

# Daniel™ 3812

## Liquid Ultrasonic Flow Meter





# A Reliable and Economical Solution for Liquid Products Measurement

## Overview

Daniel 3812 Liquid Ultrasonic Flow Meter sets new standards for accuracy and cost efficiency in your non-custody transfer applications. Using innovative electronics and digital signal processing, you can expect high-accuracy and repeatability of liquid measurements for petrochemical, oil, water and wastewater industries. Available in nominal line sizes 4" - 36", the Daniel 3812's superior design has no moving parts, therefore eliminating wear, drift and pressure loss, and is easy to install and operate.

Daniel 3812 is an in-line ultrasonic meter that measures transit times of sound pulses traveling diagonally in two parallel planes across the pipe, downstream with the flow and upstream against the flow. Each path has two integrally mounted ultrasonic transducers. Each pair of transducers acts alternately as transmitter and receiver. The difference in transit times is proportional to the average flow velocity along the acoustic paths, and is converted into an output signal and display of volumetric flowrate.

Integrated Daniel MeterLink™ advanced diagnostics allow you to access expert flow analysis and have an intuitive view of meter health. Calibration cycles can be extended to minimize your operating and maintenance costs. Daniel 3812 Ultrasonic Meter is part of Emerson's broad range of intelligent field devices that power the PlantWeb® digital plant architecture. The 3812 communicates predictive diagnostics and process variable information via the HART protocol - this allows plant personnel to quickly detect and respond to abnormal situations, avoiding process upsets and unscheduled downtime.



Figure 1: Daniel 3812 Liquid Flow Meter

## Typical Applications

This Daniel 3812 Liquid Ultrasonic Meter is for many non-custody transfer applications such as:

### Oil and Gas Industry

- Allocation measurement
- Effluent flow measurement
- Loading and unloading

### Industrial Processes

- Batch and blending processes
- Cooling water measurement
- Plant utilities and offtake measurement

### Pipelines

- Leak detection
- Crude and refined product flow measurement

### Terminal

- Loading and offloading
- Tank farms/ storage measurement

## Features and Benefits

- No incremental pressure drop increases energy savings
- No moving parts reduce maintenance costs
- Field replaceable transducers simplify maintenance
- Measurement stability
- Wide flow range
- Bi-directional flow capabilities
- Integrated advanced diagnostics
- Easy to install and operate reduces start-up time and lowers capital costs
- Wireless HART® support

# Standard Specifications<sup>(1)</sup>

## Meter Performance

### Characteristics

- Dual-path (four transducer) chordal design
- Transit-time based measurement
- Spool piece with integral mount transducers
- Repeatability is  $\pm 0.10\%$  of measured value
- Nominal velocity 40 to 2 ft/s (12.2 to 0.6 m/s) with over-range of up to 48 ft/s (14.6 m/s)
- Linearity is  $\pm 0.30\%$  of measured value over a 40 to 4 ft/s (12.2 to 1.2 m/s) range

### Transducer Capsule

- Field replaceable
- Intrinsically safe

### Calibration

- All meters are functionally flow tested at the Daniel Flow Facility

## Electronics Performance

### Power

- 10.4 to 36 VDC
- 8 watts typical
- 15 watts maximum

### Communication Protocol

- Modbus RTU/ASCII, TCP/IP (API) and Modbus TCP

### Calculation Update Time

- Configurable for  $\frac{1}{4}$  of a second and 1 second

### Calibration Method

- Piecewise linearization (meter factor per data point)

## Meter Mechanical Ratings

### Line sizes

- 4" to 36 inches<sup>(2)</sup>

### Operating Process Product Temperature

- $-58^{\circ}\text{F}$  to  $+302^{\circ}\text{F}$  ( $-50^{\circ}\text{C}$  to  $+150^{\circ}\text{C}$ )

### Operating Pressure Range

- 0 to 2,250 psig (0 to 155 Bar)

### Specific Gravity Range

- 0.30 to 1.5 units

### Flanges<sup>(3)</sup>

- Raised face and Ring Type Joint (RTJ) for ANSI Classes 150, 300, 600, 900 (PN 20, 50, 100, 150)

### NACE Compliant

- Designed for NACE compliance<sup>(4)</sup>

## Electronics Ratings

### Operating Temperature

- $-40$  to  $+140^{\circ}\text{F}$  ( $-40$  to  $+60^{\circ}\text{C}$ )

### Operating Relative Humidity

- Up to 95% non-condensing

### Storage Temperature

- $-58^{\circ}\text{F}$  to  $+185^{\circ}\text{F}$  ( $-50^{\circ}\text{C}$  to  $+85^{\circ}\text{C}$ ) with a low temperature storage limit of  $-20^{\circ}\text{C}$  for transducers

(1) Please consult Daniel if your requirements are outside the specifications noted below. Other product and material offerings may be available depending on the application.

(2) Consult factory on sizes above 36" (1050 DN).

(3) ANSI rating to 2500 Class, consult factory.

(4) It is the equipment user's responsibility to select the materials suitable for the intended services.

# Materials of Construction

## Material Specifications

### Body and Flange

#### Cast

- ASTM A352 Gr LCC Carbon Steel
- ASTM A351 Gr CF8M 316 Stainless Steel
- ASTM A995 Gr 4A Duplex Stainless Steel
- ASTM A350 Gr LF2 Carbon Steel
- ASTM A182 Gr F316 SST
- ASTM A182 Gr F51 Duplex SST
- ASTM A350 Gr LF2 Carbon Steel
- ASTM A105 Carbon Steel

### Enclosure Housing

- ASTM B26 Gr A356.0 T6 Aluminum
- ASTM A351 Gr CF8M Stainless Steel
- Stainless Steel

### Transducer Components

#### Transducer Housing O-ring

- NBR(Nitrile Butadiene Rubber) (standard)
- Other Materials Available

#### Holder

- ASTM A479 316L Stainless Steel with Proprietary Matching Layer Material

#### Cover Material

- ASTM A240 316 Stainless Steel

#### Cable Gland

- Chloroprene/Nitrile Rubber

## Paint Specifications

### Body and Flange

#### Carbon Steel Body

- 2 Coat Paint - Inorganic Zinc Primer<sup>(1)</sup> and Acrylic Lacquer Top-Coat (Standard)

#### Stainless Steel or Duplex Body

- Unpainted

### Enclosure Housing

- Aluminum is Powder Coated

**Table 1A: Body and Flange Pressure Ratings**  
- English Units<sup>(2)</sup>

Nominal Meter Size (in)	ANSI	Maximum Pressure Rating - psi	
		Carbon Steel	316 Stainless Steel
4 to 36	150	290	275
	300	750	720
	600	1500	1440
	900	2250	2160

**Table 1B: Body and Flange Pressure Ratings**  
- Metric Units<sup>(2)</sup>

Nominal Meter Size (DN)	PN	Maximum Pressure Rating - bar	
		Carbon Steel	316 Stainless Steel
100 to 900	20	20.0	19.0
	50	51.7	49.6
	100	103.4	99.3
	150	155.1	148.9

(1) Zinc primer prevents corrosion.

(2) Pressure rating information is for -20°F (-29°C) to 100°F (38°C). Other temperatures may reduce the maximum pressure rating of the materials.

# Standard Flow Ranges

**Table 2A: Daniel 3812 Flow Range Table**  
English Units

Nominal Meter Size (in)	Meter I.D. (in)	Pipe Schedule	Fluid Velocity (ft/s)			Flow rate (BPH)			Flow Rate (GPM)		
			Min	Max	Over-Range	Min	Max	Over-Range	Min	Max	Over-Range
4	4.026	Sch 40	2	40	48	113	2,267	2,721	79	1,587	1,905
6	6.065	Sch 40	2	40	48	257	5,146	6,175	180	3,602	4,322
8	7.981	Sch 40	2	40	48	446	8,910	10,692	312	6,237	7,485
10	10.020	Sch 40	2	40	48	702	14,045	16,853	492	9,831	11,797
12	11.938	Sch 40	2	40	48	997	19,936	23,923	698	13,955	16,746
14	13.124	Sch 40	2	40	48	1,205	24,094	28,912	843	16,866	20,239
16	15.000	Sch 40	2	40	48	1,574	31,474	37,769	1,102	22,032	26,438
18	16.876	Sch 40	2	40	48	1,992	39,839	47,807	1,394	27,887	33,465
20	18.812	Sch 40	2	40	48	2,475	49,504	59,405	1,733	34,653	41,583
24	22.624	Sch 40	2	40	48	3,580	71,599	85,919	2,506	50,120	60,144
30	29.25	STD	2	40	48	5984	119,680	143,616	4189	83,776	100,531
36	35.25	STD	2	40	48	8691	173,816	208,579	6084	121,671	146,005

**Table 2B: Daniel 3812 Flow Range Table**  
Metric Units

Nominal Meter Size (DN)	Meter I.D. (mm)	Pipe Schedule	Fluid Velocity (m/s)			Flow Rate (m <sup>3</sup> /hr)		
			Min	Max	Over-Range	Min	Max	Over-Range
100	102.3	Sch 40	0.61	12.2	14.6	18	360	433
150	154.1	Sch 40	0.61	12.2	14.6	41	818	982
200	202.7	Sch 40	0.61	12.2	14.6	71	1,417	1,700
250	254.5	Sch 40	0.61	12.2	14.6	112	2,233	2,679
300	303.2	Sch 40	0.61	12.2	14.6	158	3,170	3,803
350	333.4	Sch 40	0.61	12.2	14.6	192	3,831	4,597
400	381.0	Sch 40	0.61	12.2	14.6	250	5,004	6,005
450	428.65	Sch 40	0.61	12.2	14.6	317	6,334	7,601
500	477.82	Sch 40	0.61	12.2	14.6	394	7,871	9,445
600	574.65	Sch 40	0.61	12.2	14.6	569	11,383	13,660
750	742.95	STD	0.61	12.2	14.6	951	19,028	22,833
900	895.35	STD	0.61	12.2	14.6	1,382	27,634	33,161

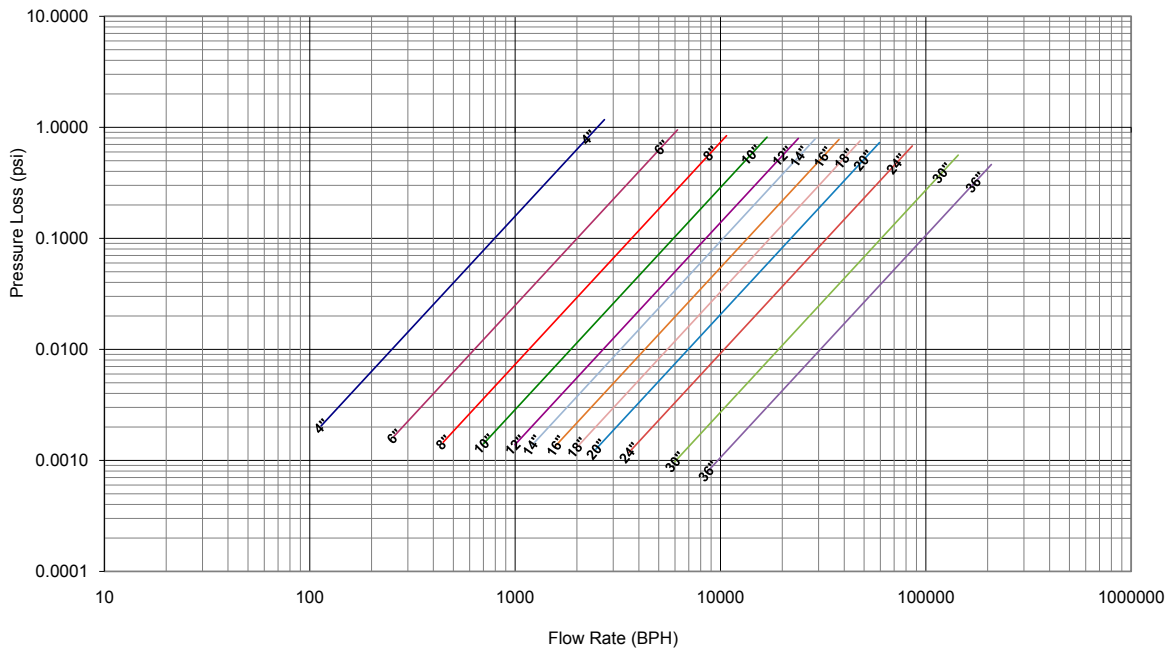


Figure 2A: Pressure Drop Chart - English Units - Meter Only

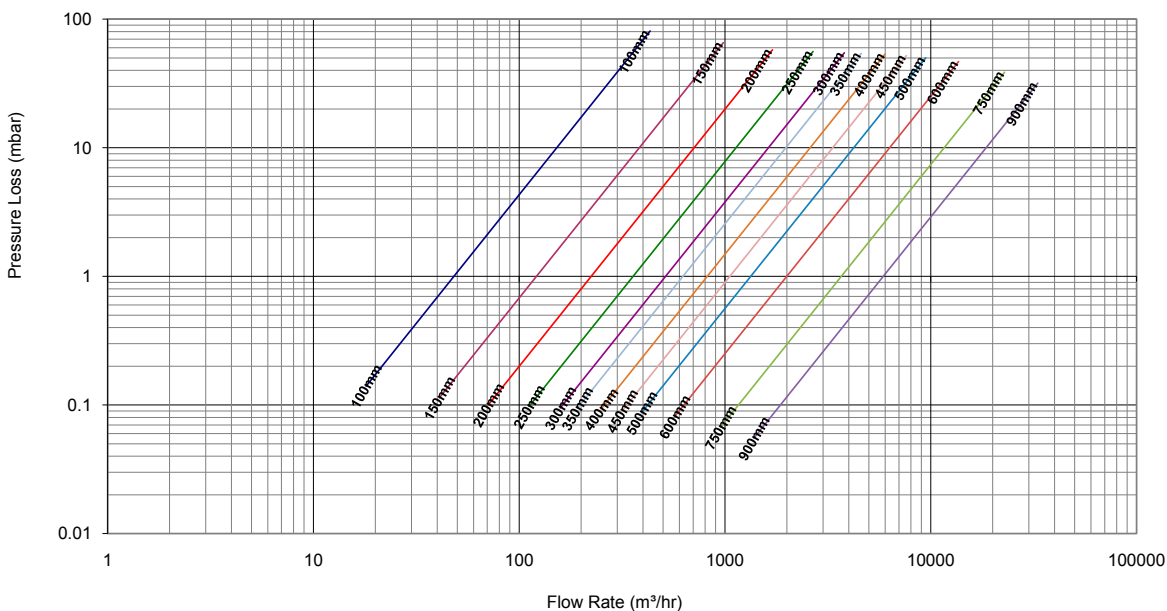


Figure 2B: Pressure Drop Chart - Metric Units - Meter Only

# Input/Output

The Daniel 3810 Series Liquid Ultrasonic Flow Meter provides the I/O connections on the CPU Module.

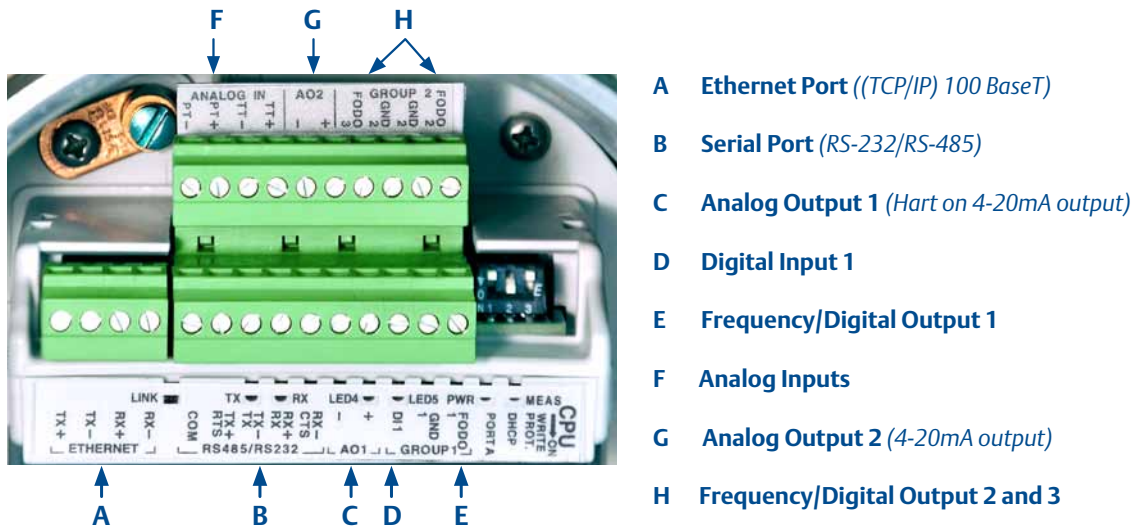


Figure 3 : CPU Module I/O connections

Communications Specifications		
<b>Communication Protocols</b>	(1) Serial RS-232/RS-485 port (115 kbps baud rate) RS-232/RS-485 Full Duplex/RS-485 Half Duplex	<ul style="list-style-type: none"> <li>Modbus RTU/ASCII</li> </ul>
	(1) Ethernet Port (TCP/IP) 100 BaseT	<ul style="list-style-type: none"> <li>Modbus TCP</li> </ul>
Digital, Analog, and Frequency Inputs		
<b>Digital Input<sup>(1)</sup></b>	(1) Single polarity (Contact closure)	<ul style="list-style-type: none"> <li>Status</li> </ul>
<b>Analog Inputs<sup>(3)</sup></b>	(2) 4-20 mA	<ul style="list-style-type: none"> <li>AI-1 Temperature<sup>(2)</sup></li> <li>AI-2 Pressure<sup>(2)</sup></li> </ul>
Digital, Analog, and Frequency Outputs		
<b>Frequency/Digital Outputs</b>	(3) Frequency/Digital Outputs	<ul style="list-style-type: none"> <li>Configuration TTL/Open Collector</li> </ul>
<b>Analog Outputs</b>	(2) 4-20 mA	<ul style="list-style-type: none"> <li>Independently configurable analog outputs</li> </ul>

(1) The analog-to-digital conversion accuracy is within ±0.05% of full scale over the operating temperature range.

(2) AI-1 and AI-2 are electronically isolated and operate in sink mode. The input contains a series resistance so HART® Communicators can be connected to configure sensors.

(3) A 24 Volt DC power supply is available to provide power to the sensors.

(4) The analog output zero scale offset error is within ±0.1% of full scale and gain error is within ±0.2% of full scale. The total output drift is within ±50 ppm of full scale per °C.



## Meter Software

### Daniel MeterLink™ Overview

Daniel's new MeterLink™ software gives users access to information not seen before. This information is presented in an intuitive graphical format that takes complexity out of your flow measurement.

Delivered to the right person at the right time, this critical information will empower your staff to work predictively, instead of reactively.

- Windows®-based Daniel MeterLink™ software is supplied with meter at no charge
- Daniel MeterLink™ is required for transmitter configuration
- Daniel MeterLink™ software requires RS-232, RS-485 full duplex, or Ethernet (recommended)
- Supports Windows 7 and Vista®, as well as Microsoft® Office® 2003-2011
- Configurable with AMS™ Device Manager or 375 / 475 Field Communicator if HART® is used

Daniel MeterLink™ Features	
<b>Powerful Analysis</b>	<ul style="list-style-type: none"> <li>▪ View, analyze and save waveforms</li> <li>▪ Daily and hourly Logs Alarms and Audit history retrieval in Excel® or CSV files</li> <li>▪ Daily and hourly log graphing</li> <li>▪ Reverse flow alert display</li> <li>▪ Alarms listed primary cause first</li> <li>▪ Separate latched alarm display</li> <li>▪ Trend maintenance logs</li> <li>▪ Compare meter configurations stored in Excel logs</li> <li>▪ Calibrate analog inputs</li> </ul>
<b>Intuitive Interface</b>	<ul style="list-style-type: none"> <li>▪ Summarized and detailed views for meter performance information</li> <li>▪ Built-in maintenance logs and inspection reports</li> <li>▪ Meter directory support</li> <li>▪ View multiple graphs simultaneously</li> <li>▪ Automatic file naming and organized saving, supports hundreds of meters</li> </ul>
<b>Quick Startup</b>	<ul style="list-style-type: none"> <li>▪ Easy upgrade of meter firmware</li> <li>▪ Modbus and HART protocol configuration</li> <li>▪ Zero calibration wizard</li> <li>▪ Field setup wizard</li> <li>▪ Flow calibration wizard and Meter factor adjustment</li> </ul>
<b>Versatile Connectivity</b>	<ul style="list-style-type: none"> <li>▪ Ethernet</li> <li>▪ Serial Port</li> <li>▪ Modem</li> </ul>

# Safety and Compliance

## Safety Classifications

Daniel 3810 Series Liquid Ultrasonic Flow Meters have electrical, metrology, intrinsic safety and Pressure Equipment Directive certifications and approvals by the agency standards listed below.

### Standards

#### US

#### Canada

#### Europe

- Explosive Atmospheres (ATEX)
- International Electrotechnical Commission (IECEX)
- Pressure Equipment Directive (PED)
- Electromagnetic Compatibility (EMC)
- International Organization of Legal Metrology (OIML)

### Approval Agencies

- UL
- ULC
- DEMKO
- NMI
- INMETRO
- NEPSI
- GOSTR

#### IMPORTANT

*Please consult Daniel for a complete approvals list.*

# Dimensions

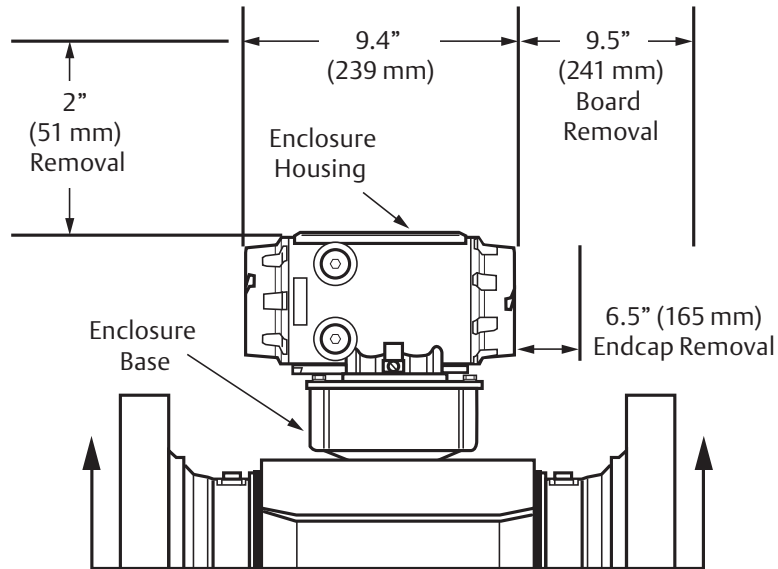


Figure 4A

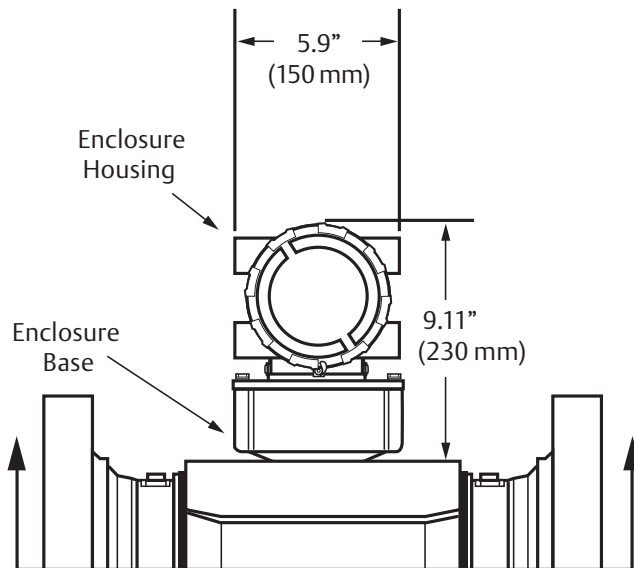


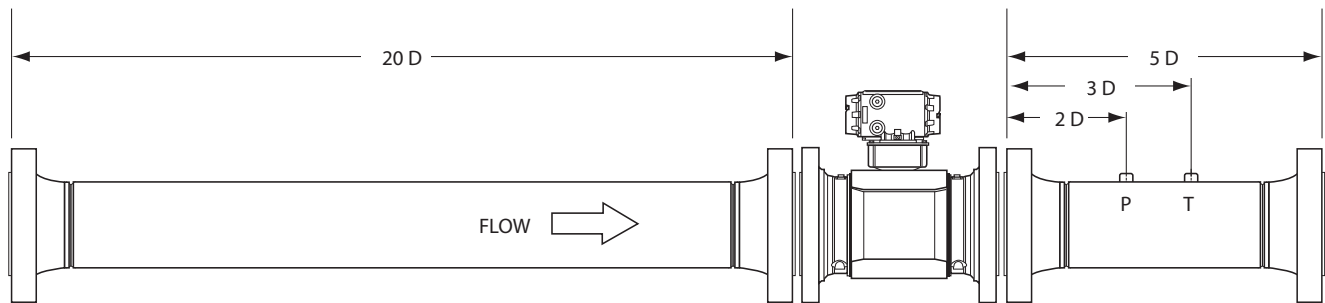
Figure 4B: Optional field installed position of enclosure housing<sup>(1)</sup>

(1) Enclosure Housing may be rotated 360 degrees in 90 degree increments.

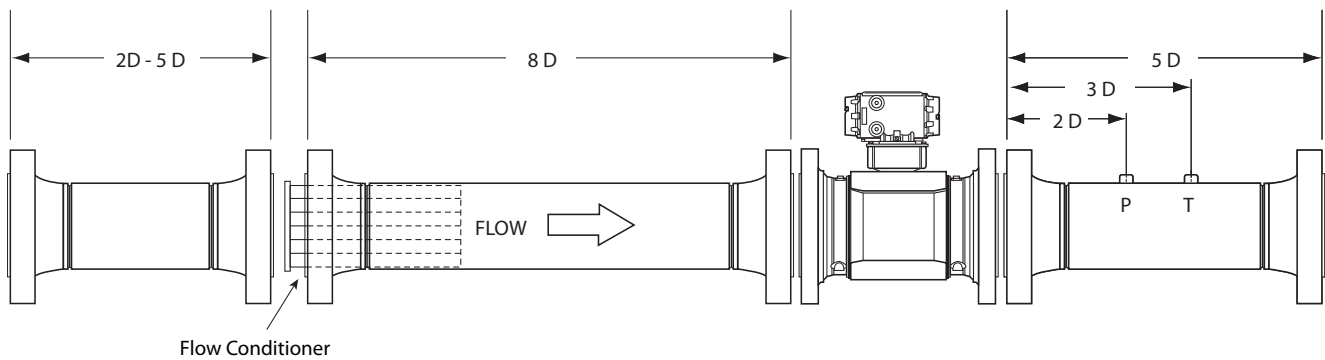
# Recommended Installation

## Minimum Recommended Pipe Lengths

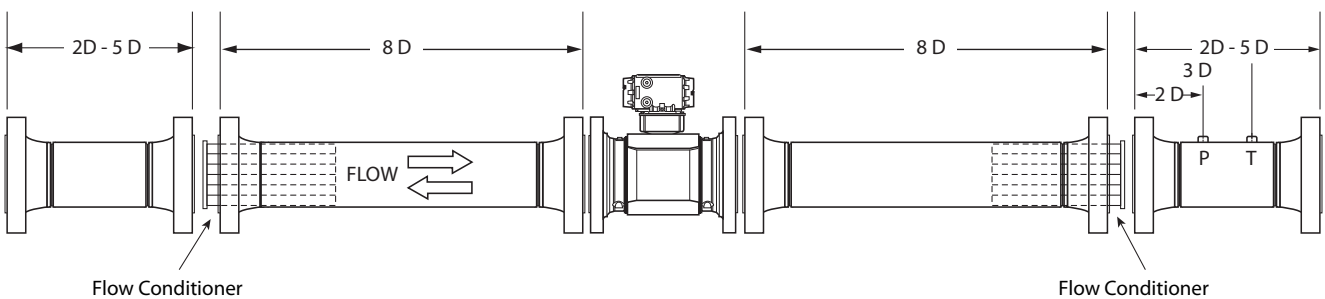
See Figure 5 below. Drawings represent minimum recommended pipe lengths for the installation of the Daniel 3812 Liquid Ultrasonic Flow Meter. If shorter lengths are used, there may be an increase in flow measurement uncertainty. Please consult Daniel for installation recommendations of your application.



**Figure 5A: Daniel Piping Recommendation for 20 Diameters Straight Pipe (No Flow Conditioners)**



**Figure 5B: Daniel Piping Recommendation for Liquid Ultrasonic Meter with a Flow Conditioner**



**Figure 5C: Daniel Piping Recommendation for Bi-directional Liquid Ultrasonic Meter with Flow Conditioners**

**Notes:**

1. For best results flow conditioning is recommended
2. All pipe lengths are minimum.
3. D = Nominal pipe size in inches (i.e. 6" pipe size; 10 D = 60 in)
4. P = Pressure measurement location
5. T = Temperature measurement location

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