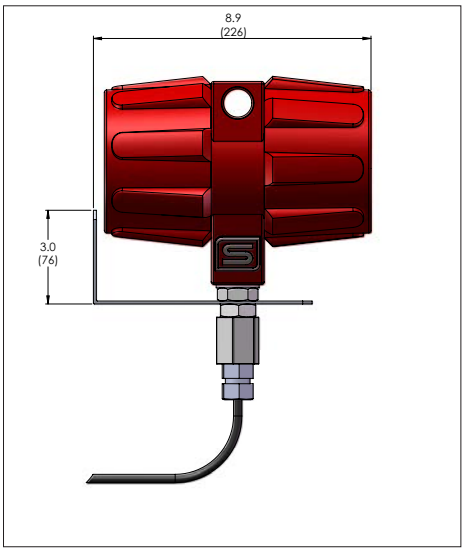
Remote Probe—Front View



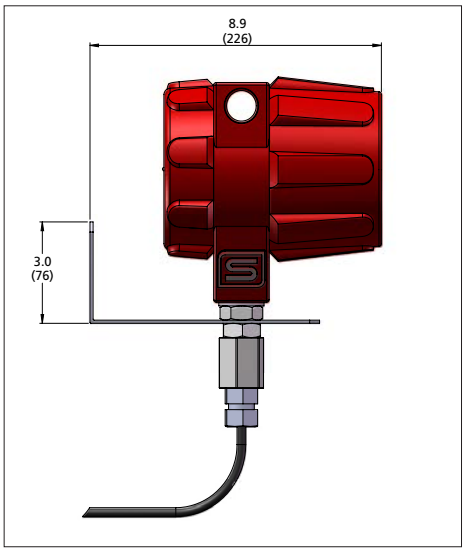
Remote Probe—Side View



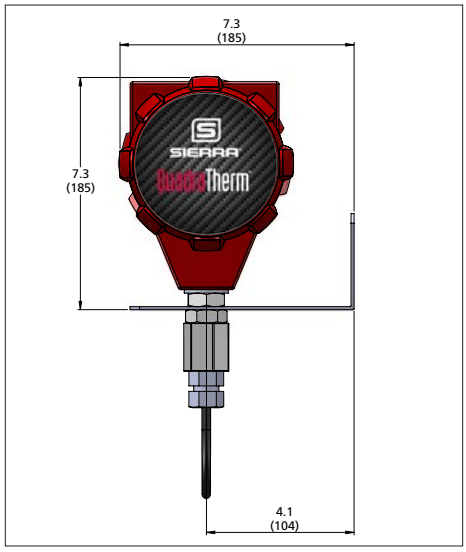
P3-DD Remote Bracket—Side View



P2-DD Remote Bracket—Side View

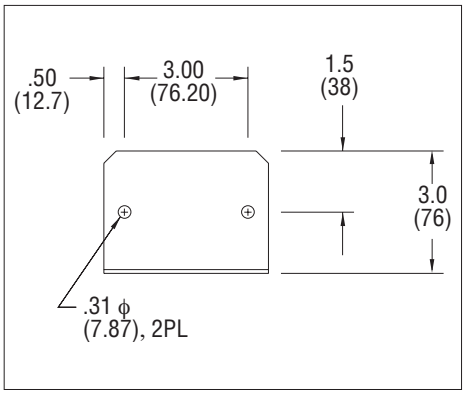


Remote Bracket—Front View



Note: All dimensions in inches with (mm) in brackets; certified drawings available upon request

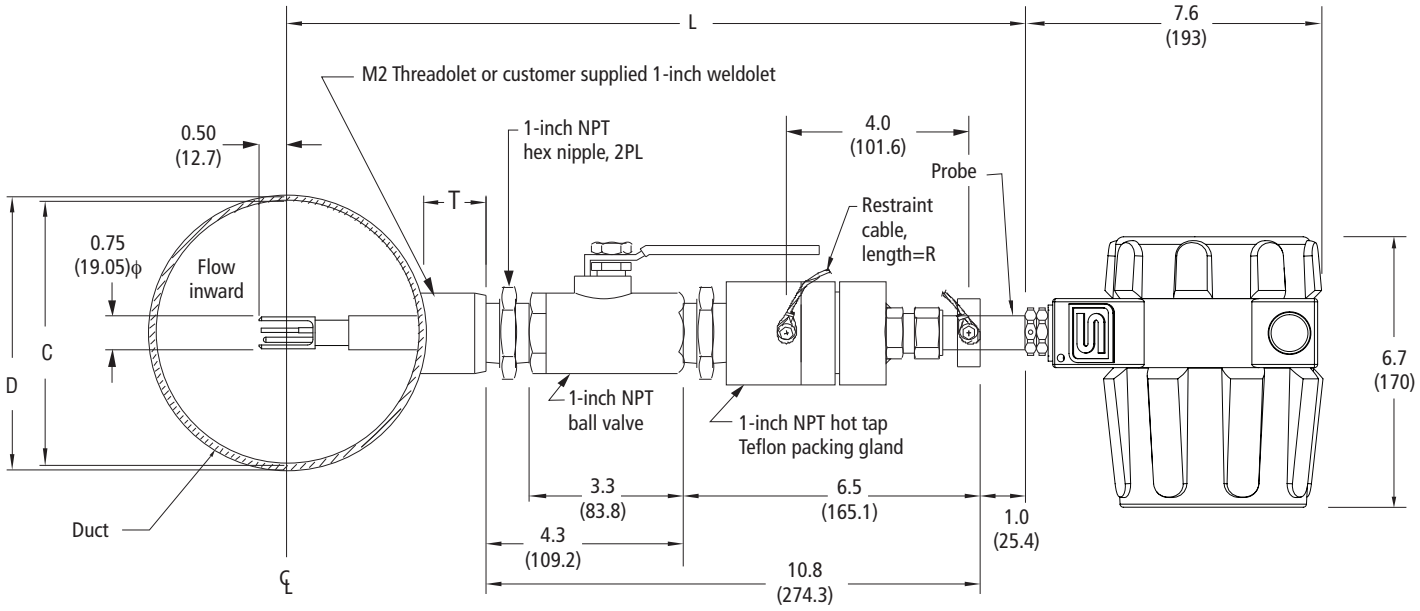
Mounting Holes for Remote Bracket



Length Chart 640i Remote Mount Junction Box		
Code	L	X
L06	6.0 (147)	7.5 (184)
L09	9.0 (221)	10.5 (257)
L13	12.0 (294)	13.5 (331)
L18	18.0 (441)	19.5 (495)
L24	21.5 (527)	23.0 (564)
L36	35.5 (902)	37.0 (940)
L48	47.5 (1164)	49.0 (1201)

Note: All dimensions in inches with (mm) in brackets; certified drawings available upon request

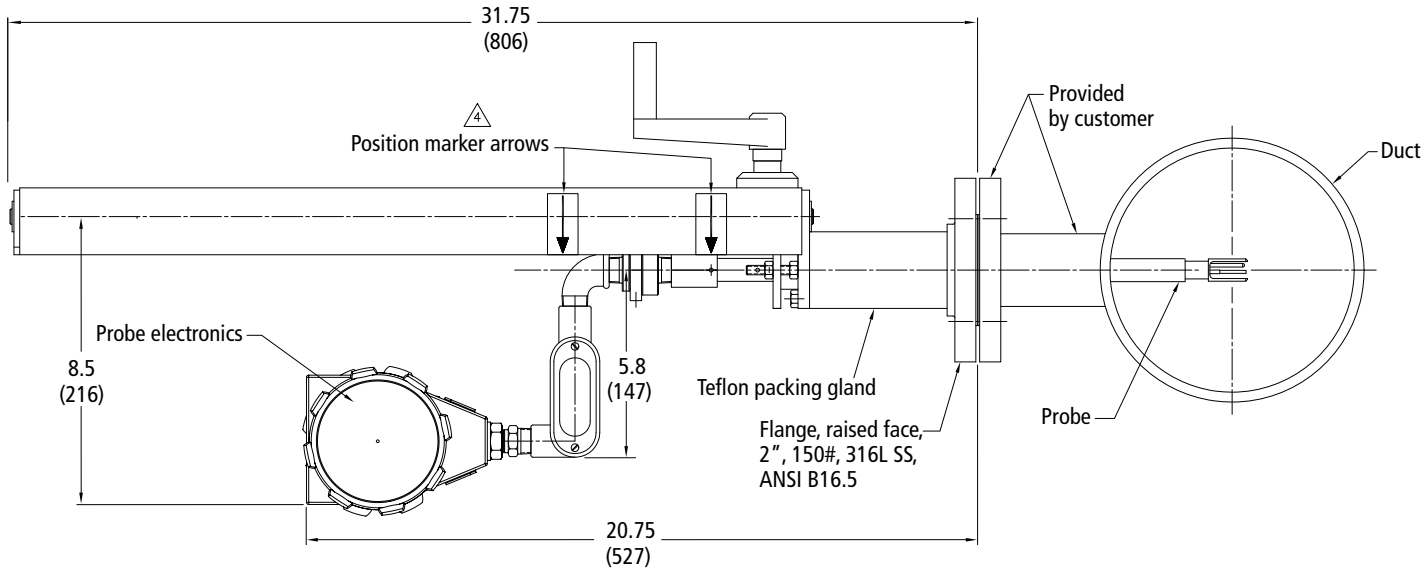
640i INSERTION LOW PRESSURE HOT TAP to 150 psia (10 bara)



Variables
L = Nominal Probe Length
D = Duct O.D.
C = Duct I.D.
T = Height of "Threadolet"
or Customer Provided Weldolet
R = Restraint Cable Length

Formula
L > 12.3 + T + D/2
So L must be equal
or greater than 12.3-inches
plus the height of the
"Threadolet" plus half the duct O.D.
R = D/2 + T + 7.3

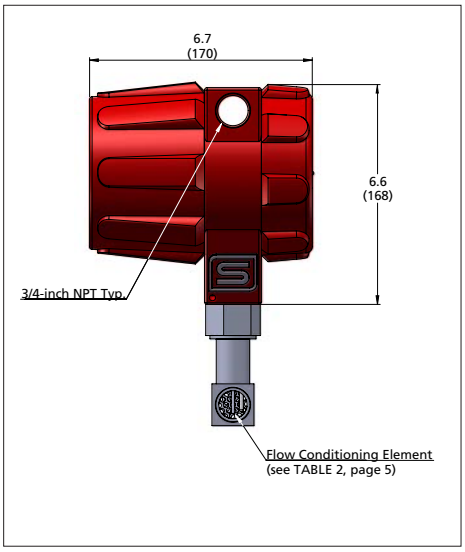
640i HIGH PRESSURE HOT TAP to 230 psia (15.3 bara)



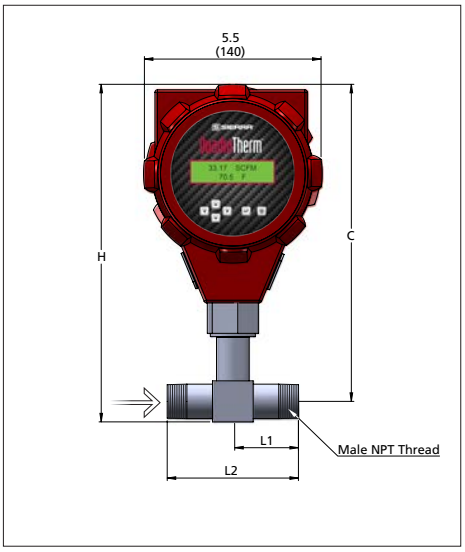
Note: All dimensions in inches with (mm) in brackets; certified drawings available upon request

780i INLINE DIMENSIONAL DRAWINGS

1/2" and 3/4" NPT—Side View

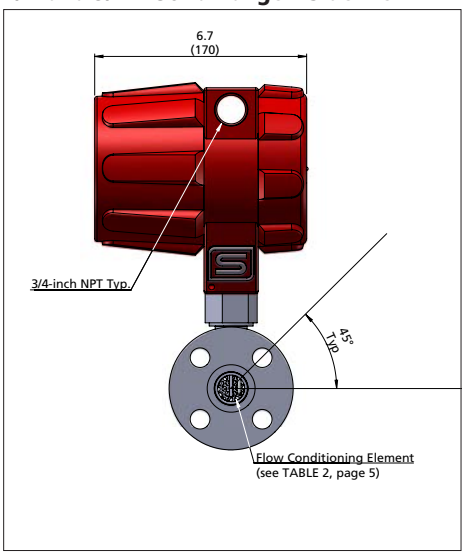


1/2" and 3/4" NPT—Front View

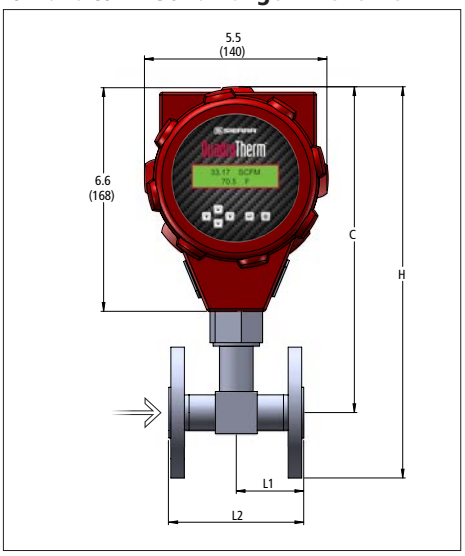


Sizes for NPT				
Size	H	C	L1	L2
1/2-inch	10.5 (267)	9.9 (251)	2.0 (51)	4.0 (102)
3/4-inch	10.8 (274)	9.9 (251)	2.0 (51)	4.0 (102)

1/2"and 3/4" 150 lb Flange—Side View

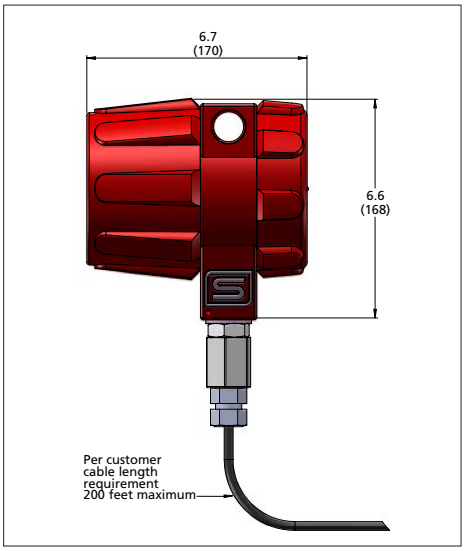


1/2"and 3/4" 150 lb Flange—Front View

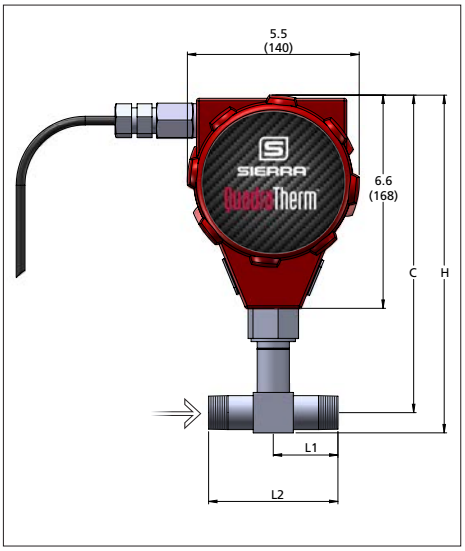


Sizes For 150 lb ANSI Flange				
Size	H	C	L1	L2
1/2-inch	11.6 (295)	9.9 (251)	2.0 (51)	4.0 (102)
3/4-inch	11.8 (300)	9.9 (251)	2.0 (51)	4.0 (102)

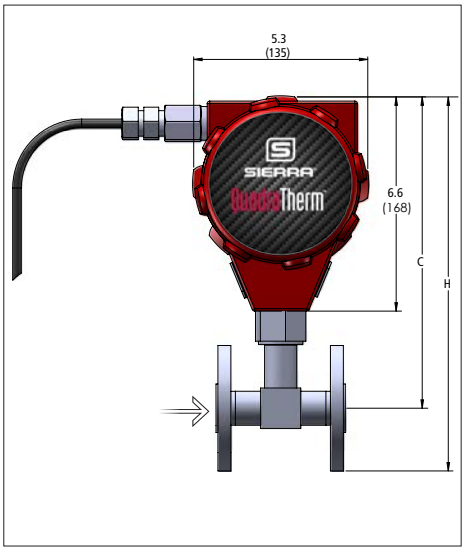
Remote—Side View



NPT Remote—Front View



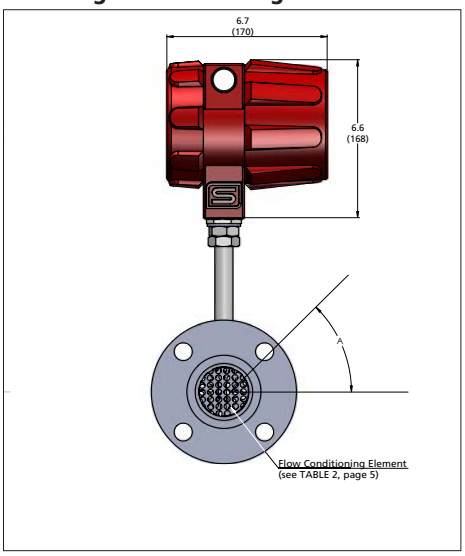
150 lb Flange Remote—Front View



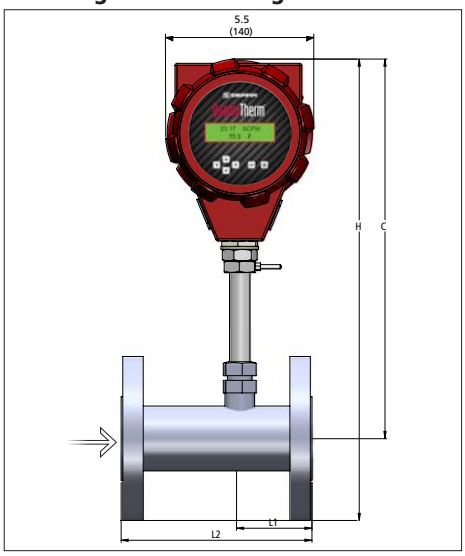
Note: All dimensions in inches with (mm) in brackets; certified drawings available upon request

780i INLINE DIMENSIONAL DRAWINGS

1" Through 8" 150 lb Flange—Side View

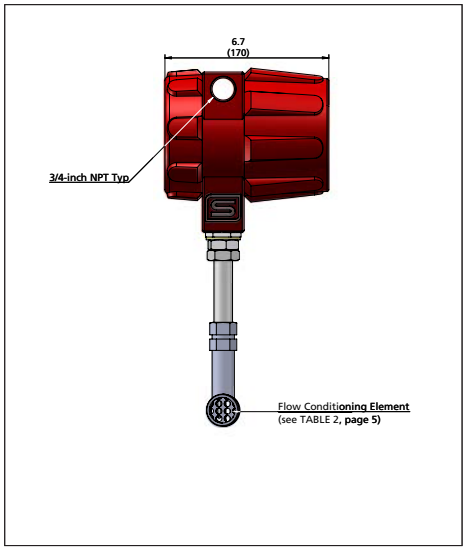


1" Through 8" 150 lb Flange—Front View

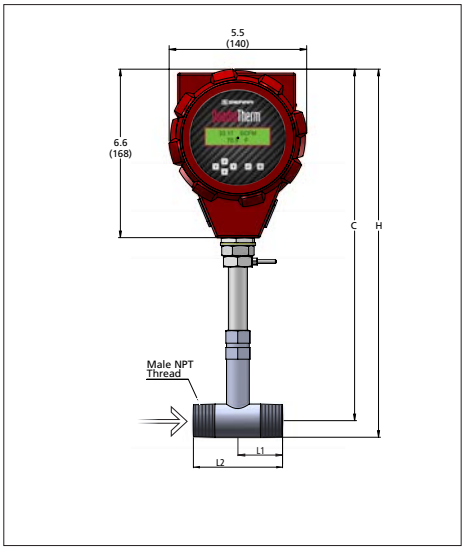


Sizes for 150 lb ANSI Flanges					
Size	H	C	L1	L2	A
1-inch	16.1 (409)	14.0 (356)	2.3 (58)	5.0 (127)	45
1.5-inch	16.1 (409)	14.0 (356)	2.6 (66)	6.0 (152)	45
2-inch	17.0 (432)	14.0 (356)	2.6 (66)	7.0 (178)	45
3-inch	17.7 (450)	14.0 (356)	2.6 (66)	10.0 (254)	45
4-inch	18.5 (470)	14.0 (356)	3.6 (91)	12.0 (305)	22.5
6-inch	19.5 (495)	14.0 (356)	5.6 (142)	18.0 (547)	22.5
8-inch	20.7 (526)	14.0 (356)	7.6 (193)	29.0 (737)	22.5

1" Through 8" NPT—Side View

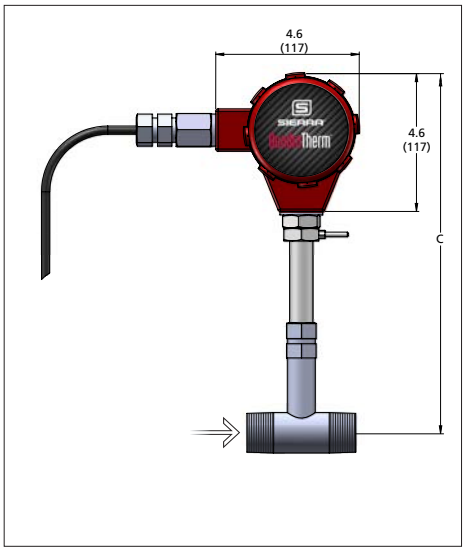


1"Through 8" NPT—Front View

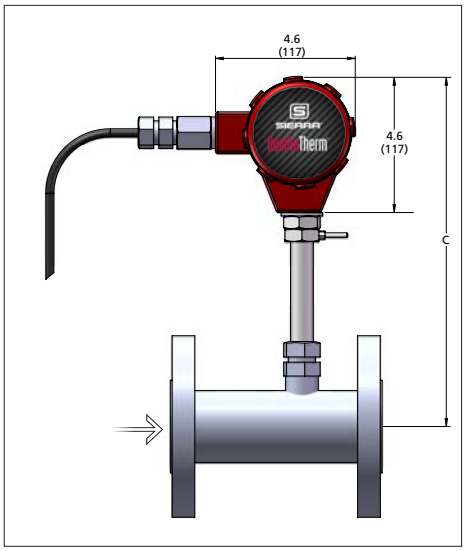


Sizes for 1-inch Through 8-inch NPT				
Size	H	C	L1	L2
1-inch	14.6 (371)	14.0 (356)	1.50 (38)	3.50 (89)
1.5-inch	15.0 (381)	14.0 (356)	2.25 (57)	5.25 (133)
2-inch	15.1 (384)	14.0 (356)	3.50 (89)	7.50 (191)
3-inch	15.7 (399)	14.0 (356)	4.00 (102)	10.00 (254)
4-inch	16.2 (411)	14.0 (356)	4.00 (102)	12.00 (305)
6-inch	17.3 (439)	14.0 (356)	6.00 (152)	18.00 (457)
8-inch	18.3 (465)	14.0 (356)	8.00 (203)	24.00 (610)

NPT Remote—Front View



Flange Remote—Front View



Sizes for PN16 DN Flanges				
Size	H	C	L1	L2
DN25	16.3 (414)	14.0 (356)	3.18 (81)	7.40 (188)
DN40	17.0 (432)	14.0 (356)	3.61 (92)	7.40 (188)
DN50	17.2 (437)	14.0 (356)	3.34 (85)	7.10 (180)
DN80	17.9 (455)	14.0 (356)	4.14 (105)	10.20 (259)
DN100	18.3 (465)	14.0 (356)	4.57 (116)	12.60 (320)
DN150	19.6 (498)	14.0 (356)	6.77 (172)	18.90 (480)
DN200	20.7 (526)	14.0 (356)	8.47 (215)	24.40 (620)

ORDERING THE 640i INSERTION

Dial-A-Gas Selection

640i - [ ] - [ ] - [ ] - [ ] - [ ] - [ ] - [ ] - [ ] - [ ] - [0] - [ ] - [ ] - [ ]

Feature	1	2	3	4	5	6	7	8	9	*10	11	12	13

Instructions: To order a 640i please fill in each feature number block by selecting the codes from the corresponding features below.

*Feature 10 is air (always included)

Feature 1: Multivariable	
VT	Thermal Insertion Mass Flow Meter; all 316L stainless steel construction; linear 4-20 mA output signals for Mass Flow Rate and Temperature; temperature range -40°F to 392°F (-40°C to 200°C); pressure to 500 psia (33.3 bara); standard accuracy (air) +/- 0.75% of reading above 50% of full scale flow and +/- 0.75% of reading plus 0.5% of full scale below 50% of full scale flow; 24 VDC +/- 10.0% or 100-240 VAC input power; configurable alarm and pulse outputs; CE approval, FM (pending)
VTP	Add a Pressure output to the 640i VT version; three analog 4-20 mA linear outputs for Mass Flow Velocity; includes pressure sensor to 500 psia (33.3 bara)

Feature 2: Approvals	
FM	Class 1, Div 1, Groups B, C, D approval pending
NAA	Non-Agency Approved

Feature 3: Probe Length	
L06	6 inch (15 cm)
L09	9 inch (23 cm)
L13	13 inch (33 cm)
L18	18 inch (46 cm)
L24	24 inch (61 cm)
L36	36 inch (92 cm)
L48	48 inch (122 cm)
L( )	Specify length in parentheses; maximum probe length 72 inches (2 m)
L( ) M5 adder	Probe with 1-inch ANSI 150 lb flange; specify length in parenthesis

Feature 4: Mounting Formation Accessories	
M0	Customer to supply own mounting hardware
M1	Compression fitting, 3/4-inch (2 cm) with 1-inch (2.5 cm) male NPT
M1-M2( )	Compression fitting, 3/4-inch (2 cm) probe feed through by 1-inch (2.5 cm) male NPT which threads into tapped hole; specify pipe O.D. in parenthesis
M3	Flat duct bracket, 3/4-inch (2 cm) tube compression fitting
M4( )	Curved duct bracket, 3/4-inch (2 cm) tube compression fitting; specify duct O.D. in parentheses
M8( )	Low pressure hot tap, includes ball valve and packing gland; specify duct O.D. in parentheses
M9	High pressure hot-tap retractor
M15( )	Quick removal hot-tap, includes ball valve and compression fitting; specify duct O.D. in parentheses; doesn't include packing gland

Feature 5: Electronics Enclosure	
E2	Hazardous-area location enclosure NEMA 4 (IP66) mounted directly on probe
E4( )	Remote hazardous-area location enclosure, includes NEMA 4 (IP66) junction box; specify cable length in parenthesis

Note: VTP not available on remotes

Feature 6: Input Power	
P2	24 VDC +/- 10.0%
P3	100-240 VAC

Feature 7: Output	
V4	Two linear 4-20mA outputs for T and mass flow rate
V6 (VTP only)	Three linear 4-20mA outputs for T, P, and mass flow rate

Feature 8: Display	
DD	UltraBright local LCD digital display indicates mass flow rate, T, P and totalized mass in engineering units
NR	No readout

Feature 9: Pressure	
MP1	30 psia (2.0 bara), VTP only
MP2	100 psia (6.7 bara), VTP only
MP3	300 psia (20.0 bara), VTP only
MP4	500 psia (33.3 bara), VTP only

Note: Put N/A in feature block 9 for VT or E4 meters

Feature 10 Through 13: iTherm Dial-A-Gas
Choose three gases in addition to air:

Gas	Actual Gas Code	Dial-A-Gas Code
Air	0	0
Argon	1A	1
Carbon Dioxide	2A	2
Chlorine	N/A	3
Digester Gas (60% CH_4, 40% CO_2)	4A	4
Helium	6A	6
Hydrogen	7A	7
Methane	8A	8
Nitrogen	10A	10
Oxygen	N/A	11
Propane	12A	12
Other–Consult Factory	99	99

Note: See iTherm Dial-A-Gas Selection chart on page 5 to choose your three gases and calibration accuracy.

ORDERING THE 780i INLINE

Dial-A-Gas Selection

780i - [ ] - [ ] - [ ] - [ ] - [ ] - [ ] - [ ] - [ ] - [0] - [ ] - [ ] - [ ]

Feature 1 2 3 4 5 6 7 8 *9 10 11 12

Instructions: To order a 780i please fill in each feature number block by selecting the codes from the corresponding features below.

*Feature 9 is air (always included)

Feature 1: Multivariable	
VT	Inline Thermal Mass Flow Meter with Flow Conditioning; all 316L stainless steel construction; linear 4-20 mA output signals for Mass Flow Rate and Temperature; temperature range -40°F to 392°F (-40°C to 200°C) and pressure to 500 psia (33.3 bara); standard accuracy +/- 0.5% of reading above 50% of full scale flow and +/- 0.5% of reading plus 0.5% of full scale below 50% of full scale flow; 24 VDC +/- 10.0% or 100-240 VAC input power; configurable alarm and pulse outputs; CE approval, FM (pending)
VTP	Add a Pressure output to the 780i VT version; three analog 4-20 mA linear outputs for Mass Flow Rate; includes pressure sensor to 500 psia (33.3 bara)

Feature 2: Approvals	
FM	Class 1, Div 1, Groups B, C, D approval pending
NAA	Non-Agency Approved

Feature 3: Inline Flow Bodies with Flow Conditioning	
N2	1/2-inch (1 cm) NPT male 316 SS
N3	3/4-inch (2 cm) NPT male 316 SS
N4	1-inch (2.5 cm) NPT male 316 SS
N5	1.5-inch (4 cm) NPT male 316 SS
N6	2-inch (5 cm) NPT male 316 SS
N7	3-inch (8 cm) NPT male 316 SS
N8	4-inch (10 cm) NPT male 316 SS
N9	6-inch (15 cm) NPT male 316 SS
N10	8-inch (20 cm) NPT male 316 SS
F2	1/2-inch ANSI 150 lb flange 316 SS
F3	3/4-inch ANSI 150 lb flange 316 SS
F4	1-inch ANSI 150 lb flange 316 SS
F5	1.5-inch ANSI 150 lb flange 316 SS
F6	2-inch ANSI 150 lb flange 316 SS
F7	3-inch ANSI 150 lb flange 316 SS
F8	4-inch ANSI 150 lb flange 316 SS
F9	6-inch ANSI 150 lb flange 316 SS
F10	8-inch ANSI 150 lb flange 316 SS
FD4	DN25, PN16, Flange
FD5	DN40, PN16, Flange
FD6	DN50, PN16, Flange
FD7	DN80, PN16, Flange
FD8	DN100, PN16, Flange
FD9	DN150, PN16, Flange
FD10	DN200, PN16, Flange

Feature 4: Electronics Enclosure	
E2	Hazardous-area location enclosure NEMA 4 (IP66) mounted directly on probe
E4( )	Remote hazardous-area location enclosure, includes NEMA 4 (IP66) junction box; specify cable length in parenthesis

Note: VTP not available on remotes

Feature 5: Input Power	
P2	24 VDC +/- 10.0%
P3	100-240 VAC

Feature 6: Output	
V4	Two linear 4-20mA outputs for T and mass flow rate
V6 (VTP only)	Three linear 4-20mA outputs for T, P, mass flow rate

Feature 7: Display	
DD	UltraBright local LCD display indicates mass flow rate, T, P and totalized mass in engineering units
NR	No readout

Feature 8: Pressure	
MP1	30 psia (2.0 bara), VTP only
MP2	100 psia (6.7 bara), VTP only
MP3	300 psia (20.0 bara), VTP only
MP4	500 psia (33.3 bara), VTP only

Note: Put N/A in feature block 8 for VT or E4 meters

Feature 9 Through 12: iTherm Dial-A-Gas

Choose three gases in addition to air:

Gas	Actual Gas Code	Dial-A-Gas Code
Air	0	0
Argon	1A	1
Carbon Dioxide	2A	2
Chlorine	N/A	3
Digester Gas (60% CH_4, 40% CO_2)	4A	4
Helium	6A	6
Hydrogen	7A	7
Methane	8A	8
Nitrogen	10A	10
Oxygen	N/A	11
Propane	12A	12
Other–Consult Factory	99	99

See iTherm Dial-A-Gas Selection chart on page 5 to choose your four gases and calibration accuracy.

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