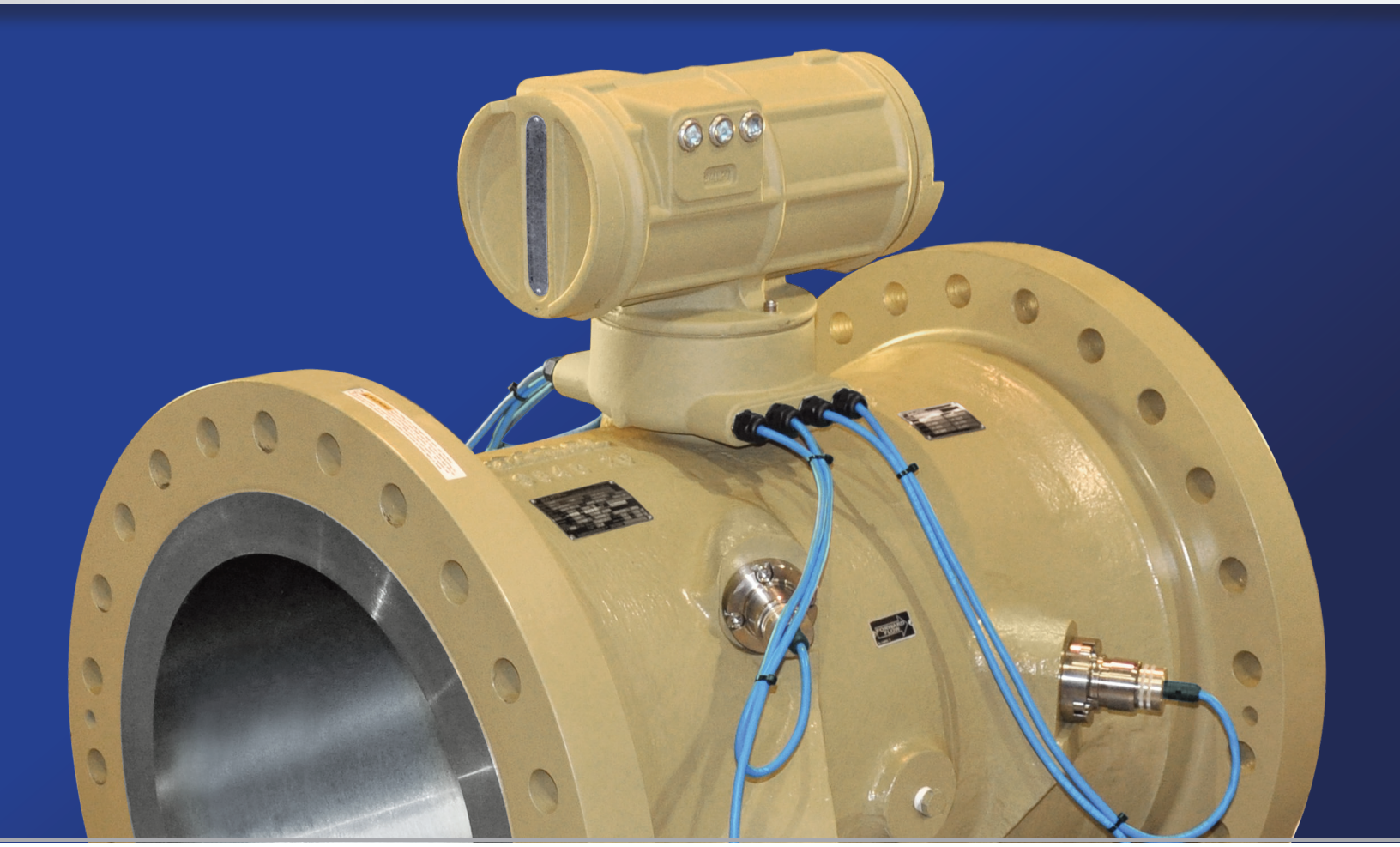
Product Datasheet
June 2014

Gas Ultrasonic Flow Meters



Daniel™ SeniorSonic™ and JuniorSonic™
Gas Flow Meters with Mark III™ Electronics

DANIEL™

EMERSON™
Process Management

Daniel SeniorSonic and JuniorSonic Gas Flow Meters with Mark III Electronics

Smart Measurement Technologies

Daniel SeniorSonic Gas Flow Meter is designed for natural gas custody transfer where high accuracy, repeatability, and long-term performance is critical. It utilizes Mark III Electronics, MeterLink™ software, and optional features for exceptional flow measurement. This advanced 4-path chordal meter helps customers reduce lost and unaccounted natural gas with exceptional accuracy and linearity throughout the flow range.

Daniel JuniorSonic Gas Flow Meter also utilizes Mark III Electronics, MeterLink software, and supports the same optional features as the SeniorSonic meter. Its bounce design was developed for accurate flow measurement of non-custody transfer applications such as production measurement, gas storage, and wet gas applications.

Both meters measure transit times of ultrasonic pulses passing through the gas. Upstream and downstream measurement times are accurately measured, and the difference is directly proportional to the velocity and volume of flowing natural gas. The SeniorSonic flow meter measures transit times on four parallel chords, while the JuniorSonic flow meter measures flow by bouncing a signal across the meter in one and two path meter designs. Each path is comprised of ultrasonic transducers that act alternately as transmitter and receiver.

Typical Applications

- Custody transfer
- Power plants
- Large industrial users
- Production
- Underground storage sites
- Offshore

SeniorSonic Gas Flow Meter

Features and Benefits

- SeniorSonic four-path chordal design allows accuracy, stability, redundancy, and operational cost savings
- JuniorSonic one-path or two-path single bounce designs provide a lower cost solution for production measurement, gas storage, and wet gas applications where fiscal measurement is not required. The two-path design provides redundancy for more critical applications
- Excellent long-term performance reduces maintenance costs
- High rangeability of >100:1 means fewer meter runs, smaller line sizes, and lower capital costs
- Integrated, smart MeterLink diagnostics extend calibration cycle and cut operation and maintenance costs
- Mark III Electronics provide fast sampling and output, an expandable electronics platform, ease-of-use, and an archive data log which enables the reading of audit, alarm, system, hourly, and daily log information
- Machined, cast body construction for the SeniorSonic meter is virtually insensitive to measurement uncertainty caused by changes in pressure
- Extractable transducers for ease of inspection
- The addition of the Series 100 Plus Board provides a direct input of pressure, temperature, and gas composition into the meter which enables the meter to act as a redundant flow computer; it calculates corrected volume rates, mass rates, energy rates, and AGA 10 speed of sound*
- The Series 100 Plus Board allows the meter to communicate directly with a digital plant architecture via the HART® protocol, such as PlantWeb®, or a 375 / 475 Field Communicator

***Optional (requires Continuous Flow Analysis feature firmware CFA Key)**

SPECIFICATIONS

Standard performance parameters and materials of construction. Should the required performance parameters or material of construction for your application fall outside of the specifications listed below, please consult with Daniel.

SeniorSonic Meter Performance

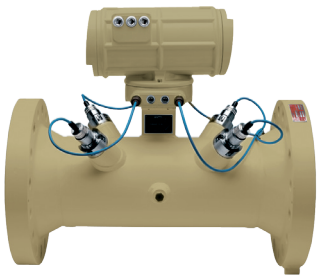
- Four-Path (eight transducer) chordal design
- Flow calibrated accuracy is ±0.1% of reading relative to lab over entire flow calibration range (Q_{min}-Q_{max})
- Accuracy is ±0.3%, including lab uncertainty
- Repeatability is ±0.05% of reading for 5 to 100 fps
- Velocity rated up to 100 fps (30 m/s) with over-range performance exceeding 125 fps (38 m/s) on some sizes
- Meter meets or exceeds AGA 9 (2007) performance specifications

	4" to 24"	30"	36"
q_{min}(ft/s)	2	2	2
q_t (ft/s)	10	8.5	7.5
q_{max} (ft/s)	100	85	75

JuniorSonic Meter Performance

- One or Two-Path bounce design
- Flow calibrated accuracy is ±0.5% of reading relative to lab*
- Accuracy is typically ±1.5% of actual volume flow* (without Flow Calibration)
- Repeatability is ±0.1% of reading for 5 to 100 fps
- Velocity rated up to 100 fps (30 m/s)

*** Does not take into consideration changes in wall roughness and installation effects**



JuniorSonic Gas Flow Meter

Mechanical Ratings

- **Line sizes:** 4" to 42" available
  - 4" and 6" are 45° dual X orientation
  - 8" and larger are 60° BG orientation
- **Operating gas temperature:** -4 to +212°F (-20 to +100°C)
- **Operating pressure range:** 100 to 4000 psig (689 to 27,579 kPa)*
  - SeniorSonic: 100 to 4000 psig (689 to 27,579 kPa)*
  - (50 psig (345 kPa) available with reduced Q_{max})**
  - JuniorSonic: 150 to 4000 psig (1034 to 27,579 kPa)
- **Flanges:** Raised face and Ring Joint Flange Type for 300 to 2500 ANSI Classes

Electronics Ratings

- **Operating temperature:** -40 to +149°F (-40 to +65°C)
- **Operating relative humidity:** up to 95% non-condensing
- **Storage temperature:** -40 to +185°F (-40 to +85°C) with a low temperature storage limit of -20°C for transducers

Electronics Performance

- **Power:** 10.4 VDC – 36 VDC
  - 8 watts typical
  - 15 watts maximum
- **Communication protocol:** Modbus RTU/ASCII, TCP/IP (API) and Modbus TCP
- **Calculation update time:** Configurable for ¼ of a second and 1 second
- **Calibration method:** Piecewise linearization (meter factor per datapoint)

*** See Tables 1A and 1B; Consult factory for lower and higher pressure applications**
**** See Tables 2A and 2B**

SeniorSonic Materials of Construction

Please consult the factory for other material offerings.

- **Body and flange material - Cast**
  - ASTM A352 Gr LCC Carbon Steel (standard)
  - ASTM A351 Gr CF8M 316 Stainless Steel (optional)
  - ASTM A351 Gr CF3M 316L Stainless Steel (optional)
  - ASTM A995 Gr 4A Duplex Stainless Steel (optional)
- **Body and flange material - Forged**
  - ASTM A105 (standard)
  - ASTM A182 Gr F316 (optional)
  - ASTM A182 Gr F316L (optional)
  - ASTM A182 Gr F51 Duplex (optional)
- **Transducer holder:**
  - 316L SS
  - INCONEL ASTM B446 (UNS N06625) Gr. 1 (optional)
- **Transducer mount:**
  - A564 Grade 630 SS
  - 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
- **Transducer cable gland material:**
  - Chloroprene/Nitrile Rubber
- **Electronic housing material:**
  - ASTM B26 grade A356.0 T6 Aluminum

Paint Specifications

- **Meter body paint specification:**
  - Carbon Steel body material:
    - 2 Coat Paint – Inorganic Zinc Primer and Acrylic Lacquer Top Coat (Standard)
    - 3 Coat Epoxy – Inorganic Zinc Primer, Epoxy Midcoat, and Polyurethane Top Coat (optional)
- **Stainless steel or duplex body material:** Unpainted
- **Electronic housing:** Powder Coat

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

Meter Size (in)**	ANSI CLASS	Maximum Pressure Rating - psi*				
		CAST CARBON STEEL	FORGED CARBON STEEL	CAST 316 SS, 316L SS, FORGED 316 SS	FORGED 316L SS	DUPLEX STAINLESS STEEL
4 to 42	300	740	740	720	600	740
	600	1,480	1,480	1,440	1,200	1,480
	900	2,220	2,220	2,160	1,800	2,220
	1500	3,705	3,705	3,600	3,000	3,705
	2500	6,170	6,170	6,000	5,000	6,170

*** Pressure rating information is for -20°F to 100°F. Other temperatures may reduce the maximum pressure rating of the materials.**
**** Cast Body Flange Designs: 300 ANSI (4-24 inch), 600 ANSI (4-24 inch), 900 ANSI (4-20 inch), 1500 ANSI (4-18 inch), 2500 ANSI (6 & 10 inch). All others Forged Body Flange Design**

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

Meter Size (DN)**	ANSI CLASS	Maximum Pressure Rating - bar*				
		CAST CARBON STEEL	FORGED CARBON STEEL	CAST 316 SS, 316L SS, FORGED 316 SS	FORGED 316L SS	DUPLEX STAINLESS STEEL
100 to 1050	300	51.1	51.1	49.6	41.4	51.1
	600	102.1	102.1	99.3	82.7	102.1
	900	153.2	153.2	148.9	124.1	153.2
	1500	255.3	255.3	248.2	206.8	255.3
	2500	425.5	425.5	413.7	344.7	425.5

*** Pressure rating information is for -29°C to 38°C. Other temperatures may reduce the maximum pressure rating of the materials.**
**** Cast Body Flange Designs: 300 ANSI (100-600 DN), 600 ANSI (100-600 DN), 900 ANSI (100-500 DN), 1500 ANSI (100-450 DN), 2500 ANSI (150 & 250 DN) All others Forged Body Flange Design**

Table 2A: SeniorSonic Recommended Maximum Velocity				
Nominal Meter Size	Maximum Velocity Rating between 50 and 100 psig (ft/s)	Capacity between 50 and 100 psig (ACFH)*	Maximum Velocity Rating between 100 and 4000 psig	Capacity at Max Rated Velocity (ACFH)*
4	50	15,913	100	31,826
6	50	36,113	100	72,226
8	50	62,534	100	125,068
10	50	98,568	100	197,136
12	50	141,372	100	282,743
16	50	228,318	100	456,635
18	50	292,131	100	584,263
20	50	363,799	100	727,598
24	50	530,696	100	1,061,392
30	45	755,952	85	1,427,909
36	40	975,906	75	1,829,824

*** Capacities are for schedule 40 (or STD Schedule)**

Table 2B: SeniorSonic Recommended Maximum Velocity				
Nominal Meter Size	Maximum Velocity Rating between 345 and 689 kPa (m/s)	Capacity between 345 and 689 kPa (ACMH)*	Maximum Velocity Rating between 689 and 27,579 kPa (m/s)	Capacity at Max Rated Velocity (ACMH)*
100	15.2	450	30.5	901
150	15.2	1,022	30.5	2,045
200	15.2	1,770	30.5	3,541
250	15.2	2,791	30.5	5,582
300	15.2	4,003	30.5	8,006
400	15.2	6,465	30.5	12,930
450	15.2	8,272	30.5	16,544
500	15.2	10,301	30.5	20,603
600	15.2	15,027	30.5	30,055
750	13.7	21,406	25.9	40,433
900	12.2	27,634	22.9	51,814

*** Capacities are for schedule 40 (or STD Schedule)**

Figure 1A: SeniorSonic CO_2 Limit by Line Size and Pressure

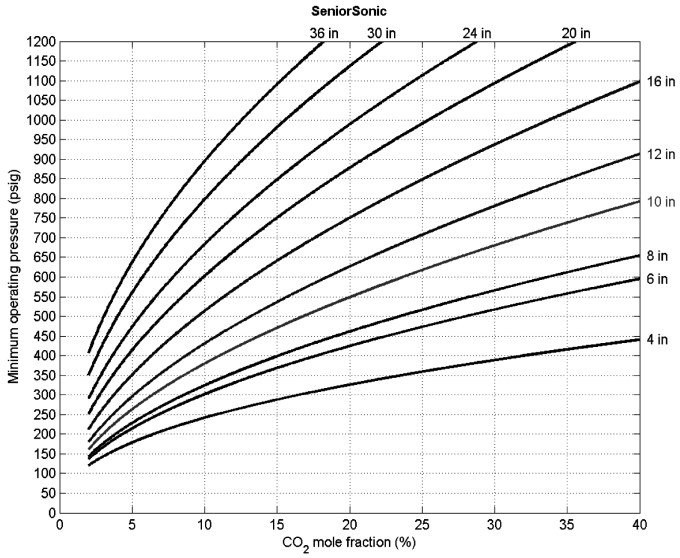
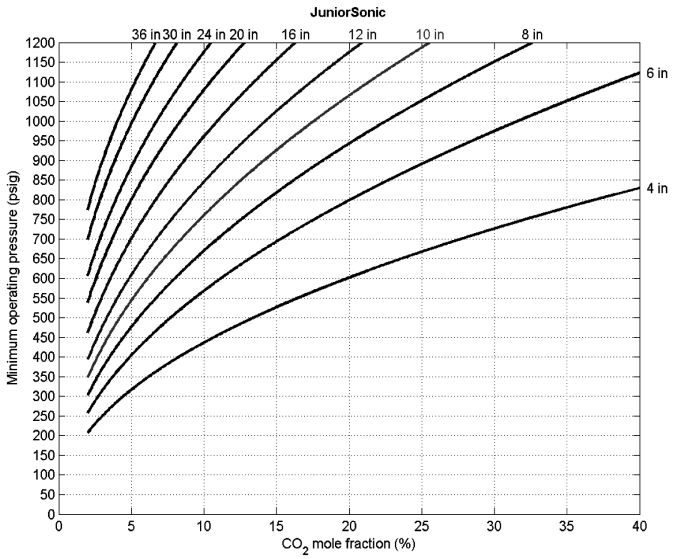


Figure 1B: JuniorSonic CO_2 Limit by Line Size and Pressure



Input/Output

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

Port	Supports	Modbus	Optional
A	RS-232 and RS-485 full and half duplex	Slave	
B	RS-232 and RS-485 full and half duplex	Slave	
C	RS-232 and RS-485 half duplex	Master	•

  - 1.2 to 115 kbps Baud Rate
  - Modbus RTU/ASCII
- **When Beldon wire No. 9940 or equivalent is used:**
  - Max. cable length is 250 ft. (88.3 m) at 9600 bps with RS-232 communications
  - Max. cable length is 1970 ft. (600 m) at 57600 bps with RS-485 communications
- **Two isolated frequency 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
  - Include Level B security
- **Two 4-20 mA outputs for volumetric flow rate****
  - One conventional 4-20 mA (optional)
  - One 4-20 mA with HART (optional)
  - Internally powered and magnetically isolated to 500V
- **Two 4-20 mA analog inputs (16 bit) for pressure and temperature (optional)**
- **One digital input**
- **Four digital outputs**
  - Individually configurable for data validity or flow direction
  - Individually configurable for open collector or TTL

*** Ethernet port interface for MeterLink diagnostics (API protocol) and Modbus/TCP**
**** Frequency, analog and serial outputs are independent of each other.**

Operation / Configuration Software - MeterLink

- Windows®-based MeterLink software is supplied with meter at no charge
- MeterLink is required for transmitter configuration
- Optional Firmware Key required to unlock Continuous Flow Analysis (CFA) features
- 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

MeterLink Features		Without Continuous Flow Analysis Feature	With Continuous Flow Analysis Feature
Operation	Mark II Gas Ultrasonic Meter Support		
	Monitor Screen	●	●
	Chart Diagnostic Data	●	●
	Multiple Charts	●	●
	Charts with Green Limit Bands	●	●
	View Waveforms	●	●
	AGA 10 Calculator	●	●
	SNR displayed in dB	●	●
	Improved Help Topics / Links	●	●
	Baseline Viewer™		●
	Maintenance Logs	●	●
History	Trend Maintenance Logs	●	●
	Hourly / Daily Log Graphing	●	●
Configuration	Field Setup Wizard	●	●
	Meter Directory Support	●	●
	Automatic File Naming	●	●
	Compare Configurations from Logs	●	●
	Analog Input Calibration	●	●
	Flow Calibration Wizard	●	●
	Modbus TCP Server Configuration	●	●
	Baseline Configuration Wizard	●	●
Alarms	Alarm/Audit Logs	●	●
	Display New Latched Alarms	●	●
	Severity Alarm Display		●
	Bore Build-up Alert		●
	Blockage Alert		●
	Abnormal Profile Alert		●
	Liquid Detection Alert		●
	SOS Deviation Alert		●
	Reverse Flow Detection Alert	●	●

Series 100 Plus Option Board

- Two 16 bit, 4-20 mA full differential analog inputs for pressure and temperature
- One 16 bit, 4-20 mA analog output for volume, energy and mass flow rate, velocity and SOS
- One Serial RS-232/485 Port for live Gas Composition from the Danalyze™ Gas Chromatograph
- Obtains power from the main CPU
- Transmitters can be source powered from the board or can be externally loop powered
- One 16 bit, 4-20mA HART® analog output for volume, energy and mass flow rate, velocity, or SOS

Safety Classifications

- UL/c-UL Class 1, Division 1, Group D
  UL file - E152246
- CE marked to directives:
  - 94/9/EC - Explosive Atmospheres (ATEX)
    - Certificate - Baseefa 04ATEX0081
    - Marking - Ex II 2 G EEx d ia IIB T4
      (T_{amb} = -40°C to + 65°C)
  - IECEx BAS 08.0004
  - 97/23/EC - Pressure Equipment Directive (PED)
  - 2004/108/EC - Electromagnetic Compatibility (EMC)

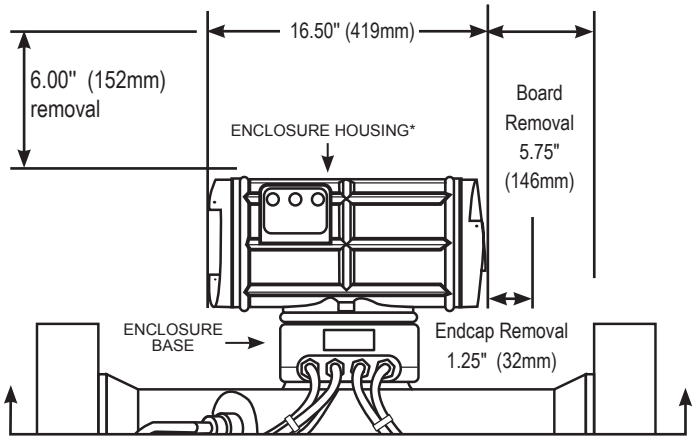
Metrology Approvals*

- NMi MID T10078
- Physikalisch-Technische Bundesanstalt No. 1.33-7.241-DAN 96.02
- Measurement Canada No. AG-0473;
- Russian Federation for Standardization, Metrology and Certification No. 13619-93
- InMetro Approval Certificate No. 233
- GOST No. PPC BA-13879
- Russian Pattern Approval Certificate No. 19334, 19335

*** Please consult Daniel for other metrology approvals.**

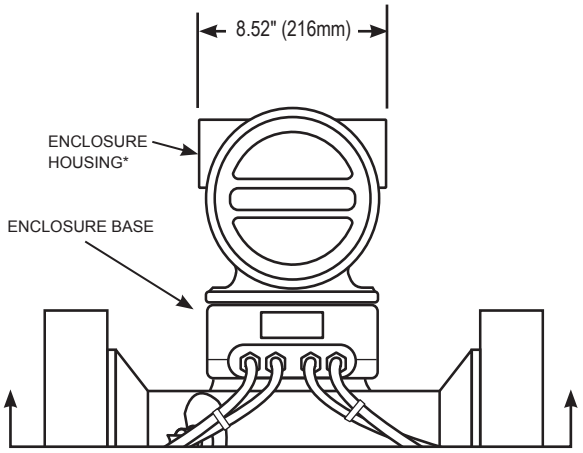
Weights and Dimensions

Figure 2A



***Enclosure Housing may be rotated 360 degrees in 90 degree increments**

Figure 2B
Optional field installed position of enclosure housing



***Enclosure Housing may be rotated 360 degrees in 90 degree increments**

Figure 2C

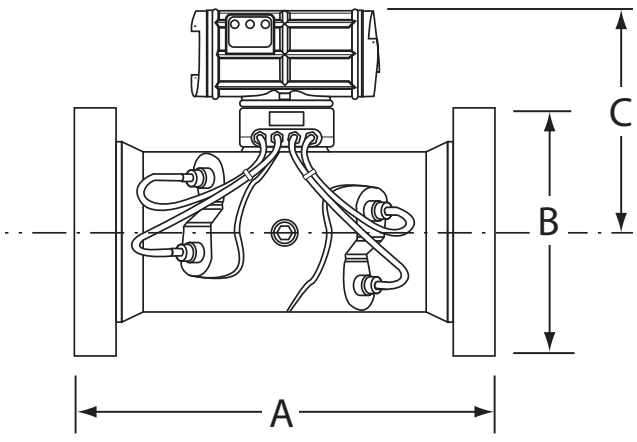


Table 5A: SeniorSonic Weight and Dimensional Data - English Units

	Nominal Line Size (in)	4	6	8	10	12	16	18	20	24	30	36
	Transducer Angle	45	45	60	60	60	60	60	60	60	60	60
300 ANSI	A (in)	29.00	29.50	21.50	24.50	26.00	30.00	31.50	35.50	39.00	44.75	51.25
	B (in)	10.00	12.50	15.00	17.50	20.50	25.50	28.00	30.50	36.00	43.00	50.00
	C (in)	16.07	16.94	17.94	19.19	20.13	21.81	22.69	23.81	26.07	30.44	32.81
	Weight (lb)	420	460	468	628	778	1,326	1,897	2,054	3,168	4,250	5,350
600 ANSI	A (in)	29.00	29.50	21.50	24.50	26.00	30.00	31.50	35.50	39.00	48.25	55.00
	B (in)	10.00	14.00	16.50	20.00	22.00	27.00	29.25	32.00	37.00	44.50	51.75
	C (in)	16.07	16.94	17.94	19.19	20.13	21.81	22.69	23.81	26.07	30.44	32.81
	Weight (lb)	435	460	550	800	950	1,750	2,067	2,650	4,000	5,500	8,300
900 ANSI	A (in)	31.00	37.00	27.50	30.50	34.50	41.50	36.00	37.00	59.00	58.00	60.75
	B (in)	11.50	15.00	18.50	21.50	24.00	27.75	31.00	33.75	41.00	48.50	57.50
	C (in)	16.07	17.19	18.44	19.44	20.94	22.69	23.31	25.07	27.31	30.69	33.75
	Weight (lb)	453	640	1,040	2,018	2,700	3,350	3,201	3,700	7,656	8,278	12,005
1500 ANSI	A (in)	31.00	37.00	27.50	30.50	34.50	41.50	CALL	60.00	68.00	Call	Call
	B (in)	12.25	15.50	19.00	23.00	26.50	32.50	CALL	38.75	46.00	Call	Call
	C (in)	16.07	17.19	18.44	19.44	20.94	22.69	CALL	25.07	27.31	Call	Call
	Weight (lb)	473	710	1,080	2,390	3,300	5,292	CALL	8,050	10,400	Call	Call

Table 5B: SeniorSonic Weight and Dimensional Data - Metric Units

	Nominal Line Size (DN)	100	150	200	250	300	400	450	500	600	750	900
	Transducer Angle	45	45	60	60	60	60	60	60	60	60	60
300 ANSI	A (mm)	737	749	546	622	660	762	800	902	991	1,137	1,302
	B (mm)	254	317	381	444	521	648	711	775	914	1,092	1,270
	C (mm)	408	430	456	487	511	554	576	605	662	773	833
	Weight (kg)	191	209	212	285	353	601	860	932	1,437	1,928	2,427
600 ANSI	A (mm)	737	749	546	622	660	762	800	902	991	1,226	1,397
	B (mm)	254	356	419	508	559	686	743	813	940	1,130	1,314
	C (mm)	408	430	456	487	511	554	576	605	662	773	833
	Weight (kg)	197	209	249	363	431	794	938	1,202	1,814	2,495	3,765
900 ANSI	A (mm)	787	940	698	775	876	1,054	914	940	1,499	1,473	1,543
	B (mm)	292	381	470	546	610	705	787	857	1,041	1,232	1,460
	C (mm)	408	437	468	494	532	576	592	637	694	780	857
	Weight (kg)	205	290	472	915	1,225	1,520	1,452	1,678	3,473	3,755	5,445
1500 ANSI	A (mm)	787	940	698	775	876	1,054	CALL	1,524	1,727	Call	Call
	B (mm)	311	394	483	584	673	825	CALL	984	1,168	Call	Call
	C (mm)	408	437	468	494	532	576	CALL	637	694	Call	Call
	Weight (kg)	215	322	490	1,084	1,497	2,400	CALL	3,651	4,717	Call	Call

Table 6A: JuniorSonic Weight and Dimensional Data - English Units												
	Nominal Line Size (in)	**4**	**6**	**8**	**10**	**12**	**16**	**18**	**20**	**24**	**30**	**36**
	Transducer Angle	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**
300 ANSI	**A (in)**	19.75	29.50	31.50	34.00	35.44	44.00	CALL	47.89	55.36	63.50	69.75
	B (in)	10.00	12.50	15.00	17.50	20.50	25.50	CALL	30.50	36.00	43.00	50.00
	C (in)	10.75	14.00	16.50	20.00	22.00	27.00	CALL	32.00	37.00	44.50	51.75
	Weight (lb)	214	284	398	490	654	905	CALL	1879	2132	4096	5540
600 ANSI	**A (in)**	18.75	29.50	31.50	34.00	35.44	44.00	CALL	50.62	58.62	67.00	73.50
	B (in)	10.75	14.00	16.50	20.00	22.00	27.00	CALL	32.00	37.00	44.50	51.75
	C (in)	20.81	20.00	20.94	22.07	23.07	24.69	CALL	26.69	28.69	31.69	34.69
	Weight (lb)	238	340	482	670	822	1,375	CALL	2,443	3,036	4,835	6,335
900 ANSI	**A (in)**	20.00	37.00	41.00	40.00	47.00	44.00	CALL	64.00	72.50	CALL	CALL
	B (in)	11.50	15.00	18.50	21.50	24.00	27.25	CALL	33.75	41.00	CALL	CALL
	C (in)	20.81	20.00	20.94	22.07	23.07	24.69	CALL	26.69	40.69	CALL	CALL
	Weight (lb)	250	310	658	740	1,170	1,580	CALL	3,100	4,500	CALL	CALL
1500 ANSI	**A (in)**	20.00	37.00	41.00	40.00	47.00	64.00	CALL	CALL	CALL	CALL	CALL
	B (in)	12.25	15.50	19.00	23.00	26.50	32.50	CALL	CALL	CALL	CALL	CALL
	C (in)	20.81	20.00	20.94	22.07	23.07	24.69	CALL	CALL	CALL	CALL	CALL
	Weight (lb)	312	410	825	1,120	1,740	3,440	CALL	CALL	CALL	CALL	CALL

Table 6B: JuniorSonic Weight and Dimensional Data - Metric Units												
	Nominal Line Size (DN)	**100**	**150**	**200**	**250**	**300**	**400**	**450**	**500**	**600**	**750**	**900**
	Transducer Angle	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**	**60**
300 ANSI	**A (mm)**	502	749	800	864	900	1,118	CALL	1,216	1,406	1,613	1,772
	B (mm)	254	318	381	445	521	648	CALL	775	914	1,092	1,270
	C (mm)	273	356	419	508	559	686	CALL	813	940	1,130	1,314
	Weight (kg)	97	129	181	222	297	411	CALL	852	967	1,858	2,513
600 ANSI	**A (mm)**	476	749	800	864	900	1,118	CALL	1,286	1,489	1,702	1,867
	B (mm)	273	356	419	508	559	686	CALL	813	940	1,130	1,314
	C (mm)	529	508	532	561	586	627	CALL	678	729	805	881
	Weight (kg)	108	154	219	304	373	624	CALL	1,108	1,377	2,193	2,874
900 ANSI	**A (mm)**	508	940	1,041	1,016	1,194	1,118	CALL	1,626	1,842	CALL	CALL
	B (mm)	292	381	470	546	610	692	CALL	857	1,041	CALL	CALL
	C (mm)	529	508	532	561	586	627	CALL	678	1,034	CALL	CALL
	Weight (kg)	113	141	298	336	531	717	CALL	1,406	2,041	CALL	CALL
1500 ANSI	**A (mm)**	508	940	1,041	1,016	1,194	1,626	CALL	CALL	CALL	CALL	CALL
	B (mm)	311	394	483	584	673	826	CALL	CALL	CALL	CALL	CALL
	C (mm)	529	508	532	561	586	627	CALL	CALL	CALL	CALL	CALL
	Weight (kg)	142	186	374	508	789	1,560	CALL	CALL	CALL	CALL	CALL

Selection of Meter Size

English Units

These tables can be used to determine the flow range at reference conditions for all meter sizes. All calculations are based on Schedule 40 bore, 60°F and typical gas composition. These values are intended to be a guide in sizing. Contact Daniel engineering for assistance with specific applications.

Table 7A: Flow Rates (MSCFH) - Based Upon Max Rated Velocity 4" through 24" = 100 ft/s; 30" = 85 ft/s; 36" = 75 ft/s

PSIG	4	6	8	10	12	16	18	20	24	30	36
100	252	571	989	1559	2213	3494	4423	5495	7948	10910	13862
200	478	1086	1880	2963	4207	6641	8406	10446	15108	20738	26349
300	712	1616	2799	4412	6263	9888	12515	15552	22493	30875	39229
400	954	2164	3747	5906	8384	13236	16754	20819	30111	41331	52515
500	1202	2729	4725	7448	10572	16690	21126	26251	37968	52117	66219
600	1459	3311	5733	9037	12828	20252	25635	31854	46071	63239	80350
700	1723	3911	6772	10675	15153	23923	30281	37627	54422	74701	94914
800	1996	4529	7842	12362	17547	27703	35065	43572	63020	86504	109910
900	2276	5165	8943	14096	20009	31590	39986	49686	71863	98642	125333
1000	2563	5817	10073	15877	22537	35581	45038	55964	80943	111105	141169
1100	2858	6486	11231	17702	25128	39671	50214	62396	90246	123875	157394
1200	3159	7169	12414	19567	27774	43850	55504	68969	99752	136923	173973
1300	3466	7865	13619	21467	30471	48107	60893	75665	109437	150217	190865
1400	3777	8571	14842	23395	33208	52428	66362	82462	119267	163711	208009
1500	4092	9285	16079	25344	35975	56797	71892	89333	129205	177352	225341
1600	4408	10004	17323	27306	38760	61193	77456	96247	139205	191079	242782
1700	4725	10724	18570	29270	41548	65595	83029	103172	149221	204826	260250
1800	5041	11441	19811	31227	44326	69981	88580	110069	159197	218520	277649
1900	5354	12151	21041	33166	47079	74327	94081	116905	169083	232090	294891
2000	5663	12852	22255	35079	49793	78612	99505	123645	178832	245472	311894

Table 7B: Flow Rates (MMSCFD) - Based Upon Max Rated Velocity 4" through 24" = 100 ft/s; 30" = 85 ft/s; 36" = 75 ft/s

PSIG	4	6	8	10	12	16	18	20	24	30	36
100	6.0	13.7	23.7	37.4	53.1	83.9	106.1	131.9	190.8	261.8	332.7
200	11.5	26.1	45.1	71.1	101.0	159.4	201.8	250.7	362.6	497.7	632.4
300	17.1	38.8	67.2	105.9	150.3	237.3	300.4	373.2	539.8	741.0	941.5
400	22.9	51.9	89.9	141.8	201.2	317.7	402.1	499.6	722.7	991.9	1260.4
500	28.9	65.5	113.4	178.7	253.7	400.6	507.0	630.0	911.2	1250.8	1589.3
600	35.0	79.5	137.6	216.9	307.9	486.1	615.2	764.5	1105.7	1517.7	1928.4
700	41.4	93.9	162.5	256.2	363.7	574.2	726.7	903.1	1306.1	1792.8	2277.9
800	47.9	108.7	188.2	296.7	421.1	664.9	841.6	1045.7	1512.5	2076.1	2637.8
900	54.6	123.9	214.6	338.3	480.2	758.2	959.7	1192.5	1724.7	2367.4	3008.0
1000	61.5	139.6	241.7	381.1	540.9	854.0	1080.9	1343.1	1942.6	2666.5	3388.1
1100	68.6	155.7	269.5	424.8	603.1	952.1	1205.1	1497.5	2165.9	2973.0	3777.5
1200	75.8	172.1	297.9	469.6	666.6	1052.4	1332.1	1655.3	2394.0	3286.2	4175.4
1300	83.2	188.8	326.9	515.2	731.3	1154.6	1461.4	1816.0	2626.5	3605.2	4580.7
1400	90.6	205.7	356.2	561.5	797.0	1258.3	1592.7	1979.1	2862.4	3929.1	4992.2
1500	98.2	222.9	385.9	608.3	863.4	1363.1	1725.4	2144.0	3100.9	4256.4	5408.2
1600	105.8	240.1	415.8	655.3	930.2	1468.6	1858.9	2309.9	3340.9	4585.9	5826.8
1700	113.4	257.4	445.7	702.5	997.2	1574.3	1992.7	2476.1	3581.3	4915.8	6246.0
1800	121.0	274.6	475.5	749.5	1063.8	1679.5	2125.9	2641.7	3820.7	5244.5	6663.6
1900	128.5	291.6	505.0	796.0	1129.9	1783.8	2257.9	2805.7	4058.0	5570.2	7077.4
2000	135.9	308.4	534.1	841.9	1195.0	1886.7	2388.1	2967.5	4292.0	5891.3	7485.5

Calculating Meter Capacity

To calculate a volume rate for a given velocity, first find the capacity in this table for the meter size and operating pressure. Next, multiply the capacity by the ratio of the desired velocity divided by 100 ft/s to obtain the desired volume rate.

Example: Determine the hourly flow rate at 70 ft/s for an 8-inch meter operating at 800 psig.

Flow Rate = 7635 MSCFH **Velocity** = 70 ft/s **Answer** = $\frac{7635 \text{ MSCFH} \times 70 \text{ ft/s}}{100 \text{ ft/s}}$ = 5344 MSCFH

Metric Units

These tables can be used to determine the flow range at reference conditions for all meter sizes. All calculations are based on Schedule 40 bore, 15°C and typical gas composition. These values are intended to be a guide in sizing. Contact Daniel engineering for assistance with specific applications.

Table 8A: Flow Rates (MSCMH) Based Upon Max Rated Velocity 4" through 24" = 30.5 m/s; 30" = 25.9m/s; 36" = 22.9 m/s

kPag	4	6	8	10	12	16	18	20	24	30	36
1000	10	23	39	62	88	139	175	218	315	432	550
1500	15	33	58	91	129	204	258	320	463	635	809
2000	19	44	77	121	171	270	342	425	615	843	1074
2500	24	55	96	151	214	339	429	533	770	1056	1345
3000	29	67	116	182	259	408	517	642	929	1274	1622
3500	35	78	136	214	304	480	607	754	1091	1496	1905
4000	40	90	156	247	350	553	700	869	1257	1724	2195
4500	45	103	178	280	397	627	794	987	1427	1957	2491
5000	51	115	199	314	446	704	891	1107	1600	2195	2794
5500	56	128	221	349	495	781	989	1229	1778	2438	3104
6000	62	141	244	384	545	861	1090	1354	1959	2686	3420
6500	68	154	267	420	597	942	1193	1482	2143	2939	3742
7000	74	168	290	457	649	1025	1297	1612	2331	3197	4071
7500	80	181	314	495	702	1109	1404	1744	2523	3460	4405
8000	86	195	338	533	757	1195	1512	1879	2718	3727	4745
8500	92	209	363	572	812	1281	1622	2015	2915	3997	5090
9000	99	224	388	611	867	1369	1733	2154	3115	4272	5439
9500	105	238	413	651	924	1458	1846	2294	3318	4550	5793
10000	112	253	438	691	981	1548	1960	2435	3522	4830	6149

Table 8B: Flow Rates (MMSCMD) Based Upon Max Rated Velocity 4" through 24" = 30.5 m/s; 30" = 25.9m/s; 36" = 22.9 m/s

kPag	4	6	8	10	12	16	18	20	24	30	36
1000	0.240	0.544	0.941	1.484	2.106	3.325	4.208	5.229	7.563	10.372	13.205
1500	0.352	0.799	1.384	2.182	3.097	4.889	6.188	7.690	11.122	15.251	19.418
2000	0.467	1.061	1.837	2.895	4.110	6.489	8.213	10.206	14.761	20.242	25.773
2500	0.585	1.328	2.300	3.626	5.147	8.126	10.285	12.780	18.485	25.348	32.273
3000	0.706	1.602	2.774	4.373	6.207	9.800	12.404	15.414	22.293	30.571	38.923
3500	0.829	1.882	3.259	5.137	7.292	11.512	14.572	18.107	26.189	35.914	45.725
4000	0.956	2.168	3.755	5.919	8.401	13.264	16.789	20.862	30.174	41.378	52.682
4500	1.085	2.461	4.262	6.718	9.536	15.055	19.056	23.679	34.248	46.964	59.795
5000	1.216	2.760	4.780	7.535	10.695	16.885	21.373	26.558	38.412	52.674	67.065
5500	1.351	3.066	5.309	8.369	11.880	18.755	23.740	29.499	42.665	58.508	74.492
6000	1.489	3.378	5.850	9.221	13.089	20.664	26.156	32.502	47.009	64.463	82.075
6500	1.629	3.697	6.401	10.090	14.322	22.612	28.621	35.565	51.439	70.538	89.810
7000	1.772	4.021	6.963	10.975	15.579	24.596	31.133	38.686	55.953	76.729	97.692
7500	1.917	4.351	7.535	11.877	16.859	26.616	33.690	41.863	60.549	83.031	105.716
8000	2.065	4.687	8.116	12.793	18.160	28.670	36.290	45.094	65.221	89.438	113.873
8500	2.215	5.028	8.706	13.723	19.480	30.754	38.928	48.372	69.962	95.940	122.151
9000	2.368	5.373	9.304	14.666	20.818	32.866	41.601	51.694	74.766	102.528	130.539
9500	2.521	5.722	9.909	15.619	22.170	35.002	44.304	55.053	79.625	109.190	139.021
10000	2.677	6.075	10.519	16.580	23.535	37.157	47.032	58.442	84.527	115.913	147.581

Calculating Meter Capacity

To calculate a volume rate for a given velocity, first find the capacity in this table for the meter size and operating pressure. Next, multiply the capacity by the ratio of the desired velocity divided by 30 m/s to obtain the desired volume rate.

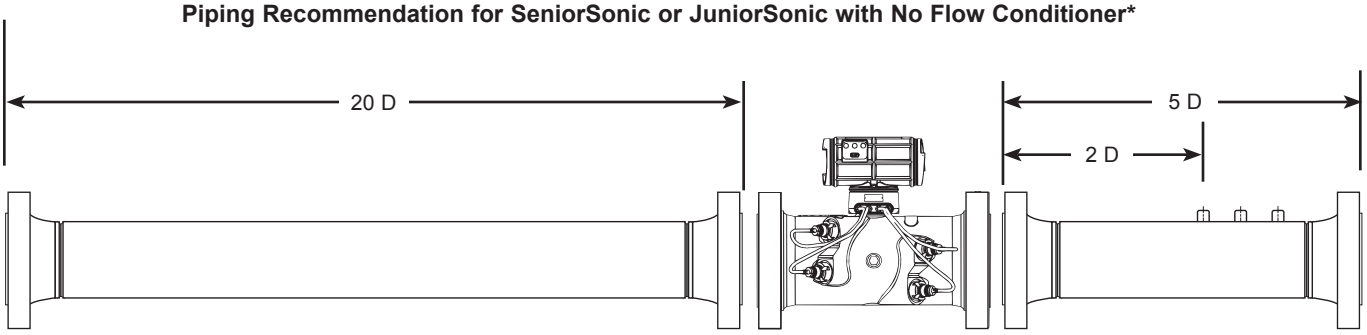
Example: Determine the hourly flow rate at 21 m/s for an 8 inch meter operating at 4500 kPag.

Flow Rate = 171.6 MSCMH **Velocity** = 21 m/s **Answer** = $\frac{171.6 \text{ MSCMH} \times 21 \text{ m/s}}{30 \text{ m/s}}$ = 120.12 MSCMH

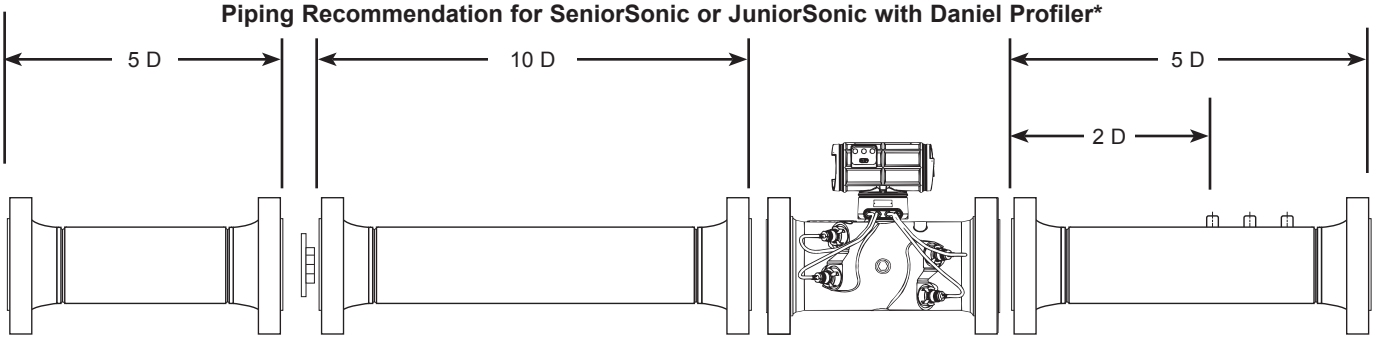
Recommended Installation

The drawings below represent recommended piping lengths with or without Daniel® Profiler flow conditioners when installed with Daniel SeniorSonic flow meter. Other lengths or flow conditioners can be accommodated - consult factory.

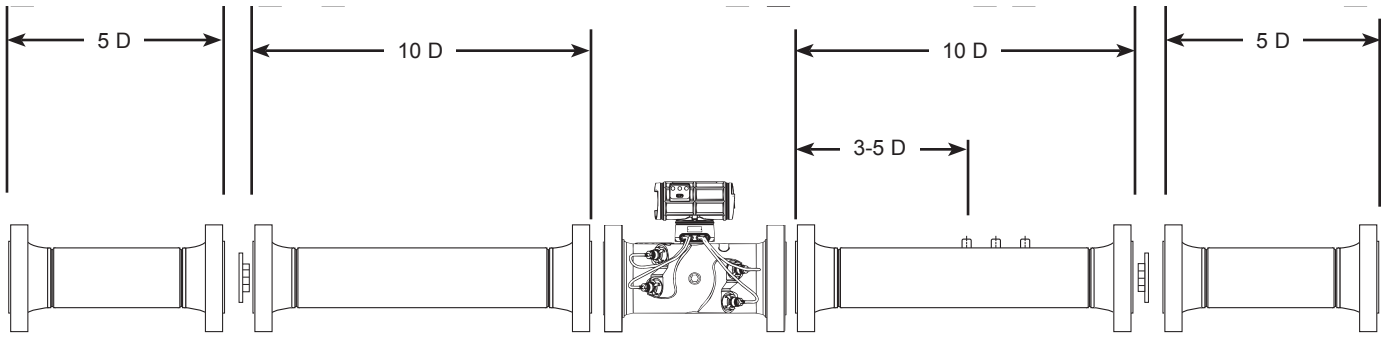
Piping Recommendation for SeniorSonic or JuniorSonic with No Flow Conditioner*



Piping Recommendation for SeniorSonic or JuniorSonic with Daniel Profiler*



Piping Recommendation for Bi-directional SeniorSonic or JuniorSonic with Daniel Profiler*



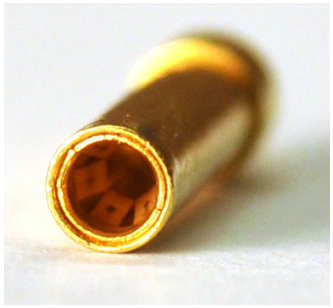
***Note: these are Daniel default recommended lengths. Many users specify 10 D + Flow Conditioner + 10 D for upstream in uni-directional designs and the same for bi-directional designs per AGA9 second edition April, 2007 default installation recommendation. Per AGA9 and ISO 17089 it is recommended the entire metering package be calibrated.**

Daniel T-20 Series Gas Ultrasonic Transducers

All Daniel gas ultrasonic flow meters are equipped with T-20 Series Transducers. SeniorSonic meters are supplied with T-21 or T-22 Transducers depending on the fluid temperature range (see the specifications below) and JuniorSonic meters are supplied with T-21 Transducers.

The T-20 Series Transducers feature a non-wetted transformer located outside of the pressurized process to increase tolerance to liquid borne dirt and corrosive fluids, such as H_2S. Robust electrical connectors with six raised surfaces minimize contaminant build-up. In addition to improved performance, cleaning cycles in harsh environments are extended and operators can replace the transformer, as needed, without depressurizing the meter to minimize maintenance and meter downtime.

Non-wetted transformer



Robust connector

- **Materials of Construction**
  - 316L SS
- **Fluid Types**
  - Hydrocarbons, industrial gases, H_2S limit 10,000 ppm (1%)
- **Fluid Temperature**[1]
  - T-22: –50°C to 100°C (–58°F to +212°F)
  - T-21: –20°C to 100°C (–4°F to +212°F)
- **Operating Pressure**
  - 345 to 27,579 kPa (50 to 4,000 psig)
- **Operating Frequency**
  - 125 kHz
- **Safety Classifications**[2]
  - Underwriters Laboratories (UL / cUL) Hazardous Locations – Class I, Div 1, Groups C & D

SeniorSonic Gas Flow Meter with T-21 Transducers

1. SeniorSonic meters are supplied with either T-21 or T-22 Transducers depending on the fluid temperature range. JuniorSonic meters are only available with T-21 Transducers.

2. T-20 Series Transducers are approved for use in hazardous areas with Daniel Mark III electronics only. T-20 Series Transducers are not electrically certified for use with Mark II or prior electronics.

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