



(DT94 Clamp-on transducer and DP7 Insertion probe shown above)

## DOPPLER ULTRASONIC FLOW METER

Series DFX Ultrasonic Doppler Flow Meters measure the flow of liquids that contain sound reflectors - suspended solids or gas bubbles - greater than 35 micron size. The DFX software automatically adjusts filtering parameters and gain settings so that reliable readings are ensured over a wide range of liquid and reflector conditions. DFX is housed in a NEMA 4X (IP-66) enclosure and is configured by the user via the front panel keypad. A two-line backlit LCD displays rate and accumulated flow values in user selected measuring units. Power supply options include AC or DC operation and output options include 4-20mA, rate pulse and dual relay.

Two transducer types are available with the DFX meter:

Series DT9 clamp-on, non-intrusive transducer is recommended for use on most pipes constructed from metal or plastic. The DT9 is rated to NEMA 6P (IP-68) and has the ability to work with temperatures up to +400 °F (+200 °C).

Series DP7 hot-tappable insertion probe transducer is available for installations on pipe systems that do not permit ultrasound penetration. The DP7 inserts into the pipe wall and directly contacts the flowing liquid.

Both transducer types can be located up to 990 feet (300 meters) from the DFX display enclosure utilizing RG59 coaxial cable.

## FEATURES

- Non-intrusive, clamp-on transducers for most pipes from 1/4" (6 mm) and above.
- Minimal installation time: the DFX may be installed and fully operational within minutes. For most homogeneous pipe materials, there is no need to break into pipelines.
- Minimal material costs: clamp-on sensor eliminates the need for in-line flanges, pipe fittings, strainers, or filters.
- Wide measuring range: 0.15 to 30 FPS (0.05 to 9 MPS).
- Inherent immunity to VFD and other electronic/ultrasonic noise.
- Microprocessor-based system; configuration and accumulation data stored in non-volatile flash ROM.
- Hot tappable Insertion probe transducer available for concrete, FRP/GRP, or woodstave pipes.
- Reduced down-time: installation may be performed on full pipes and active systems - there is no need to shut the process down for installation or maintenance.
- Lower maintenance costs: with no moving parts, there is nothing on the DFX to wear down.
- Provision for multiple meters on a single pipe/manifold installation.
- Accuracy  $\pm 2\%$  full scale over calibrated span.
- Flexibility: with automatic gain control and in-field linearization, the DFX will adapt to a wide variety of applications.



# Series DFX

## PRINCIPLE OF OPERATION / TRANSDUCER OPTIONS

The DFX flow meter operates by transmitting ultrasonic sound from its transmitting transducer through the pipe wall or from the probe tip into the flowing liquid. Each transducer and probe tip contains piezoelectric crystals to transmit this signal. The sound will be reflected by useful sonic reflectors (See "Product Applications" page) suspended within the liquid and recorded by the receiving transducer (see Figure 1). If the reflectors are moving within the sound transmission path, sound waves will be reflected at a frequency shifted (Doppler shift) from the transmitted frequency. The difference between the reflected frequencies and transmitted frequencies is directly proportional to the speed of the sonic reflectors, resulting in a liquid flow rate that is converted to various user defined measuring units.

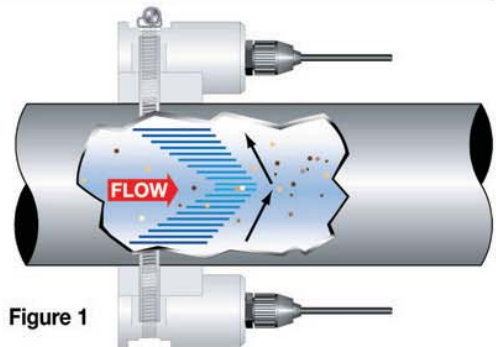
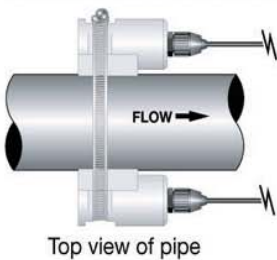


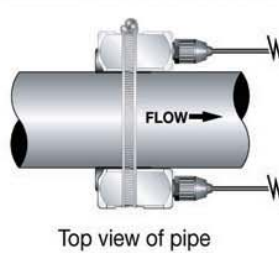
Figure 1

### Clamp-On Transducer Options

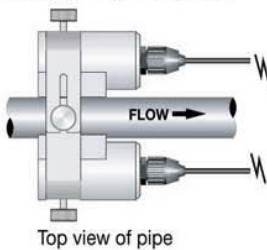
Standard temperature  
Standard pipe system (DT94)



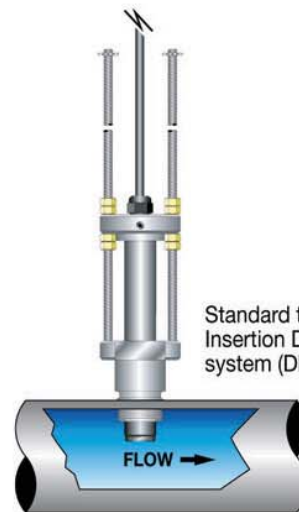
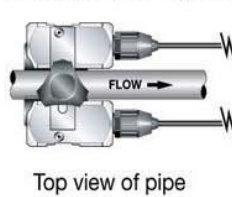
High temperature  
Standard pipe system (DT96)



Standard temperature  
Small pipe system (DT95)

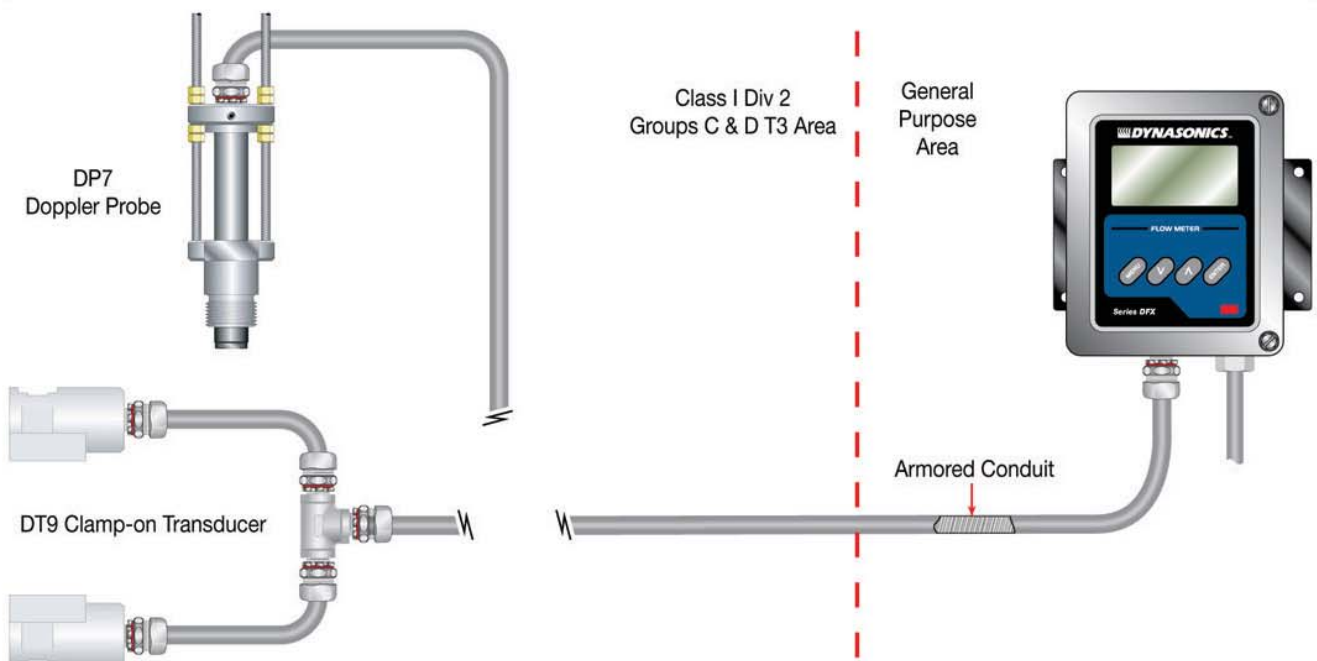


High temperature  
Small pipe system (DT97)



Standard temperature  
Insertion Doppler  
system (DP7)

### DFX Hazardous Area Installation



## SPECIFICATIONS

### GENERAL

DESCRIPTION	SPECIFICATION
Measuring Principle	Doppler Ultrasonic
Flow Velocity Range	0.15-30 FPS (0.05-9 MPS)
Accuracy	±2% full scale, over calibrated span
Liquid Types	Liquids containing a minimum of 100 ppm of useful sonic suspended reflectors greater than 35 micron size, and at least 25% of the overall particle volume is larger than 100 microns (See "Product Applications" page for details)

### MONITOR

DESCRIPTION	SPECIFICATION
Enclosure	NEMA 4X (IP-66), polycarbonate, stainless steel, brass, plated-steel mounting brackets 7.00H x 5.75W x 3.88D inches (178H x 146W x 99D mm)
Power Supply	115/230 VAC 50/60 Hz ±15% @ 5 VA Max; 12-28 VDC @ 2.5 VA Max
Display	2 line x 8 character LCD; LED backlighting; Top row 7-segment 0.7 inch (18 mm); Bottom row 14-segment 0.35 inch (9 mm); 8-digit rate 8-digit total (resettable)
Units	User configured - feet, gallons, ft <sup>3</sup> , Mil-gal, meters, liters, Mil ft <sup>3</sup> , m <sup>3</sup> , Mil-liters, acre-feet, oil barrels (42 gallon), liquid barrels (32.5 gallons), lbs., Kg
Rate Interval	Second, minute, hour, day. Totalizer exponent: E-2 to E+6 (x 1/100 to x 1,000,000)
Response Time	User selectable: 6-60 seconds
Outputs	4-20mA: 800 ohms max; internal or external power supply; 12-bit resolution; optically isolated Dual Relay: independently configured; Form C, 200 VAC @ 0.5 A resistive; rate alarm, totalizer pulse, error Rate Pulse: two output types—500 mVAC or open collector; 2,500 Hz max; 12-bit resolution; 500 mVAC into 2K ohm minimum; Open collector 1 A at 100 V max
Multiple Meters	Synchronization provision included—utilized for multiple meter, single pipe/manifold system. Up to four meters may be interconnected, up to 100 feet (30 meters) apart.
Keypad	Four keys, tactile
Ambient Conditions	-40 °F to +185 °F (-40 °C to +85 °C)
Approvals	(Std.) General Purpose, CE meets the requirements of IEC 61326-1 Ed.1.0 b:2005 (Opt.) General Purpose certified by QPS to CSA 22.2 No. 142-87, CEC (2006)

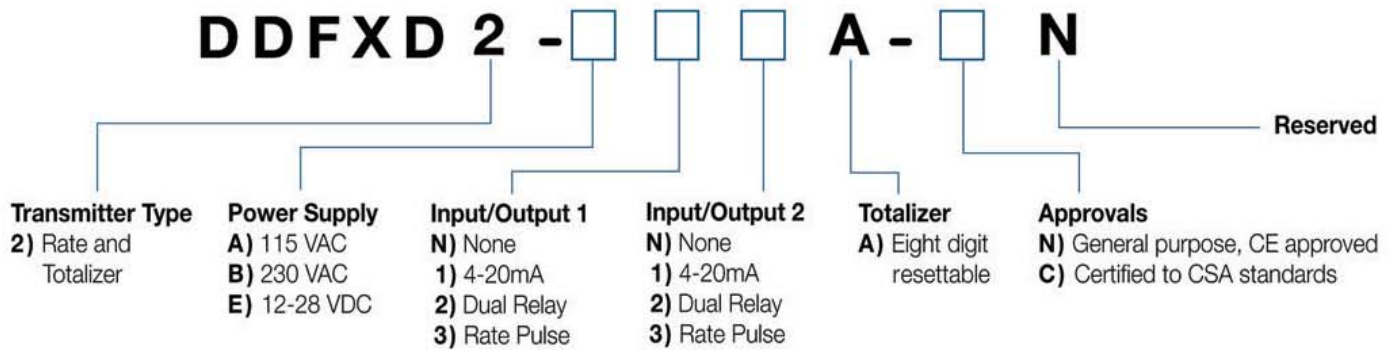
### TRANSDUCERS

DESCRIPTION	SPECIFICATION
Type	Compression-mode Ultrasonic; 625 kHz
Housing Material	Standard Clamp-On: NEMA 6P (IP67) -40 °F to +210 °F (-40 °C to +100 °C) CPVC, Ultem®, Nylon, PVC (Cable Jacket), Aluminum (small pipe) High Temp Clamp-On: NEMA 4 (IP65) -40 °F to +400 °F (-40 °C to +200 °C) Vespel®, Anodized Aluminum, Nickel-plated brass, Teflon® (Cable Jacket) Doppler Probe: NEMA 6 (IP67) -40 °F to +210 °F (-40 °C to +100 °C); 700 PSI (48 Bar) Max. 316 Stainless Steel, Ultem®, Viton®, Nylon, PVC (Cable Jacket) Optional Flexible Armored Conduit: Zinc-plated steel, PVC
Pipe Sizes	Standard Clamp-On Transducers: 1 inch (25 mm) and above Small Pipe Clamp-On Transducers: ¼ to 1 inch (6 to 25 mm) Probe Transducers: 4 to 120 inch (101 to 3050 mm)
Cable Length	Standard Lengths: 20, 50 and 100 Feet (6, 15, 30 m) Optional Lengths: to 990 Feet (300 m)
Installation	General Purpose; (Opt.) Class I Division 2, Groups C and D, T3 area certified to CSA C22.2 No. 213-87m (99), CAN/CSA E60079-15:02

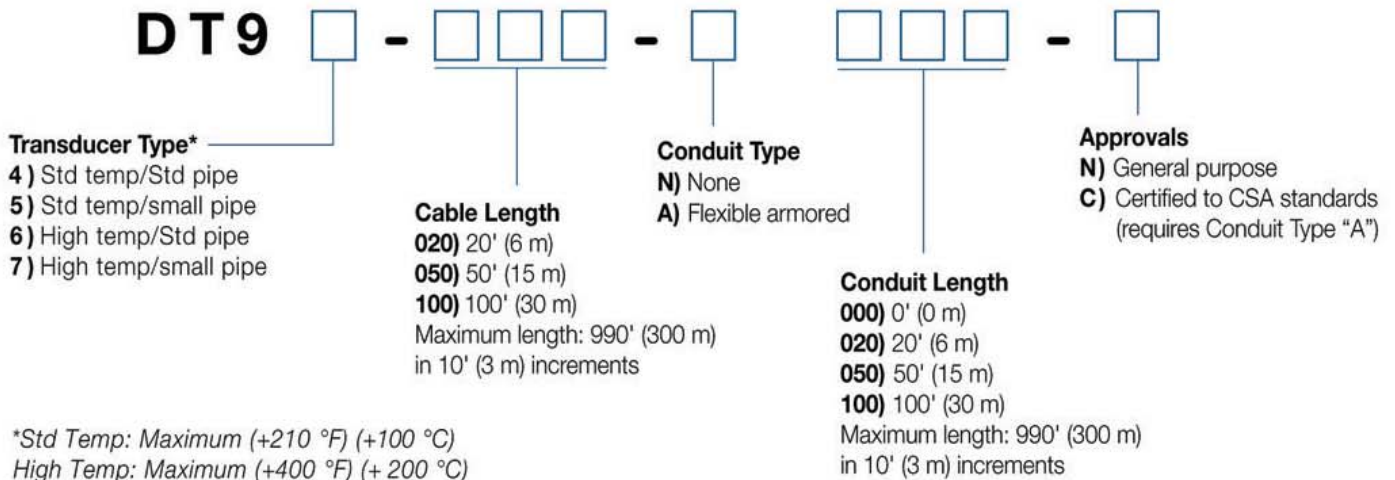


## PART NUMBER CONSTRUCTION

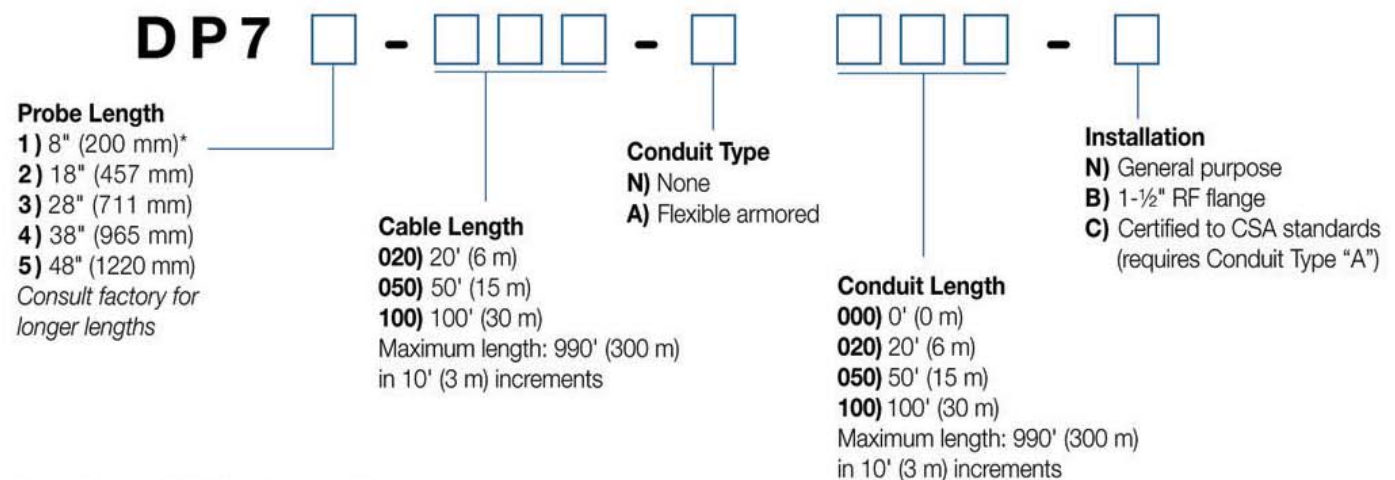
### DDFX Digital Doppler Ultrasonic Flow Transmitter



### DT9 Clamp-On Doppler Ultrasonic Transducer Set



### DP7 Insertion Doppler Probe



*\*Cannot be used with hot tap assembly.*

*Note: All DP7 probes include a seal fitting for mounting in 1-½" NPT.  
Isolation Valve Kits are available for hot-tapped applications.  
Insertion/Retraction crank tools are available, consult factory.*

## PRODUCT APPLICATIONS / APPLICATION QUALIFICATION

### Applications

- Sewage – Wastewater
- Paper Stock
- Primary Sludge
- RAS and WAS
- Dredging
- Carbonated liquids
- Mining slurry
- Drilling mud
- Coal-seam water

Successful application of Doppler ultrasonic flow meters relies on three physical constraints:

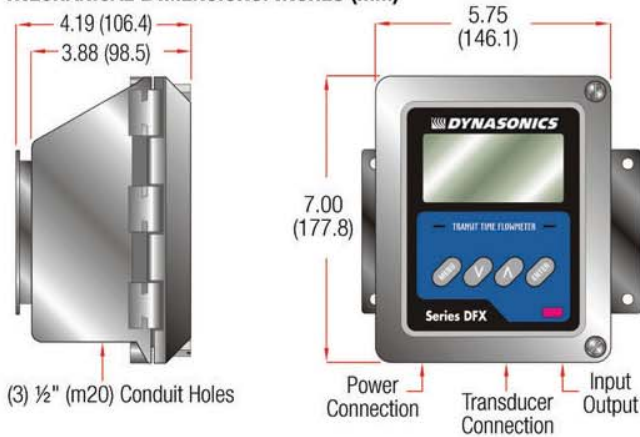
1. The liquid flowing within the pipe must contain 100 ppm of useful sonic suspended reflectors – dissolved solids do not generate reflections and are not relevant.
  - The speed of sound of the reflector must vary by greater than 10% from that of the liquid carrier.
  - Particles must be large enough to cause longitudinal reflection. Particles greater than 35 micron size meet this criteria.
  - In typical applications, there is often a distribution of particle sizes. If the volume of particles greater than 100 microns is 25 percent of the overall particle volume, then the reflectors are adequate for a Doppler ultrasonic flow meter.
  - The reflecting material must travel at the same velocity as the fluid for good accuracy. Upward flowing pipes running at low velocities may not carry heavier reflectors at the same velocity as the carrying liquid – leading to inaccurate flow measurements.
2. A significant portion of the ultrasound energy generated by the transducer must reach the sonic reflectors. In the case of a clamp-on transducer, the ultrasonic transducer must be acoustically coupled to the outside of a pipe (using grease or RTV couplant) and the pipe must permit ultrasound to pass without significant attenuation. Most pipes constructed of solid, homogenous materials meet this qualification. Pipes that cause application difficulty include concrete pressure pipes, woodstave pipes, Teflon®-lined pipes and fiberglass reinforced pipes. Pipes that do not readily pass ultrasound are candidates for the DP7 insertion probe transducer.
3. The pipe must be completely filled with liquid when measurements are made. The DFX microprocessor assumes that the pipe is completely full when it calculates flow rate. Use on partially-filled pipes may result in inaccurate readings.



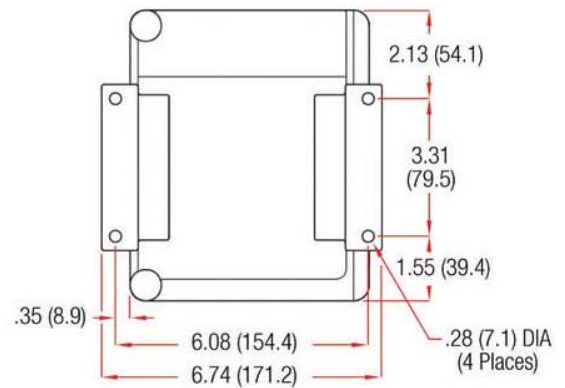
# Series DFX

## DIMENSIONAL SPECIFICATIONS

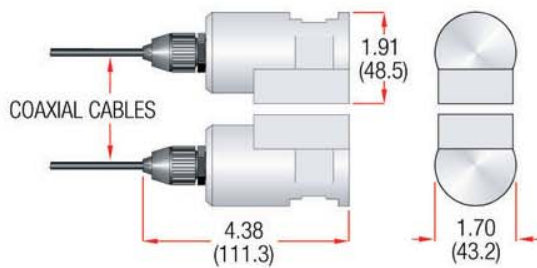
### MECHANICAL DIMENSIONS: INCHES (mm)



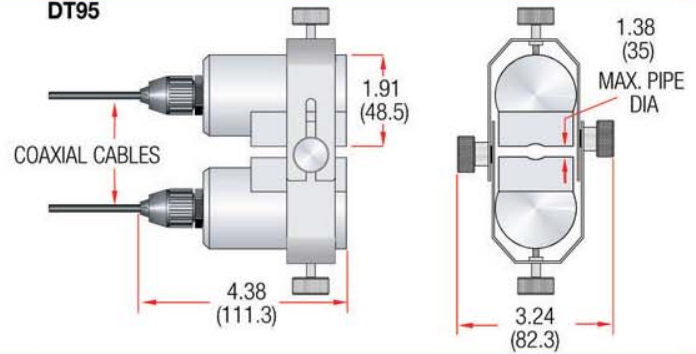
### Wall Mount



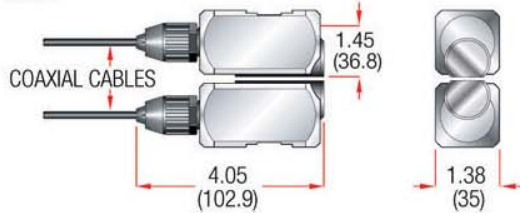
### DT94



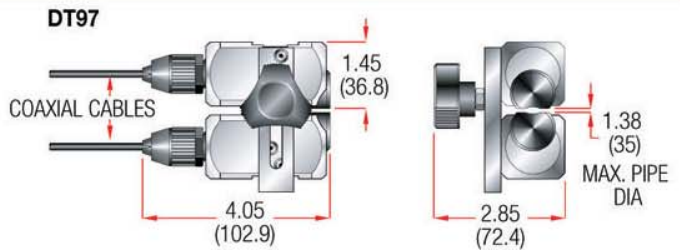
### DT95



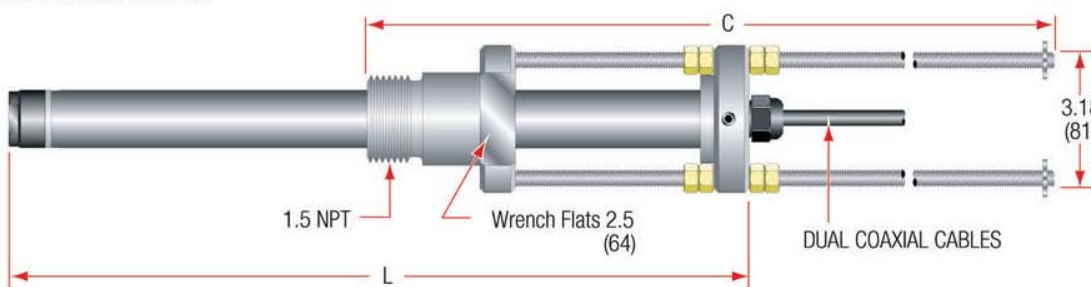
### DT96



### DT97



### DP7 Insertion Probe



Model	L Inches (mm)	C Inches (mm)
DP71	9.50 (241)	11.31 (287)
DP72	19.50 (495)	21.31 (541)
DP73	29.50 (749)	31.31 (795)
DP74	39.50 (1003)	41.31 (1049)
DP75	49.50 (1257)	51.31 (1303)

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