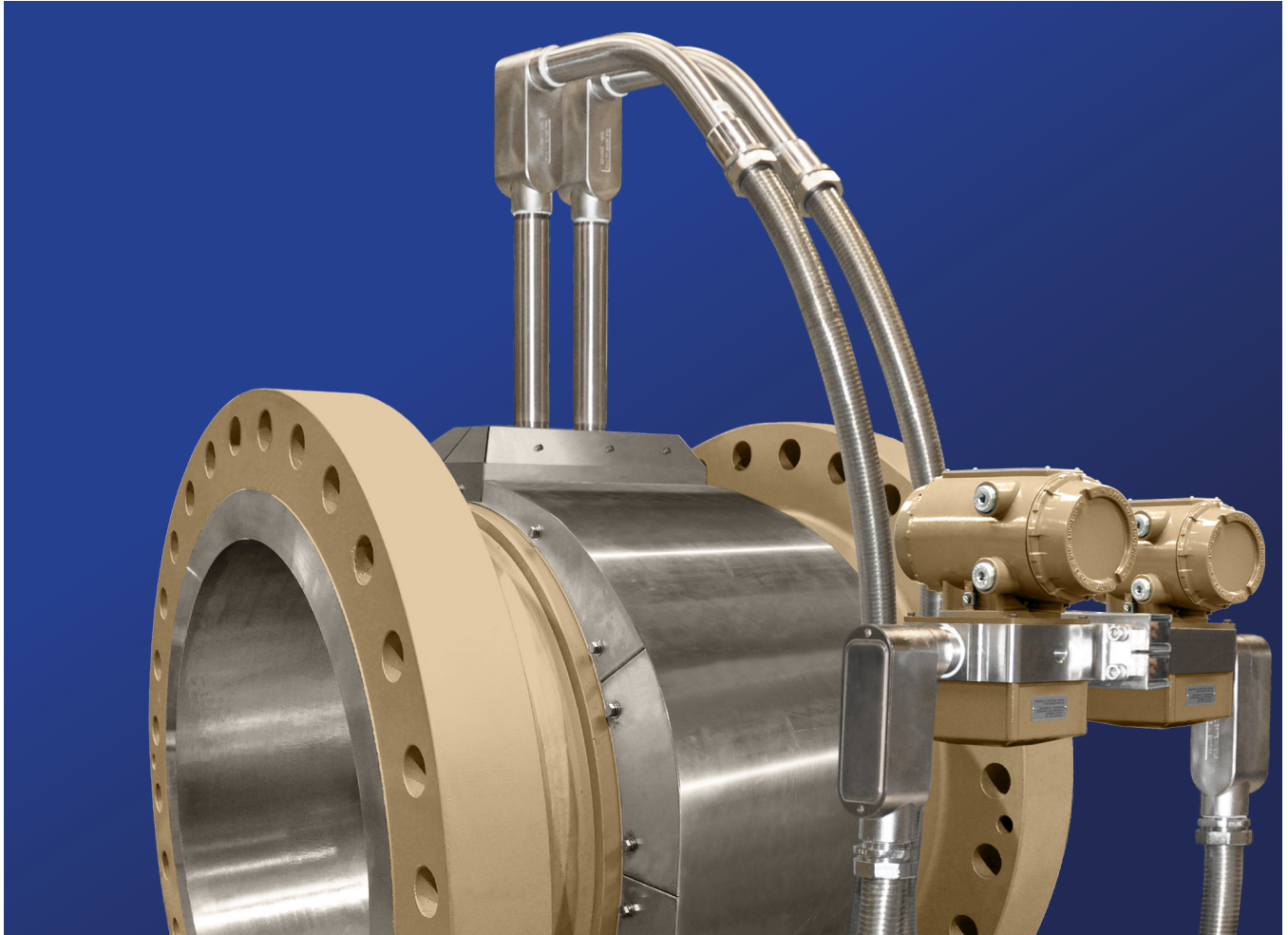


Daniel™ 3818 for Liquefied Natural Gas

Liquid Ultrasonic Flow Meters



Redundancy for High Accuracy and Long-Term Stability

Overview

The Daniel 3818 Liquid Ultrasonic Flow Meter is designed for high accuracy and long-term, reliable performance in LNG applications. The 3818 features a unique multi-plane interlocked 8-path British Gas design.

The equivalent of two 4-path meters in a single body, the completely redundant design utilizes two independent transmitters—one for each set of four (4) chordal paths and offers the ability to poll each 4-path meter separately. Acoustic processing is performed by specialized electronics designed to achieve high sampling rates, provide stable ultrasonic signals and optimal low flow response delivering accurate, stable and reliable measurement.

Ideal for meeting strict safety and environmental regulations, the 3818 LNG meter was engineered, designed and manufactured to Daniel's ISO certifications (9001, 14001). Additionally, the meter comes equipped with advanced diagnostics software, which allows operators to learn more about system performance and monitor the meter's health. Meters are calibrated using both a static zero flow test on liquid nitrogen and a full dynamic test on water in our ISO 17025 certified flow calibration facility.

Available in nominal line sizes 8" to 36", the 3818 LNG meter offers increased flow capacity and no incremental pressure drop, therefore minimizing operating costs and improving measurement integrity and safety.

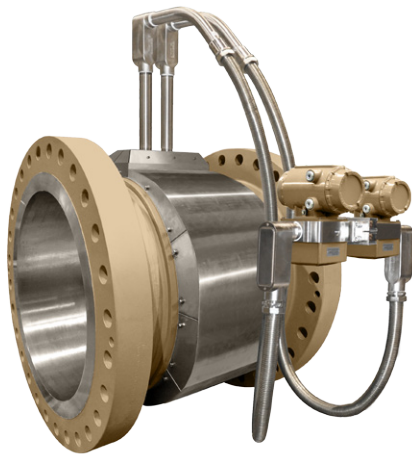


Figure 1: Daniel 3818 Liquid Ultrasonic Flow Meter for Liquefied Natural Gas Applications

LNG Applications

- Custody Transfer
- Tanker Loading and Off-Loading
- Liquefaction Trains (Rundown Lines)
- Storage Allocation
- Check Metering
- Line Balance

Features and Benefits

- Redundant 4-path chordal design ensures accuracy, stability and operational cost savings
- Ease of installation and operation reduces start-up time and lowers capital costs
- Full bore design eliminates incremental pressure drop, improving measurement and reducing energy costs
- Geometric correction calculations account for meter body expansion/contraction due to changes in pressure and temperature
- Meter factory insulation minimizes heat sinks and hot spots and reduces startup time
- Equipped with MeterLink™ advanced diagnostics software for monitoring meter and system performance
- 3810 Series Electronics provide fast sampling rates, enabling quick response to process upsets
- Communicates predictive diagnostics and processes variable information via the HART® protocol which allows plant personnel to quickly detect and respond to abnormal situations, avoiding process upsets and unscheduled downtime
- The 3818 is part of Emerson's broad range of intelligent field devices that power the PlantWeb® digital plant architecture

Standard Specifications⁽¹⁾

Meter Specifications

Characteristics

- Eight-path (sixteen transducer) chordal design
- British Gas (BG) configuration
- Two paths are paired at each of the four horizontal chords in the pipe cross section. The paired paths are angled with respect to the pipe axis such that four horizontal chords lie in each of the angled planes, forming an X when viewed from above. This allows a true 3-D representation of the flow profile.

Meter Performance

- Factory proven linearity is $\pm 0.15\%$ of measured value over a 1.2 to 12.2 m/s (4 to 40 ft/s) range
- Factory proven linearity is $\pm 0.20\%$ of measured value over a 0.6 to 12.2 m/s (2 to 40 ft/s) range (option)

Uncertainty of Meter Factor

- $< \pm 0.027\%$ (API MPMS, chapter 5, section 8, table B-1)

Velocity Range

- 0.6 to 12.2 m/s (2 to 40 ft/s) with an over-range of 0.3 to 14.6 m/s (1 to 48 ft/s)

Calibration

- ISO 17025 certified flow laboratory available for all meters

Electronics Performance

Power (Each set of electronics)

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

Meter Mechanical Ratings

Line Sizes

- 200 mm to 900 mm (8" to 36")⁽²⁾

Operating Product Temperature

- -196°C to $+60^{\circ}\text{C}$ (-385°F to $+140^{\circ}\text{F}$)

Operating Pressure Range

- 0 to 250 Bar (0 to 3600 psig)

Specific Gravity Range

- 0.35 and higher (nominal 0.45)

Flanges

- Raised Face for ANSI Classes 150 to 1500

Electronics Ratings

Remote Mounted Electronics

- 2.1 m (7ft) cable included
- Ambient Temperature
 - -40°C to $+60^{\circ}\text{C}$ (-40°F to $+140^{\circ}\text{F}$)
- Relative Humidity
 - Up to 95% non-condensing

Storage Temperature

- -50°C to $+60^{\circ}\text{C}$ (-40°F to $+140^{\circ}\text{F}$)

(1) Please consult Daniel if your requirements are outside the list specifications. Improved performance, other product and material offerings may be available depending on the application.

(2) Consult factory on sizes above 900 mm (36").

Materials of Construction⁽¹⁾

Material Specifications

Body and Flange

Forgings

- ASTM A182 dual grade F316/F316L SST
-196°C to +60°C (-385°F to +140°F)

Electronic Enclosures

- ASTM A351 Gr CF8M stainless steel

Transducer Components

Transducer Housing

- Full penetration weld for pressure containment

Transducer Housing Materials

- ASTM A479 316L stainless steel with proprietary matching layer material

Insulation Package

Shroud Material

- ASTM A240 316 stainless steel

Factory Insulation

- Insulation is positioned around all transducers and meter body reducing likelihood of hot spots
- Reduces installation and start-up time in the field

Paint Specifications

Body and Flange

Stainless Steel

- Unpainted
- Consult factory for painted stainless steel specification

Electronic Enclosures

Stainless Steel

- Unpainted
- Consult factory for painted stainless steel specification

Table 1A: Body and Flange Maximum Pressure Ratings by Construction Materials - bar⁽²⁾
[Meter Sizes 200 to 900 mm]

PN	F316/F316L SST
20	19.0
50	49.6
100	99.3
150	148.9
250	248.2

Table 1B: Body and Flange Maximum Pressure Ratings by Construction Materials - psi⁽²⁾
[Meter Sizes 8" to 36"]

ANSI	F316/F316L SST
150	275
300	720
600	1440
900	2160
1500	3600

(1) Please consult Daniel if your requirements are outside the list specifications. Improved performance and other product and material offerings may be available.

(2) Pressure rating information is for -385°F (-196°C) to 140°F (60°C).

Standard Flow Ranges

Table 2A: Daniel 3818 Flow Range Table - Metric Units

Nominal Meter Size (mm)	Meter I.D. (mm)	Pipe Schedule	Fluid Velocity (m/s)			Flow Rate (m ³ /hr)		
			Min	Max	Over-Range	Min	Max	Over-Range
200	202.72	Sch 40	0.61	12.2	14.6	71	1,417	1,700
250	254.51	Sch 40	0.61	12.2	14.6	112	2,233	2,679
300	303.23	Sch 40	0.61	12.2	14.6	158	3,170	3,803
400	381.00	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	27,635	33,162

Table 2B: Daniel 3818 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
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
30	29.25	STD	2	40	48	5,984	119,680	143,617	4,189	83,776	100,531
36	35.25	STD	2	40	48	8,691	173,816	208,580	6,084	121,671	146,005

Input/Output

The Daniel 3818 LNG Ultrasonic Flow Meters provide the following I/O connections on the CPU Module. Each meter has two sets of electronics with independent transmitters—one for each set of four (4) chordal paths.

Communications Specifications		
Communication Protocols	(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"> ▪ Modbus RTU/ASCII
	(1) Ethernet Port (TCP/IP) 100 BaseT	<ul style="list-style-type: none"> ▪ Modbus TCP
Digital, Analog and Frequency Inputs		
Digital Input⁽¹⁾	(1) Single polarity (Contact closure)	<ul style="list-style-type: none"> ▪ Status
Analog Inputs⁽³⁾	(2) 4-20 mA	<ul style="list-style-type: none"> ▪ AI-1 Temperature⁽²⁾ ▪ AI-2 Pressure⁽²⁾
Digital, Analog and Frequency Outputs		
Frequency/Digital Outputs	(3) Frequency/Digital Outputs	<ul style="list-style-type: none"> ▪ User Configurable TTL/Open Collector
Analog Outputs⁽³⁾⁽⁴⁾	(2) 4-20 mA	<ul style="list-style-type: none"> ▪ Independently configurable analog outputs ▪ HART 7 Compliant, consult factory for HART 5

(1) The analog-to-digital conversion accuracy is within $\pm 0.05\%$ 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 $\pm 0.1\%$ of full scale and gain error is within $\pm 0.2\%$ of full scale. The total output drift is within ± 50 ppm of full scale per °C.

Meter Software

MeterLink™ Overview

Daniel’s 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.

This critical information will empower your staff to work predictively, instead of reactively.

- MeterLink™ software is supplied with meter at no charge
- MeterLink™ is required for transmitter configuration
- MeterLink™ software requires RS-232, RS-485 full duplex, or Ethernet (recommended)
- Supports Windows™ XP, 7 and 8, as well as Microsoft® Office® Excel® 2000 or later

Table 3: Daniel MeterLink™ Features			
Powerful Analysis	<ul style="list-style-type: none"> ▪ View, analyze and save waveforms ▪ Daily and hourly Logs alarms and audit history retrieval in Excel® or CSV files ▪ Daily and hourly log graphing ▪ Reverse flow alert display ▪ Alarms listed primary cause first ▪ Separate latched alarm display ▪ Trend maintenance logs ▪ Compare meter configurations saved in Excel® logs ▪ Calibrate analog inputs 	Intuitive Interface	<ul style="list-style-type: none"> ▪ Summarized and detailed views for meter performance information ▪ Built-in maintenance logs and inspection reports ▪ Meter directory support ▪ View multiple graphs simultaneously ▪ Automatic file naming and organized saving, supports hundreds of meters
Quick Start-up	<ul style="list-style-type: none"> ▪ Easy upgrade of meter firmware ▪ Modbus and HART configuration ▪ Zero calibration wizard ▪ Field setup wizard ▪ Flow calibration wizard and meter factor adjustment 	Versatile Connectivity	<ul style="list-style-type: none"> ▪ Ethernet ▪ Serial port ▪ Modem

The 3818 is also configurable with AMS™ Device Manager or 375 / 475 Field Communicator via HART®

Safety and Compliance


The Daniel 3818 LNG Ultrasonic Flow Meter meets the following worldwide standards for hazardous area and intrinsic safety certifications and approvals.

Safety Classifications

(UL / cUL) – Underwriters Laboratories

- Hazardous – Locations - Class I, Division 1, Groups C, D

CE Marked to Directives

- (ATEX) – Explosive Atmospheres
 - Certificate – DEMKO 11 ATEX 1006133X
 - Marking –  II 2G Ex d ia IIB T4 Gb
(-40°C ≤ T ≤ +60°C)
- (PED) – Pressure Equipment Directive
- (EMC) – Electromagnetic Compatibility
- (IECEX) – International Electrotechnical Commission
 - Certificate – IECEX UL 11.0004X
 - Marking – Ex d ia IIB T4

IMPORTANT: Please consult Daniel for a complete list of agencies and certifications.

General Arrangement Drawings⁽¹⁾

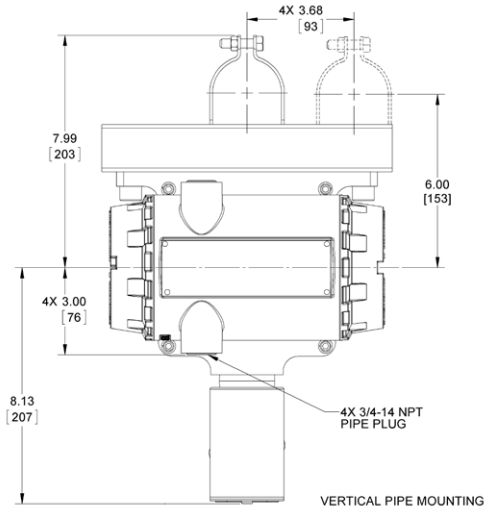


Figure 2A: Electronics Enclosure (Top)

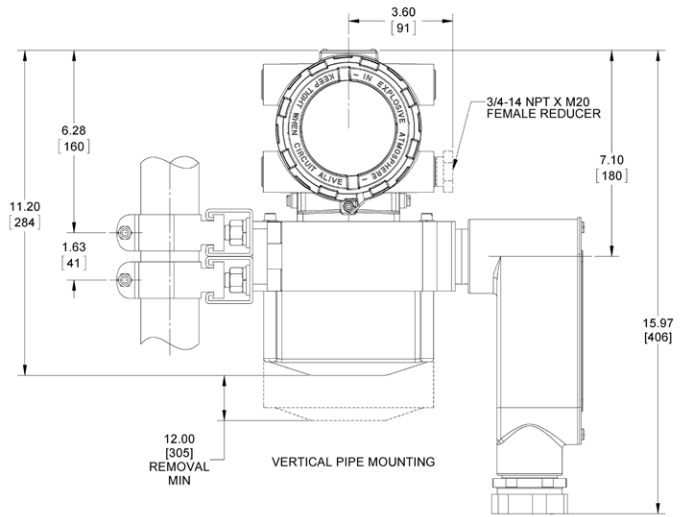


Figure 2B: Electronics Enclosure (Front)

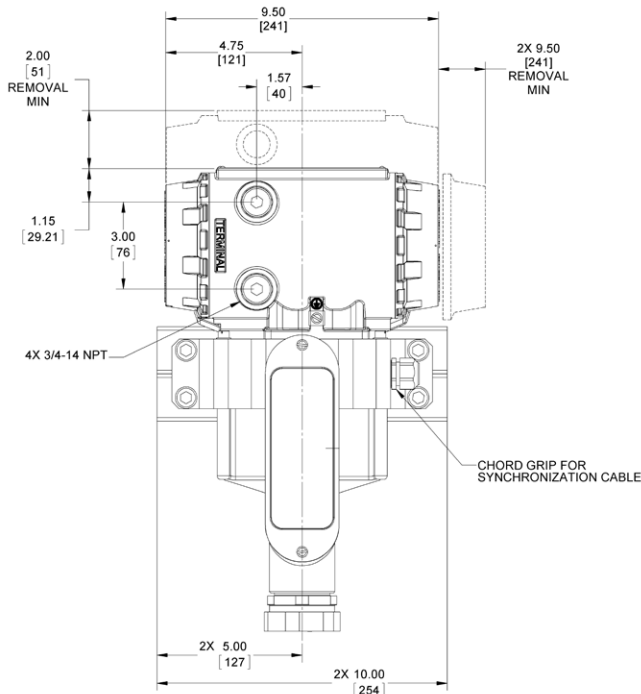


Figure 2C: Electronics Enclosure (Side)

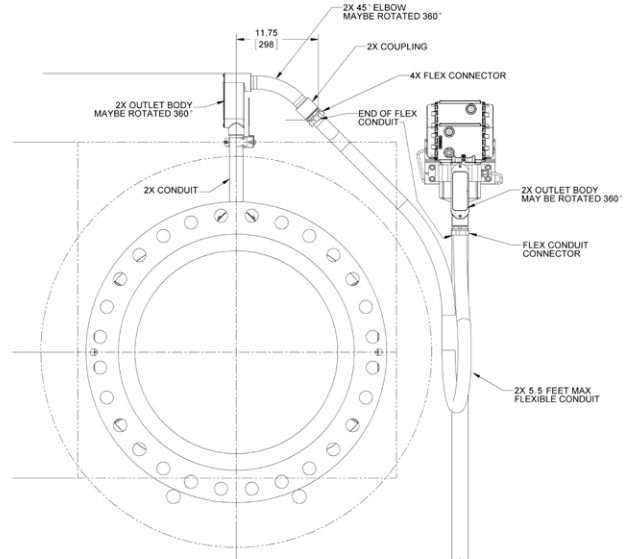


Figure 2D: Remote Mounted Electronics

(1) Consult factory for weight and dimensional data on all line sizes.

Recommended Installation for LNG Applications

Recommended Pipe Lengths

The drawings below represent recommended pipe lengths for the installation of the Daniel 3818 Liquid Ultrasonic Flow Meter. Please consult Daniel for installation recommendations of your specific application.

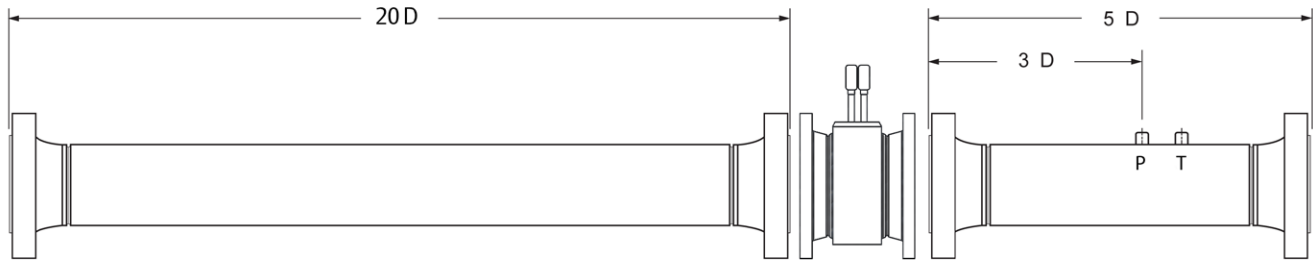


Figure 3A: Daniel Piping Recommendation for Straight Pipe (No Flow Conditioner)

Notes:

- 1. Flow conditioning is not recommended as it creates additional pressure drop and potential gas breakout*
- 2. D = Nominal pipe size in inches (i.e. 8 inch pipe size; $20D = 160$ inches)*
- 3. P = Pressure measurement location*
- 4. T = Temperature measurement location*

Emerson Process Management

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