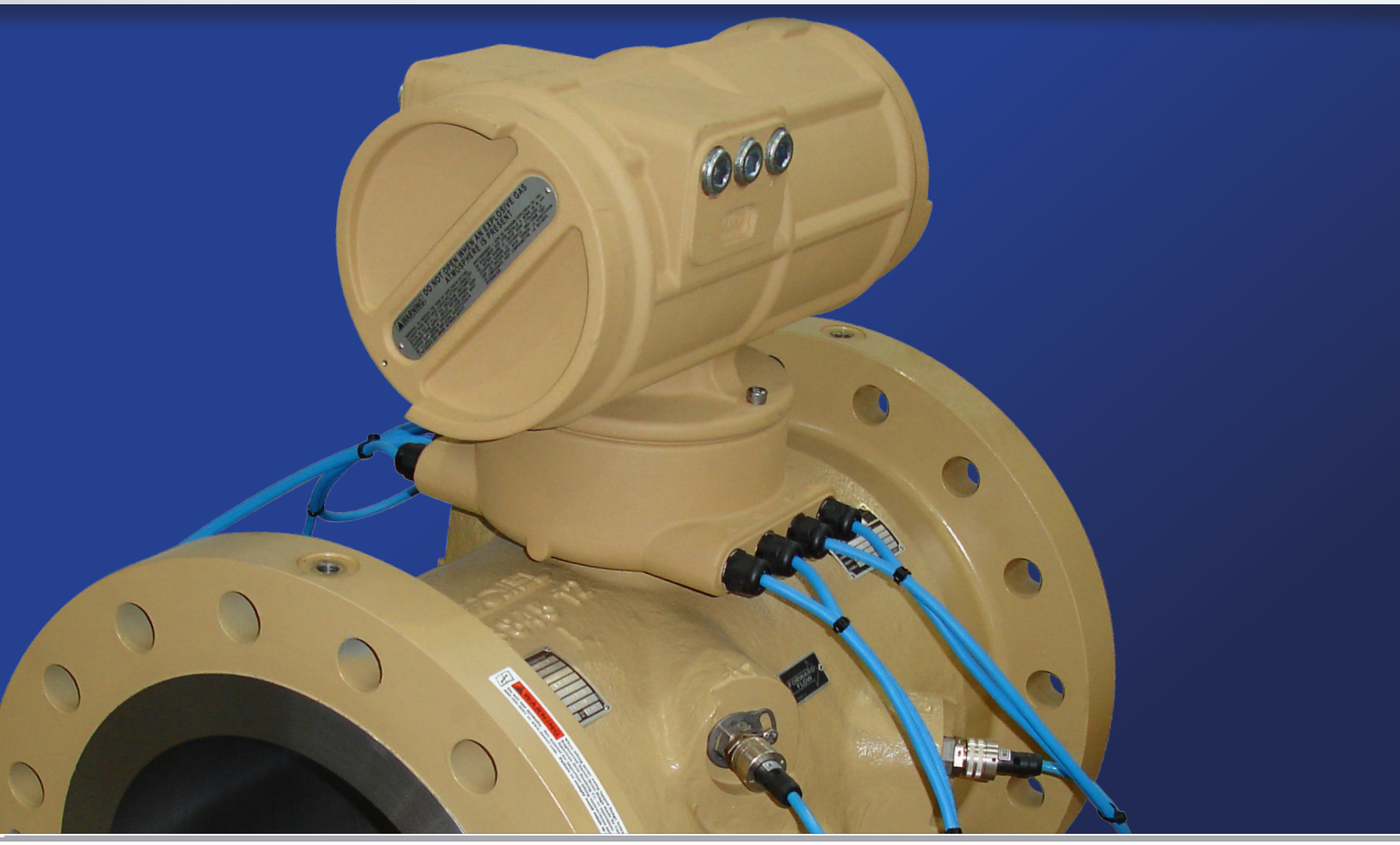
Product Datasheet
April 2011

Liquid Ultrasonic Flow Meters



Daniel™ Model 3804
Liquid Ultrasonic Flow Meter

DANIEL™

EMERSON™
Process Management

Product Datasheet
April 2011

Daniel® 3804 Liquid Ultrasonic Flow Meter

Digital Intelligence at Work

Daniel 3804 Liquid Ultrasonic Flow Meter is designed to accurately measure liquid products in accordance with API Chapter 5.8 and OIML R117. With an exceptional rangeability and linearity throughout the flow range, Daniel 3804 Liquid Ultrasonic meter reduces lost and unmeasured liquid products and features HART® equipped electronics. Not only does the meter deliver precise process variable data through the PlantWeb® digital plant architecture, it also transmits meter health information to the operator and maximizes uptime.

Daniel 3804 is a four-path, in-line ultrasonic meter that measures transit times of ultrasonic pulses passing through the liquid in four parallel planes. Each of the four paths has two integrally mounted ultrasonic transducers. Each pair of transducers acts alternately as transmitter and receiver. The difference in transit times of the downstream-directed pulses and the upstream-directed pulses is directly proportional to the measured fluid velocity. With no moving parts, the meter is ideal for bi-directional measurement as it provides accurate measurement of both upstream and downstream transit times.

Metrology Approvals

- OIML R117 Draft Edition April 2004(E), Accuracy Class 0.3
  - NMi Certificate Test Number CPC-607284
  - MID Certificate Number TC7227

Daniel Model 3804 Liquid Ultrasonic Flow Meter

Typical Applications

This technology can be applied to custody transfer, allocation measurement, check metering, leak detection and inventory control applications such as:

- Offshore
  - Floating Production Storage and Off-loading (FPSO)
  - Offshore platforms
  - Barges
- Pipelines
  - Crude oil pipelines
  - Refined product pipelines
    - Ethane
    - LPG
    - Gasoline
    - Diesel
    - Aviation fuel
- Terminals
  - Loading and off-loading (such as ships, barges, and railcars)
  - Tank Farms
  - Cavern Storage

Features and Benefits

- Reduce unaccounted fluid loss
- Increase energy savings
- Intrinsically safe / explosion proof
- Lower capital costs
- Reduce maintenance costs
- Reduce inventory costs
- Reduce start-up time
- Improve uptime
- Reduce field technician costs
- Optimize meter operation

SPECIFICATIONS

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

Meter Type

- **Number of paths:**
  - Four-path (eight transducer) chordal design
- **Ultrasonic type:**
  - Transit-time based measurement
  - Spool piece with integral mount transducers

Meter Performance

- **Linearity:**
  - ± 0.15% of measured value over a 40 to 4 ft/s (12.2 to 1.2 m/s) range
  - ± 0.20% of measured value over a 40 to 2 ft/s (12.2 to 0.6 m/s) range
- **Uncertainty of meter factor:**
  - < ± 0.027% (API MPMS, Chapter 5, Section 8, Table B-1)
- **Repeatability:**
  - ± 0.02% of measured value
- **Velocity range:**
  - Nominal 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)

Process Parameters

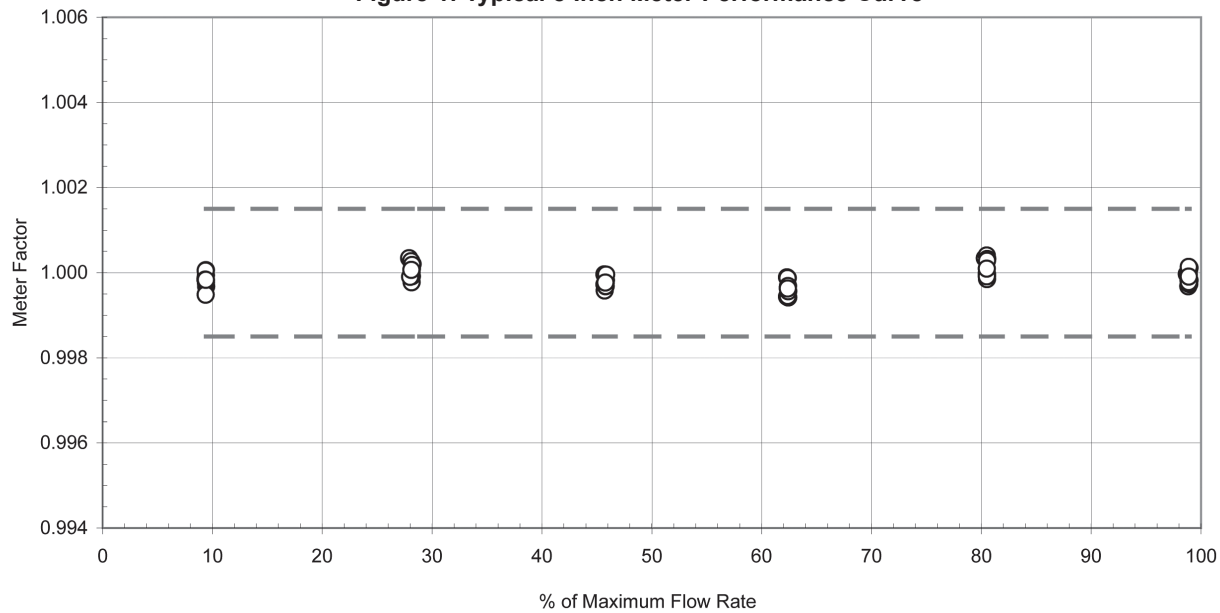
- **Process product temperature:**
  - -50°F to +212°F (-45°C to +100°C) (Standard)
  - -58°F to +302°F (-50°C to +150°C) (Optional)
- **Specific gravity range:**
  - 0.35 to 1.50 units

Meter Capabilities

- **Line sizes:**
  - 4" to 24" nominal bore (DN 100 to 600)
- **Operating pressure range:**
  - 0 to 2250 psig (0 to 155 Bar)
- **Flanges:**
  - Raised face and Ring Type Joint (RTJ) for ANSI Classes 150, 300, 600, 900 (PN 20, 50, 100, 150)
  - Higher ANSI ratings available upon request
- **NACE compliant:**
  - Designed for NACE compliance*
- **Humidity:**
  - Up to 95%, non-condensing

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

Figure 1: Typical 8 Inch Meter Performance Curve



Materials of Construction

- **Body and flange material:**
  - ASTM A352 Gr. LCC Carbon Steel (standard)
  - ASTM A351 Gr. CF8M 316 SS (optional)
  - ASTM A351 Gr. CF3M 316L SS (optional)
  - ASTM A995 Gr. 4A Duplex SS (optional)
- **Transducer housing material:**
  - ASTM A479 316L SS with proprietary matching layer material
  - INCONEL ASTM B446 (UNS N06625) Gr. 1 (optional)
- **Transducer cable material:** (for local and remote mounting)
  - TPE Jacket, Tinned Copper Braided Armor, Aluminum Foil Shield, 20 Gauge Twisted Pair (standard) (up to 100°C)
  - Conductor Insulation Material ETFE, Tinned Copper Braid Shield, 20 gauge Tin Coated Copper Wire, Extended Modified Silicone Rubber Jacket (optional) (up to 150°C)
- **Transducer cable gland material:**
  - Chloroprene/Nitrile Rubber
- **Electronic housing material:**
  - ASTM B26 grade A356.0 T6 Aluminum
- **Meter body paint specification:**
  - **Carbon steel body material:**
    - 2 Coat Paint – Inorganic Zinc primer and Acrylic Lacquer Top Coat (standard: 100°C)
    - 3 Coat Epoxy – Inorganic Zinc primer, Epoxy Midcoat, and Polyurethane Top Coat (optional: 100°C)
    - 2 Coat Paint - Inorganic Zinc primer and Modified silicon top coat (optional: 150°C)
  - **Stainless steel or duplex body material:**
    - Unpainted
  - **Electronic housing:**
    - Powder coat

Table 1A: Daniel 3804 Body and Flange Pressure Ratings - English Units

		Maximum Pressure Rating - psi			
Meter Size (in)	**ANSI**	**Carbon Steel**	**316 SS**	**316L SS**	**Duplex Stainless Steel**
4 to 24	150	290	275	275	290
	300	750	720	720	750
	600	1,500	1,440	1,440	1,500
	900	2,250	2,160	2,160	2,250

Note: Pressure rating information is for -20°F to 100°F. Other temperatures may reduce the maximum pressure rating of the materials.

Table 1B: Daniel 3804 Body and Flange Pressure Ratings - Metric Units

		Maximum Pressure Rating - bar			
Meter Size (DN)	**PN**	**Carbon Steel**	**316 SS**	**316L SS**	**Duplex Stainless Steel**
100 to 600	20	20.0	19.0	19.0	20.0
	50	51.7	49.6	49.6	51.7
	100	103.4	99.3	99.3	103.4
	150	155.1	148.9	148.9	155.1

Note: Pressure rating information is for -29°C to 38°C. Other temperatures may reduce the maximum pressure rating of the materials.

Standard Flow Ranges

Table 2A: Daniel 3804 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
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

Table 2B: Daniel 3804 Flow Range Table - Metric Units								
Nominal Meter Size (DN)	Meter I.D. (mm)	Pipe Schedule	Fluid Velocity (m/s)			Flow Rate (m^3/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
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

Electronics Platform

- **Power:** 10.4 VDC – 36 VDC
  - 8 watts typical
  - 15 watts maximum
- **Ambient temperature range:** -40°F to +149°F (-40°C to +65°C)
- **Storage temperature range:** -58°F to +185°F (-50°C to +85°C)
- **Operating relative humidity:** up to 95% non-condensing
- Six conduit ports (3/4" NPT or M20)
  - Plugs provided
- **Electronic housing options:**
  - Integral (standard)
  - Remote mount - (optional)
    - required when process temperature exceeds 150°F (+65.5°C)
    - 15ft (4.6 m) transducer cables
- Weather proof to NEMA 4X, IP66 to EN60529

Safety Classifications

- UL / c-UL Class I, Division 1, Group C,D UL file – E152246
- CE Marked to Directives:
  - 94/9/EC – Explosive Atmopheres (ATEX)
    - Certificate Baseefa 04ATEX0129
    - Marking – Ⓔx II 2G Ex d ia IIB T4 (-40º C ≤ T_a ≤ +65º C)
  - 97/23/EC – Pressure Equipment Directive (PED)
  - 92004/108/EC – Electromagnetic Compatibility (EMC)
- IECEx
  - Certificate BAS 08.0005
  - Marking – Ex d ia IIB T4

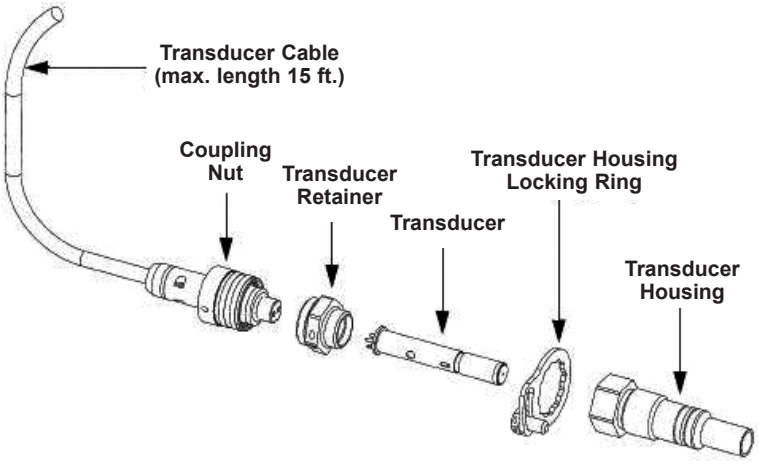
Electronics Functionality

- Meter body expansion correction
  - Fixed or live analog inputs for pressure and temperature
- Configuration write protection
  - Hardware security switch
  - Wire seal security available
- Archive logging (Historical Record Retention)
  - Hourly and daily logs
  - Audit log (for configuration changes)
  - Alarm log
- Field-upgradeable firmware
  - Via serial or Ethernet port

Transducer Assembly

- Transducer capsule
  - Field replaceable
  - Intrinsically safe
- Transducer cable glands
  - Comply with BS 6121 and EN 50262 standards
  - IP 66 rated for water ingress
  - Approved by UL and ATEX
- Eight conduit ports for transducer cables
- Transducer housing locking ring
- Wire seal security available
- Transducer housing O-ring material: NBR(Nitrile butadiene rubber) (Standard) other materials available

Figure 2: Transducer Assembly



Input / Output

- One Ethernet port (TCP/IP) (Up to 10 Mbps) Half-Duplex
  - Modbus TCP
- Three serial ports *

Port	Supports
A	RS-232 and RS-485 full and half duplex
B	RS-232 and RS-485 full and half duplex
C	RS-232 and RS-485 half duplex

  - 1.2 to 115 kbps baud rate
  - Modbus RTU/ASCII
- Maximum cable length (with Beldon wire No. 9940 or equivalent)
  - RS-232 communications: 250 ft. (88.3 m) at 9600 bps
  - RS-485 communications: 1970 ft. (600 m) at 57600 bps
- Two isolated freqency pair outputs for volumetric flow rate *
  - Individually configurable frequency range as 0-1000 Hz or 0-5000 Hz frequency range (frequency over-range 150% of full scale)
  - Individually configurable as forward, reverse, absolute, or bi-directional flow
  - Individually configurable for Open Collector or TTL
  - Each pair capable of level B security
- Two 4-20 mA outputs for volumetric flow rate *
  - One conventional 4-20 mA
  - One 4-20 mA output with HART
  - Internally powered and magnetically isolated to 500V
- Two 4-20 mA analog inputs (16 bit) for pressure and temperature
- One digital input for flow calibration gating (contact closure)
  - Single input for starting and stopping gate
  - Four pulse configurations available
- Four digital outputs
  - Individually configurable for data validity or flow direction
  - Individually configurable for Open Collector or TTL

***Frequency, analog and serial outputs are electronically isolated from each other.**

Operation / Configuration Software

- Windows®-based MeterLink™ software is supplied with meter at no charge
- It is recommended to upgrade to MeterLink™ if you are still using Daniel CUI 5 Edition
- MeterLink™ allows for transmitter configuration
- MeterLink™ requires RS-232, RS-485 full duplex, or Ethernet (recommended)
- Configurable with AMS™ Device Manager or 375 / 475 Field Communicator if HART® is used

Table 3: MeterLink™ Features
Comprehensive monitor screen shows meter performance information
Create maintenance logs and reports
Audit / alarm / history retrieval in Excel® or CSV files
Field set up wizard
Meter directory support
View and chart advanced diagnostic data
View and save waveforms
Automatic file naming and organized saving
Supports hundreds of meters
Trend maintenance logs
View multiple graphs simultaneously
Compare meter configurations stored in Excel logs
Calibrate analog inputs
Meter factor wizard for flow calibration
Hourly and daily log graphing
SNR displayed in dB
Alarms displayed by severity
Separate latched alarm display
Modbus TCP server configuration
Reverse flow alert display

Weights and Dimensions

Figure 3A: Factory installed position of enclosure housing for 4" and 6" meters*

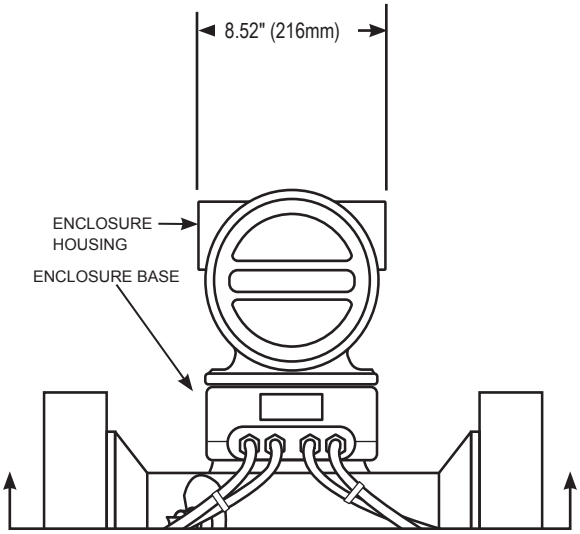


Figure 3B: Optional field installed position of enclosure housing*

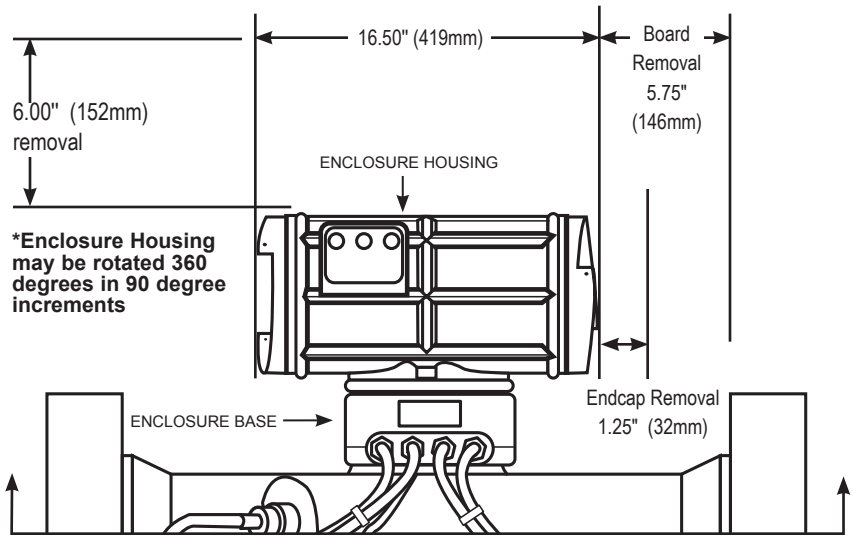


Figure 3C

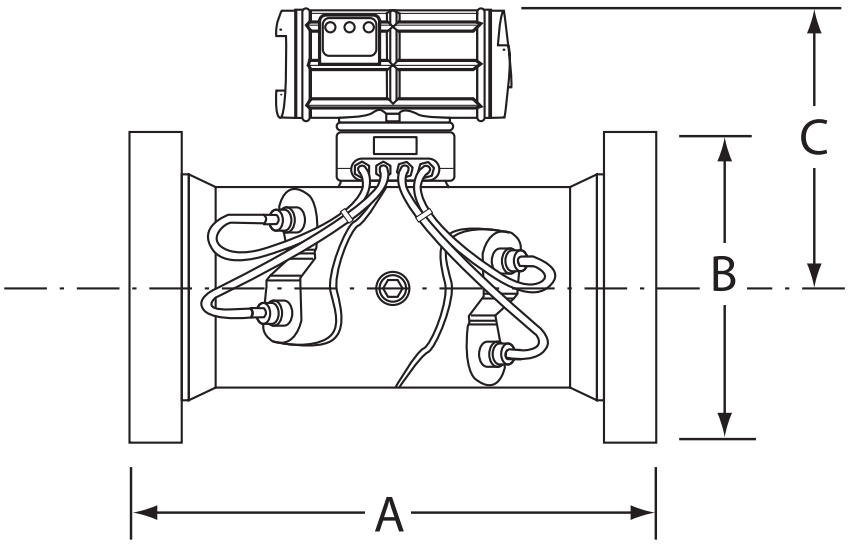


Table 4A: Daniel 3804 Weight and Dimension Data - English Units

		Nominal Line Size (in)								
		4	6	8	10	12	16	18	20	24
150 ANSI	A (in)	16.00	18.00	21.50	24.50	26.00	30.00	31.50	35.50	39.00
	B (in)	9.00	11.00	13.50	16.00	19.00	23.50	25.00	27.50	32.00
	C (in)	15.69	16.94	17.94	19.19	20.13	21.81	22.69	23.81	26.07
	Weight (lb)	234	328	451	649	838	1,260	1,426	1,878	2,812
300 ANSI	A (in)	16.00	18.00	21.50	24.50	26.00	30.00	31.50	35.50	39.00
	B (in)	10.00	12.50	15.00	17.50	20.50	25.50	28.00	30.50	36.00
	C (in)	15.69	16.94	17.94	19.19	20.13	21.81	22.69	23.81	26.07
	Weight (lb)	254	362	509	733	943	1,493	1,743	2,273	3,442
600 ANSI	A (in)	16.00	18.00	21.50	24.50	26.00	30.00	31.50	35.50	39.00
	B (in)	10.75	14.00	16.50	20.00	22.00	27.00	29.25	32.00	37.00
	C (in)	15.69	16.94	17.94	19.19	20.13	21.81	22.69	23.81	26.07
	Weight (lb)	274	419	580	877	1,054	1,723	2,033	2,658	4,000
900 ANSI	A (in)	16.50	18.50	27.50	30.50	34.50	41.50	36.00	37.00	48.00
	B (in)	11.50	15.00	18.50	21.50	24.00	27.75	31.00	33.75	41.00
	C (in)	15.69	16.94	18.44	19.44	20.94	22.69	29.94	25.07	26.19
	Weight (lb)	298	474	847	1,039	1,824	2,623	3,163	3,696	6,153

Table 4B: Daniel 3804 Weight and Dimension Data - Metric Units

		Nominal Line Size (DN)								
		100	150	200	250	300	400	450	500	600
PN20	A (mm)	406	457	546	622	660	762	800	902	991
	B (mm)	229	279	343	406	483	597	635	699	813
	C (mm)	399	430	456	487	511	554	576	605	662
	Weight (kg)	106	149	204	294	380	572	647	852	1,275
PN50	A (mm)	406	457	546	622	660	762	800	902	991
	B (mm)	254	318	381	445	521	648	710	775	914
	C (mm)	399	430	456	487	511	554	576	605	662
	Weight (kg)	115	164	231	332	428	677	791	1,031	1,561
PN100	A (mm)	406	457	546	622	660	762	800	902	991
	B (mm)	273	356	419	508	559	686	745	813	940
	C (mm)	399	430	456	487	511	554	576	605	662
	Weight (kg)	124	190	263	398	478	781	922	1,206	1,814
PN150	A (mm)	419	470	699	775	876	1,054	914	940	1,219
	B (mm)	292	381	470	546	610	705	785	857	1,040
	C (mm)	399	430	463	494	532	576	760	637	665
	Weight (kg)	135	215	384	471	827	1,190	1,435	1,676	2,791

Note: This information is not intended for construction. Certified dimensional drawings are available. Please consult the factory.

Figure 4A: Pressure Drop Chart - U.S. Customary Units
Meter Only

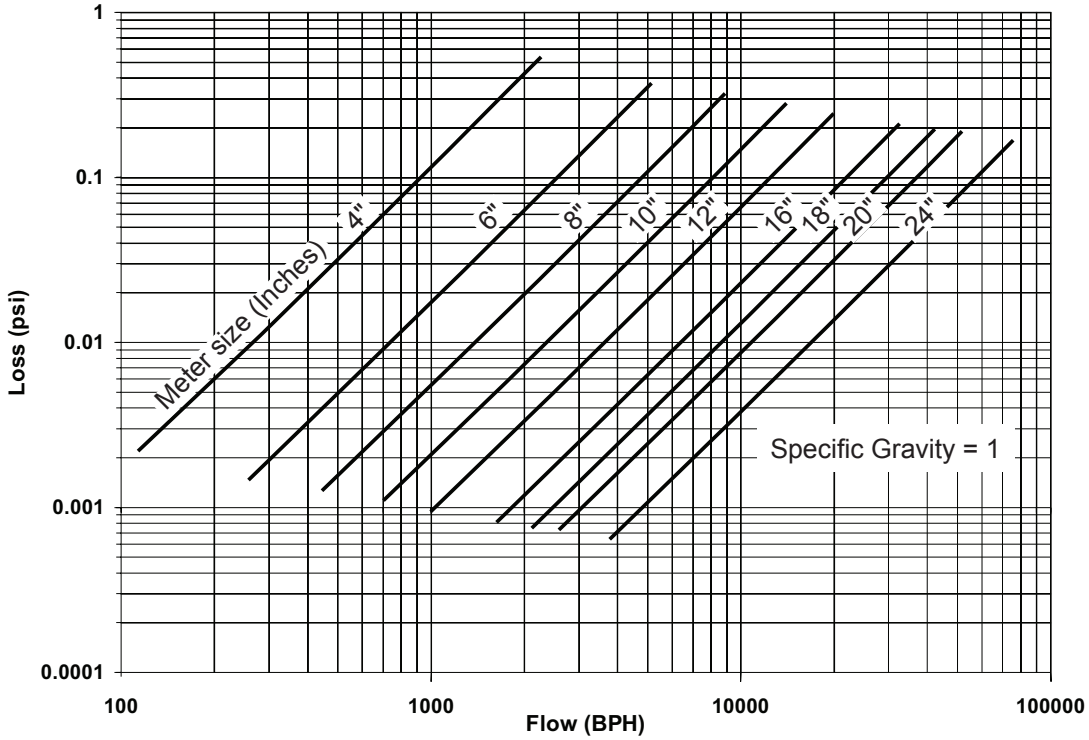
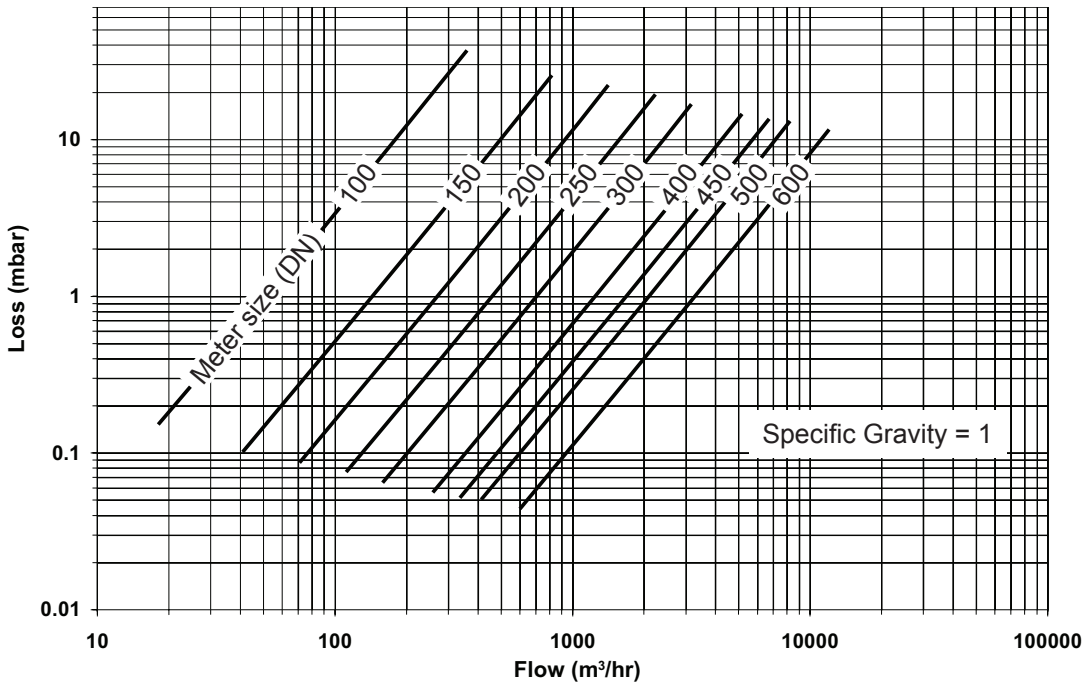


Figure 4B: Pressure Drop Chart - Metric Units
Meter Only



Recommended Installation

The drawings below represent minimum recommended pipe lengths for the installation of the Daniel 3804 Liquid Ultrasonic Flow Meter. If shorter lengths are used, there may be an increase in flow measurement uncertainty. Please consult Daniel for best installation recommendations for your application.

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

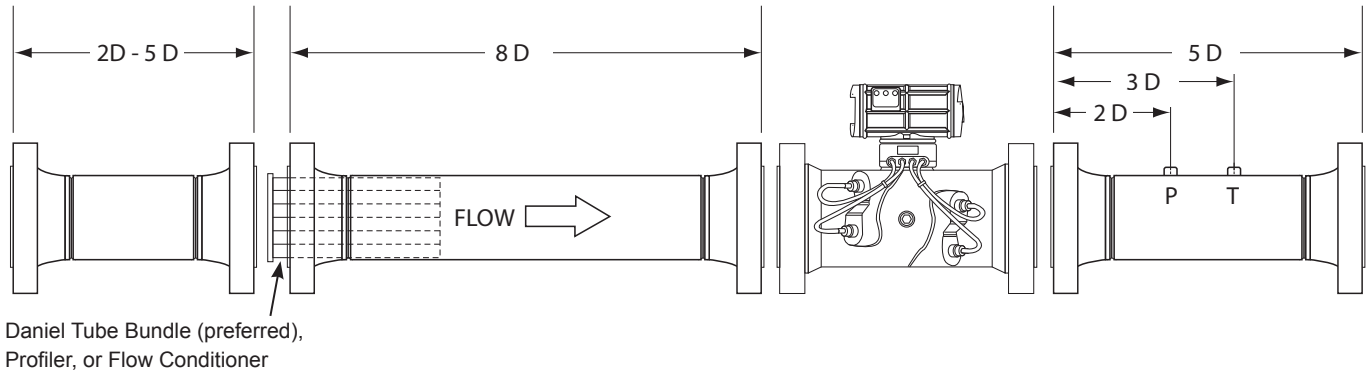
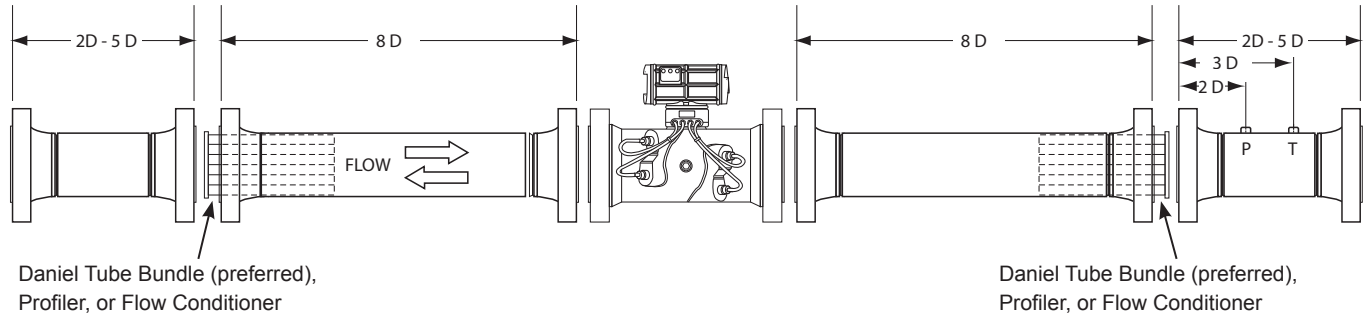
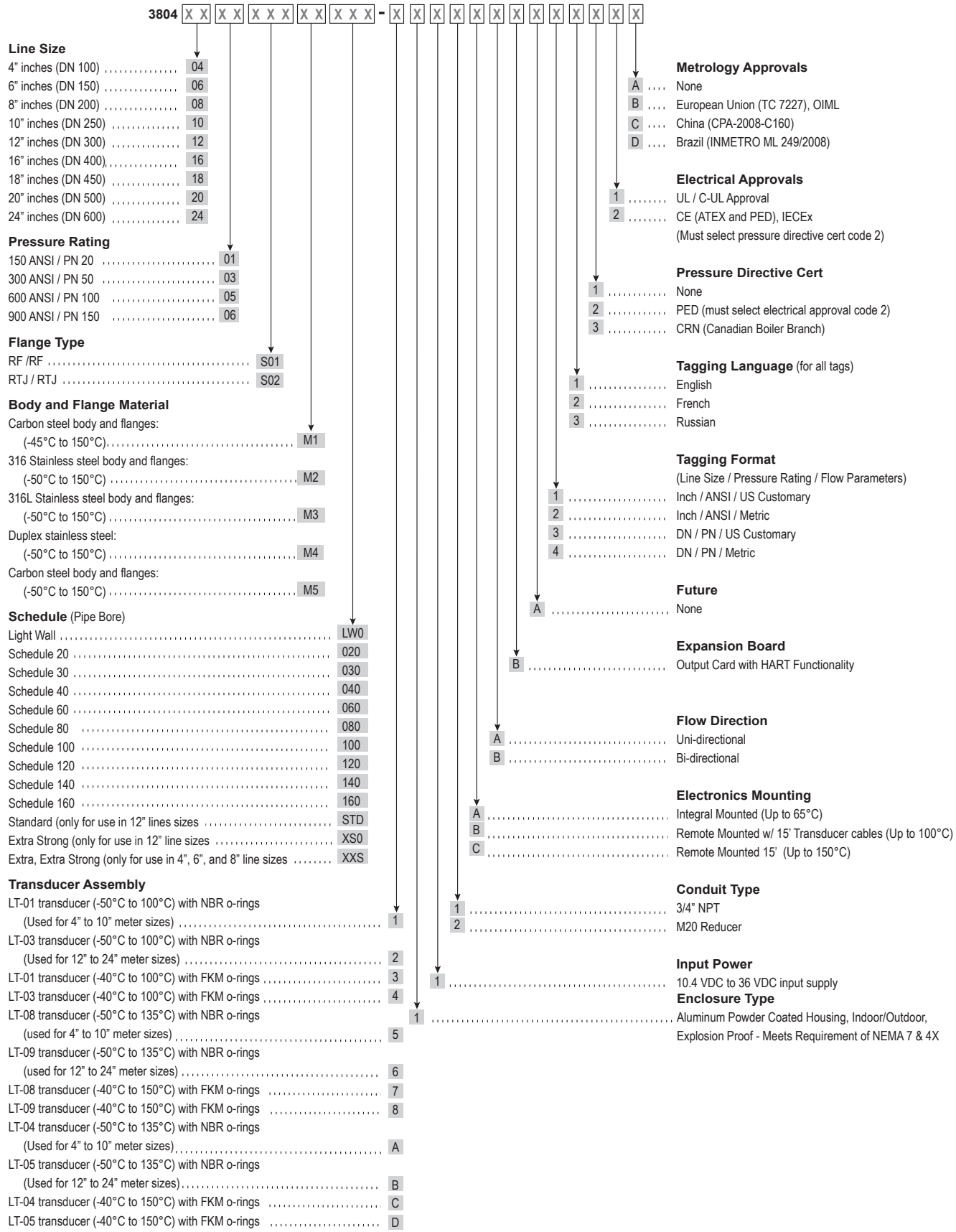


Figure 6: Daniel Piping Recommendation for Bi-Directional Liquid Ultrasonic Meter with Flow Conditioners



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**

DANIEL 3804 LIQUID ULTRASONIC FLOW METER SELECTOR



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