People. Power. Possibilities.
Central Hudson
A FORTIS COMPANY

April 21, 2014

Hon. Kathleen H. Burgess
Secretary to the Commission
New York State Public Service Commission
Agency Building 3
Albany, New York 12223-1350

Subject: Part 227 – Request for Approval of Q.Sonic Plus Multi-Path Ultrasonic Gas Meter

Ms. Burgess:

In accordance with the requirements of the rules and regulations of the Public Service Commission of the State of New York, 16NYCRR, Part 227 – Approval of Types of Gas Meters and Accessories, Central Hudson requests the approval for the use of the Elster Instromet Q.Sonic Plus Multi-Path Ultrasonic Gas Meter for the purpose of metering the high load gas usage of the Danskammer Generating Plant. The Q.Sonic Plus is manufactured by Elster Instromet, Rijkmakerlaan 9, 2910 Essen, Belgium.

It is Central Hudson's intent to deploy two of these meters at the Danskammer Gas Regulating Station primarily to record high load gas usage to the Danskammer Generating Plant. Previously, Central Hudson had utilized Elster Instromet Ultrasonic meters but was taken out of service when the Danskammer Power Plant was also removed from service. The new Q.Sonic Plus meter is a newer technology and lower cost option that Central Hudson would like to deploy. The Q.Sonic Plus utilizes the same swirl and reflective ultrasonic beam technology as the industry standard Q.Sonic USM that has been installed since 1995. Additionally, the Q.Sonic Plus technology uses advanced computational electronics, a local display/flow computer, Titanium encapsulated transducers, and an additional swirl path that enhances the ability of the meter to detect and compensate for flow disturbances.

This document is being submitted to you electronically (PDF format) with Attachments.

Please contact me at 845-334-3591 if you should have any questions regarding this matter.

Very truly yours,

Brett Arteta
Director of Meter Services

CC: Records Retention w/a

Kingston\Meter Department\Elster Instromet\Q Sonic Plus Approval 20140421

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ATTACHMENT 1

Q.Sonic Plus Step Into a New Dimension

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Q.Sonic^{plus}

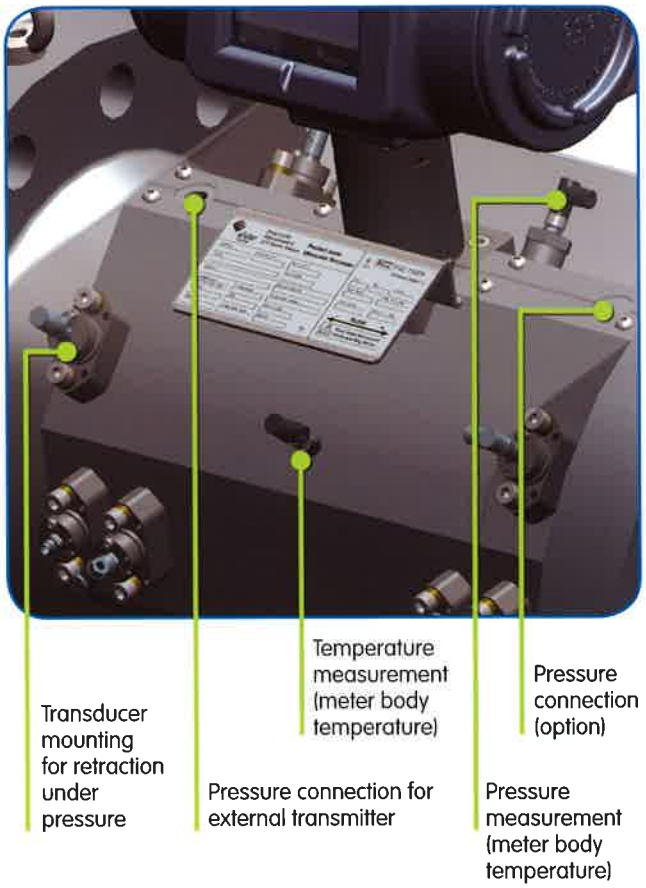
Step into a new dimension

The new ultrasonic gas flow meter Q.Sonic^{plus} is a six-path meter which subject to an 'enhanced' Elster-Instromet patent, with more functionality, bringing about new end-user benefits, along with greater processing power that yields a lower measurement uncertainty.

Q.Sonic^{plus} technical data

Measurement principle	Ultrasonic transit time measurement
Main application	Fiscal metering for natural gas production, transmission, distribution and storage
Sizes	3 to 56 inch (DN 80 – DN 1400)*
Pressure range	Up to 2175 psi (7250 psi extended)
Velocity range	-160 ft/s to +160 ft/s (depending on meter size)
Temperature range	Ambient -40 to +140°F, process -58 to +250°F
Body materials	Low temp carbon steel, stainless steel, duplex
Body length	3 x nominal diameter (3D)
Accuracy	0.2% of reading (Q_i - Q_{max}) after flow calibration
Linearity	0.2% (Q_i - Q_{max}) after dry cal
Repeatability	0.05% (Q_i - Q_{max})
Power supply	12 – 36 V DC, 10 to 15 W (depending on configuration)
Local display	GUI, 4.3" widescreen graphical display with 7 capacitive soft keys (touch)
Metrological approval	MID (pending)
Hazardous area approvals	IECEx, ATEX, FM, CSA (all pending)
Interfaces (by default)	2 serial ports (RS 232/485 configurable) 1 Ethernet port / high-speed DSL 2 frequency outputs 2 digital outputs ** 2 analogue outputs ** 1 USB port
Optional IS input board (IS: intrinsically safe)	2 digital inputs *** 2 frequency inputs *** 1 analogue input (HART loop) 1 Pt-100 input (4-wire)

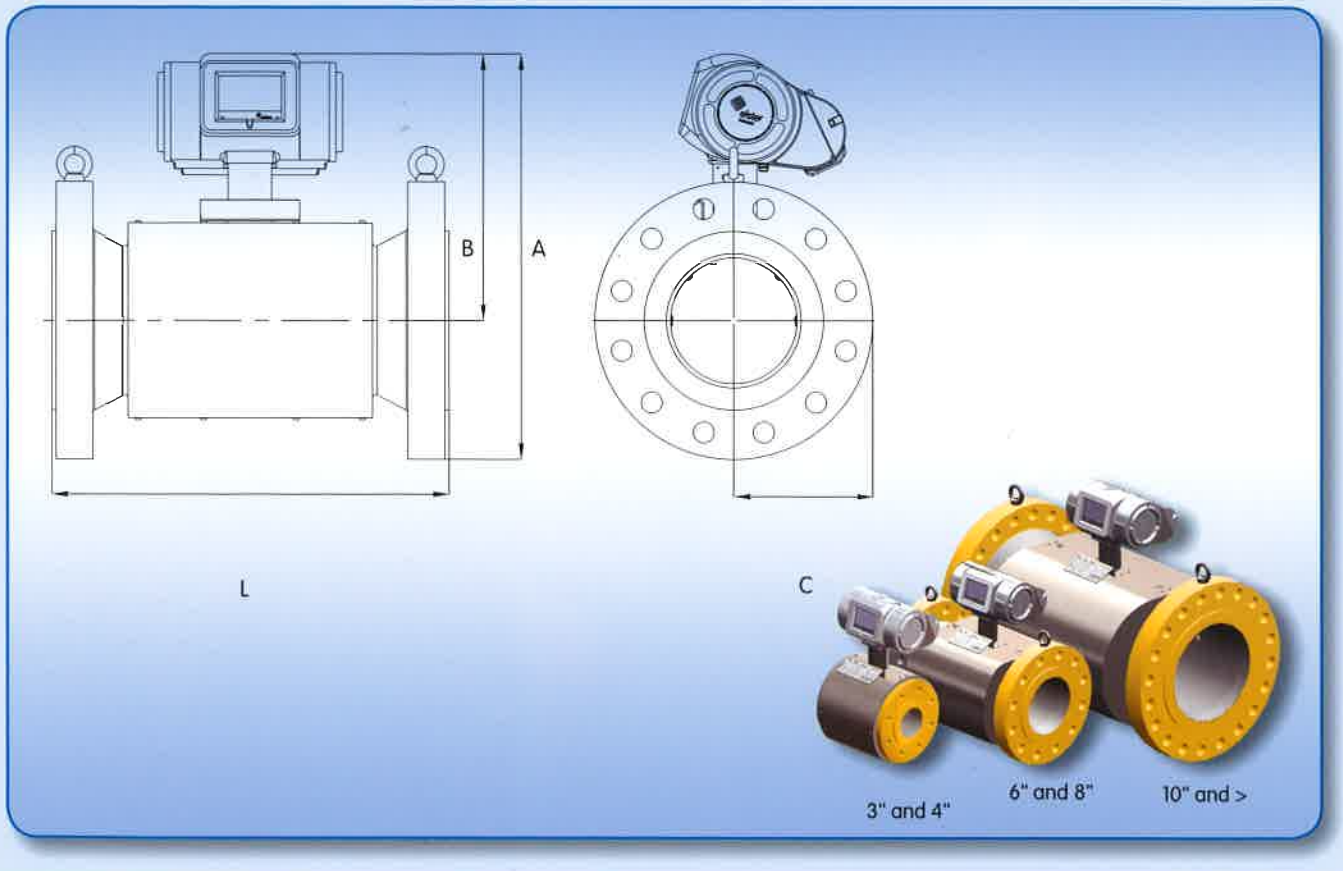
* The 3" (DN 80) Q.Sonic^{plus} has a 4-path (2 swirl + 2 axial) configuration
** Analogue outputs and digital outputs share the terminal clamps
*** Digital inputs and frequency inputs share the terminal clamps



Q.Sonic^{plus} dimensions

Meter size	A	B	C	D
3"	19-1/2	15-1/8	6-5/8	9-1/2
4"	**21-1/4**	**15-5/8**	**6-5/8**	**11-3/4**
6"	22	15	7-1/4	17-3/4
8"	**24-1/8**	**15-7/8**	**8-1/4**	**23-5/8**
10"	26-7/8	16-7/8	10	29-1/2
12"	**28-7/8**	**17-7/8**	**11**	**35-3/8**
14"	30-3/8	18-1/2	11-7/8	41-3/8
16"	**32-7/8**	**19-3/8**	**13-3/4**	**47-1/4**
18"	35-3/8	20-3/4	14-5/8	56-1/8
20"	**37-3/4**	**21-3/4**	**16**	**59**
24"	42-1/4	23-3/4	18-1/2	70-7/8
26"	**45**	**25**	**20**	**76-3/4**
30"	49-1/4	27	22-1/4	88-5/8
36"	**56-1/4**	**30-3/8**	**25-7/8**	**106-1/4**
42"	59-5/8	32	27-5/8	124
48"	**66-7/8**	**35-1/2**	**31-3/8**	**141-3/4**
56"	76-7/8	40-3/8	36-1/2	165-3/8

For flange rating ANSI 600
All dimensions rounded to the nearest 1/8 of an inch



Q.Sonic^{plus} technical data

Type	Size [inch]	Flange connection [Schedule]	Converted internal diameter [inch]	ID from ANSI pipe schedules	Flow [ft³/h] Q_{max}	Flow [ft³/h] Q_{min}	Turndown
Tapered bore fixed internal diameters	3	STD - XS	2.874	—	24,720	388	64
		XS - 100	2.756	—	22,601	353	64
	4	STD - XS	3.819	—	37,787	459	83
		XS - 100	3.543	—	34,255	388	89
	6	STD - XS	5.748	—	78,752	636	124
		XS - 120	5.472	—	70,629	565	125
	8	STD - XS	7.480	—	140,906	1,059	133
		XS - 120	7.087	—	123,248	953	130
	10	STD - 80	9.449	—	207,297	1,695	123
		80 - 120	9.055	—	190,346	1,554	123
	12	30 - 60	11.614	—	304,413	2,578	119
		60 - 100	11.024	—	274,042	2,331	118
	14	30 - 60	12.795	—	358,797	3,002	120
		60 - 100	12.008	—	316,067	2,649	120
	16	30 - 60	14.567	—	451,322	4,061	112
		60 - 100	13.780	—	403,647	3,531	115
Straight bore customized	18	STD	17.250	17.25	625,070	5,650	111
		40	16.876	15.25	480,280	4,238	114
	20	STD	19.250	19.25	741,609	7,063	105
		40	18.812	17	579,161	5,297	110
	24	STD	23.250	23.25	1.045,315	10,241	103
		40	22.624	20.376	847,553	8,122	105
	26	STD	25.250	25.25	1,161,854	11,301	103
		20/XH	25.000	—	981,749	9,535	103
	30	STD	29.250	29.25	1,628,008	16,245	101
		20/XH	29.000	—	1,306,644	12,713	103
	36	STD	35.250	35.25	2,369,616	23,661	101
		40	34.500	—	1,857,553	18,364	102
	42	STD	41.250	41.25	2,924,057	32,136	91
		40	40.500	—	2,383,742	26,133	92
	48	STD	47.250	47.25	3,842,239	42,378	91
		XH	47.000	—	3,217,169	35,668	91
	56	STD	55.000	—	5,261,890	58,269	91
		120	54.000	—	5,074,722	56,150	91

Sonic Explorer

The new PC software Sonic Explorer combines an easy-to-use set-up for the Q.Sonic^{plus} with extended diagnostic functions.

Elster Instromet

Q.Sonic plus

Leading technology with innovative solutions for ultrasonic flow metering

In the last years the market has clearly shown a desire for more reliable metering with less overall uncertainty. By now it is widely accepted that ultrasonic meters can meet accuracy figures down to 0.1% of reading. The question is: will it still be accurate in the actual installation and, above all, will it still be accurate after several months or years?

The smart metering concept of the Q.Sonic^{plus} is a major step to cover these aspects and will, in the future, eliminate the need for extensive commissioning, installation and health checks. Already implemented are healthcare diagnostics, such as real time monitoring and trending of flow profile factors, swirl angles, asymmetry, turbulence, etc.

The new patented path configuration, a fully symmetrical layout of four swirl paths with double reflection and two single reflection paths, enables the measurement of swirl and asymmetry as well, resulting in an until now unmatched profile recognition and diagnostics.

- Fully compliant with ISO/FDIS 17089-1:2009 (E), AGA-9, OIML R137-1:2006 (E), and other standards
- For use in hazardous areas, compliant to International (IECEx), European (ATEX), American (FM) and Canadian (CSA) regulations
- 3D body length for all meter sizes
- Enhanced all-metal-encapsulated, intrinsically safe transducer technology
- Transducers retractable under pressure
- Technology for improved performance
- Real time CMB (Coded Multiple Burst) code transmission and cross correlation techniques to further minimize noise influences with additional digital signal processing
- Custom designed and built electronics enclosure including a built-in display with touch screen functionality
- Built-in P&T measurement for meter body correction and highly accurate Reynolds calculation
- Sonic Explorer – new PC software for set-up, diagnostics and health care
- Built-in flow computer function (future option)

About Elster

Elster (NYSE: ELT) is one of the world's largest electricity, gas and water measurement and control providers. Its offerings include distribution monitoring and control, advanced smart metering, demand response, networking and software solutions, and numerous related communications and services - key components for enabling consumer choice, operational effi ciency and conservation. Its products and solutions are widely used by utilities in the traditional and emerging Smart Grid markets.

Elster has one of the most extensive installed revenue measurement bases in the world, with more than 200 million metering devices deployed over the course of the last 10 years. It sells its products and services in more than 130 countries across electricity, gas, water and multi-utility applications for residential, commercial and industrial, and transmission and distribution applications.

For more information about Elster, please visit www.elster.com.

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EI-BR0045-EN-P – May 2011

ATTACHMENT 2

Q.Sonic Plus Multi-Path Ultrasonic Gas Meter For Custody Transfer Measurement

Q.Sonic®plus

Multi-path ultrasonic gas meter
for custody transfer measurement

Applications

- Custody transfer measurement of natural gas
- Gas exploration, transmission and distribution

Brief information

The ultrasonic gas flow meter Q.Sonic^{plus} is a six-path meter covered by an 'enhanced' Elster-Instromet patent, with extended functionality, bringing about new benefits for the end user, along with greater processing power that yields a lower measurement uncertainty.

The patented path configuration – a fully symmetrical layout of four swirl paths with double reflection and two single reflection paths – enables the measurement of both swirl and asymmetry, resulting in hitherto unequalled profile recognition and diagnostic possibilities.
Another innovation of the Q.Sonic^{plus} is that it can be equipped with an internal pressure and temperature measurement function. This means that the device measures both the gas pressure and temperature of the measuring tube. On the one hand, these measurements allow for a more accurate calculation of the Reynolds number for the flow profile analysis and on the other, they can be used to correct the meter body diameter and path geometry. This is useful if the process conditions differ massively from the conditions during the calibration process since both high pressure and high temperatures result in an increase in the tube cross-section and a change in path lengths and angles.

The electronics unit is a completely redeveloped modular hardware and software platform, which will be used in many Elster-Instromet devices in the future. It also provides sufficient computing power reserve to meet future requirements. The real-time operating system used in the device, INTEGRITY from Green Hills Software, is regarded as one of the most secure and reliable systems in the world.
The electronics are located in a flame-proof housing (Ex d) with a separate connection compartment for field wiring. Thanks to its modular hardware design with a free slot, the device is also prepared to tackle future requirements. For user operation the system is equipped with a graphical user interface with touch screen functionality.

The Q.Sonic^{plus} is supplied with SonicExplorer, an all-new PC software package for configuration, diagnostics and health care.
One of the unique features of SonicExplorer is the "Create Customer Service Pack" function. SonicExplorer collects a short log of the entire state of the ultrasonic flow meter including the device configuration, a present diagnostic snapshot, a pass/fail report, all diagnostic values as well as analyses of all acoustic signals and the noise spectrum. This information is sent to the Elster-Instromet support team for detailed investigation so that the on-site service engineer can be given efficient support.

Main features

- 6-path reflective technology
- Sizes 3" to 56"
  (DN 80 to DN 1400)
- Pressure ratings
  ANSI class 150 to 2500
  PN on request
- All-metal-encapsulated
  intrinsically safe transducers
- Internal temperature sensor
- Flow profile detection with swirl and asymmetry measurement
- No moving parts
- No pressure drop
- Bi-directional measurement
- SonicExplorer® PC software for configuration, diagnostics and health care
- OIML R137-1 compliant
- AGA 9 compliant
- MID approved

Options

- VDSL range extender for high-speed communication (TCP/IP)
- Pressure sensor (retrofit)
- Retraction tool for transducer exchange 'under pressure'

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Path configuration

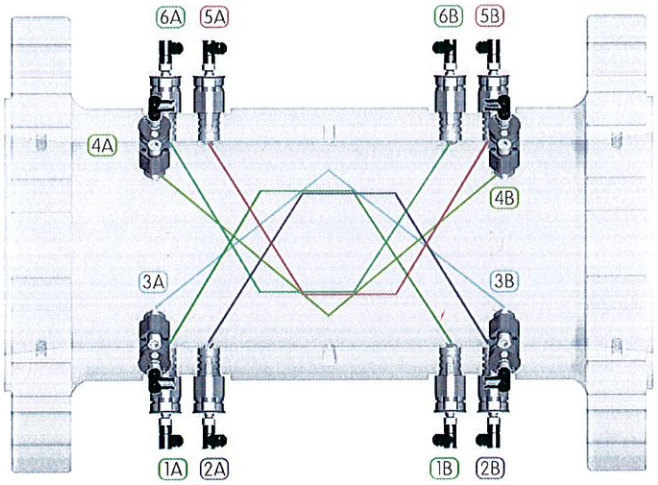
The Q.Sonic^{plus} uses two pairs of double and two single reflection paths.
Taking the mean value of both pairs will result in a symmetrically weighted measurement.

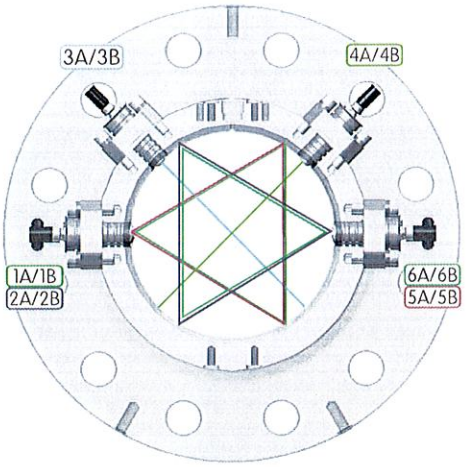
The subtraction of the paired paths provides an indication of asymmetric flow along the mirror plane of the paths as an additional diagnostic feature.

Transducer path

Path No.	Path type
1A / 1B	Swirl path (B1-CW *)
2A / 2B	Swirl path (B1-CCW**)
3A / 3B	Axial path (A1)
4A / 4B	Axial path (A2)
5A / 5B	Swirl path (B2-CW)
6A / 6B	Swirl path (B2-CCW)

* clockwise
** counter-clockwise



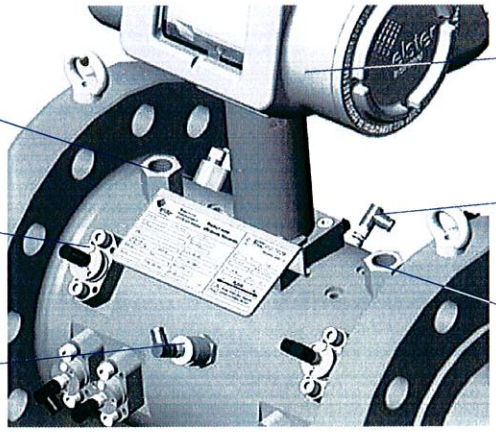


Components on the meter body

Pressure connection point for external transmitter

Transducer with mounting plate, prepared for retraction under pressure

Optional pressure sensor for geometry correction and line density estimation (profile correction)



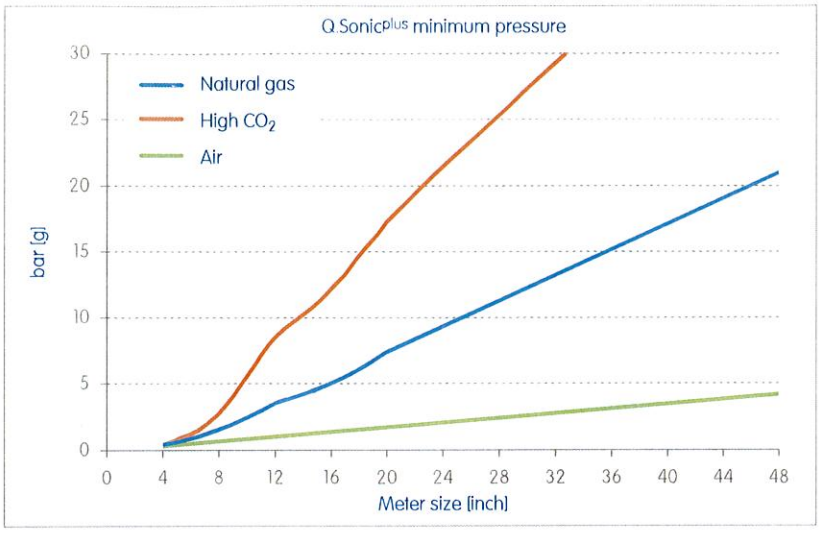
Signal processing unit (SPU)

Temperature sensor for meter body temperature

Second pressure connection point

Ultrasonic transducers model NG

The transducers are all-metal encapsulated with titanium, which offers a smooth surface to minimize contamination. The ultrasonic frequency of 200 kHz ensures a good balance between resolution and attenuation/propagation of the signal.



Signal processing unit (SPU) series 6

The SPU electronic resides in a flame-proof housing with a separate compartment for the terminal connections. The boards are mounted in a card cage with one free slot for future extensions.
A colour graphic screen with 7 touch-sensitive sections allows easy operation by using a menu structure to access the data. Thanks to the built-in web server, this can also be done remotely when a network connection is available.

The heart of the system is the EnCore with up to 16 GB of data memory.
Diagnostic and self-checking functions in conjunction with a flexible, user-configurable data archive and an event list allow a detailed analysis of the meter's performance and the metering situation at any time.

SonicExplorer®

Windows-based software package for the Q.Sonic^plus for on-site and remote use. SonicExplorer is a tool that allows the health and performance of the device to be determined in situ so that informed decisions can be made in respect of maintenance or other tasks related to the ultrasonic flow meter.

Function overview:
- Meter data base
- Configuration, setting and documentation
- Diagnostics
- Health care reporting
- Customer service pack (automated collection of relevant data for off-site analysis)

Flow ranges metric

Type	Size [Inch]	Size DN	Flange connection ANSI schedule	Flange connection EN1092-1	Spool diameter ANSI flange max ID [mm]	Spool diameter PN flange max ID [mm]	Internal diameter [mm]	Flow [m³/h] Q_{min}	Flow [m³/h] Q_t	Flow [m³/h] Q_{max}	Turndown
Reduced bore Fixed inner diameter	3	80	STD – XS	PN 10 – PN 100	77.90	82.50	73	11	70	600	56
			XS – 160		73.70		70	10	65	550	56
	4	100	STD – XS	PN 10 – PN 100	102.30	107.10	97	13	110	1000	79
			XS – 120		97.20		90	11	100	900	80
	6	150	STD – XS	PN 10 – PN 100	154.10	159.30	146	18	220	2200	124
			XS – 120		146.30		139	16	200	2000	125
	8	200	STD – XS	PN 10 – PN 100	202.70	206.50	190	30	400	4000	133
			XS – 120		193.70		180	27	350	3500	130
	10	250	STD – 80	PN 10 – PN 100	254.50	260.40	240	48	590	5900	123
			80 – 120		242.80		230	44	540	5400	123
	12	300	30 – 60	PN 10 – PN 100	307.00	309.70	295	73	860	8600	118
			60 – 100		295.30		280	66	780	7800	118
	14	350	30 – 60	PN 10 – PN 100	336.50	341.40	325	85	1000	10000	118
			60 – 100		325.40		305	75	900	9000	120
	16	400	30 – 60	PN 10 – PN 100	387.30	392.20	370	115	1300	13000	113
			60 – 100		373.00		350	100	1150	11500	115
Full bore Customized	18	450	STD	PN 10 – PN 40		442.80	max. 437.90	165	1800	18000	109
			120				min. 387.10	120	1350	13500	113
	20	500	STD	PN 10 – PN 100		493.80	max. 488.90	200	2100	21000	105
			120				min. 431.80	160	1600	16000	100
	24	600	STD	PN 10 – PN 63		594.00	max. 590.90	295	3000	30000	102
			100				min. 532.22	240	2400	24000	100
	26	650	STD	n/a			max. 640.90	330	3300	33000	100
			S = 25.4				min. 609.20	275	2750	27500	100
	30	750	STD	n/a			max. 742.90	460	4600	46000	100
			S = 31.75				min. 730.30	370	3700	37000	100
	36	900	STD	PN 10 – PN 63		889.00	max. 894.90	670	6700	67000	100
			S = 31.75				min. 850.50	525	5250	52500	100
	42	1050	STD	n/a			max. 1047.90	920	8300	83000	90
			S = 31.75				min. 1003.50	750	6750	67500	90
	48	1200	STD	PN 10 – PN 63		1194.00	max. 1199.90	1200	11000	110000	92
			S = 31.75				min. 1155.50	1000	9100	91000	91
	56	1400	S = 12.7	PN 10 – PN 40		1393.60	max. 1396.60	1650	15000	150000	91
			S = 31.75				min. 1358.50	1600	14300	143000	89

Flow ranges imperial

Type	Size [Inch]	Size DN	Flange connection ANSI schedule	Flange connection EN1092-1	Spool diameter ANSI flange max ID [inch]	Spool diameter PN flange max ID [inch]	Internal diameter [inch]	Flow [MC F D] Q_{min}	Flow [MC F D] Q_t	Flow [MC F D] Q_{max}	Turndown
Reduced bore Fixed inner diameter	3	80	STD – XS	PN 10 – PN 100	3.07	3.25	2.87	9	59	509	56
			XS – 160		2.90		2.76	8	55	466	56
	4	100	STD – XS	PN 10 – PN 100	4.03	4.22	3.82	11	93	848	79
			XS – 120		3.83		3.54	9	85	763	80
	6	150	STD – XS	PN 10 – PN 100	6.07	6.27	5.75	15	186	1865	124
			XS – 120		5.76		5.47	14	170	1695	125
	8	200	STD – XS	PN 10 – PN 100	7.98	8.13	7.48	25	339	3390	133
			XS – 120		7.63		7.09	23	297	2966	130
	10	250	STD – 80	PN 10 – PN 100	10.02	10.25	9.45	41	500	5001	123
			80 – 120		9.56		9.06	37	458	4577	123
	12	300	30 – 60	PN 10 – PN 100	12.09	12.19	11.61	62	729	7289	118
			60 – 100		11.63		11.02	56	661	6611	118
	14	350	30 – 60	PN 10 – PN 100	13.25	13.44	12.80	72	848	8476	118
			60 – 100		12.81		12.01	74	763	7628	120
	16	400	30 – 60	PN 10 – PN 100	15.25	15.44	14.57	97	1102	11018	113
			60 – 100		14.69		13.78	85	975	9747	115
Full bore Customized	18	450	STD	PN 10 – PN 40		17.43	max. 17.24	140	1526	15256	109
			120				min. 15.24	102	1144	11442	113
	20	500	STD	PN 10 – PN 100		19.44	max. 19.25	170	1780	17799	105
			120				min. 17	136	1356	13561	100
	24	600	STD	PN 10 – PN 63		23.39	max. 23.26	250	2543	25427	102
			100				min. 20.95	203	2034	20341	100
	26	650	STD	n/a			max. 25.23	280	2797	27969	100
			S = 25.4				min. 23.98	233	2331	23308	100
	30	750	STD	n/a			max. 29.25	390	3899	38987	100
			S = 31.75				min. 28.75	314	3136	31359	100
	36	900	STD	PN 10 – PN 63		35.00	max. 35.23	568	5679	56786	100
			S = 31.75				min. 33.48	445	4450	44496	100
	42	1050	STD	n/a			max. 41.26	780	7035	70347	90
			S = 31.75				min. 39.51	636	5721	57210	90
	48	1200	STD	PN 10 – PN 63		47.01	max. 47.24	1017	9323	93231	92
			S = 31.75				min. 45.49	848	7713	77127	91
	56	1400	S = 12.7	PN 10 – PN 40		54.87	max. 54.98	1398	12713	127133	91
			S = 31.75				min. 53.48	1356	12120	121200	89

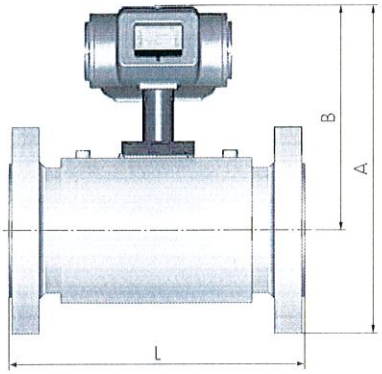
For MID approved sizes and flow ranges, please also refer to the latest EC Type- examination Certificate T10335

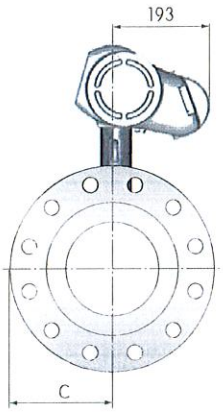
Material specifications ANSI 150 - 600 (flow cell)

LTCS forging	ASTM A350-LF2 Cl.1
LTCS welding	ASTM A333 grade 6 / ASTM A350-LF2 Cl.1
SS forging	ASTM A182-F316
SS welding	ASTM A312-TP316L / ASTM A182-F316L
LTCS/SS	size > 24" as per customer specification

Material certificate 3.1

LTCS: Low temperature carbon steel
Other materials on request





Flange rating ANSI 150 metric

Meter size [inch]	Meter size [mm]	Dimensions [mm] A	B	C	L	Flow cell material	Weight forged [kg]	Weight welded [kg]	Length
3"	DN 80	517	422	147	320	LTCS/SS	47	-	4D
4"	DN 100	546	431	153	400	LTCS/SS	61	-	4D
6"	DN 150	570	430	184	450	LTCS/SS	84	-	3D
8"	DN 200	625	452	205	600	LTCS/SS	134	-	3D
10"	DN 250	680	477	252	750	LTCS/SS	195	-	3D
12"	DN 300	747	505	280	900	LTCS/SS	280	-	3D
14"	DN 350	802	535	310	1050	LTCS/SS	-	247	3D
16"	DN 400	859	561	336	1200	LTCS/SS	-	341	3D
18"	DN 450	903	586	331	1350	LTCS/SS	-	351	3D
20"	DN 500	961	611	356	1500	LTCS/SS	-	447	3D
24"	DN 600	1069	662	407	1800	LTCS/SS	-	687	3D
30"	DN 750	1230	738	492	2250	LTCS/SS	-	781	3D
32"	DN 800	1294	764	530	2400	LTCS/SS	-	929	3D
36"	DN 900	1399	814	584	2700	LTCS/SS	-	1354	3D
40"	DN 1000	1510	865	645	3000	LTCS/SS	-	1650	3D

Flange rating ANSI 150 imperial

Meter size [inch]	Meter size [mm]	Dimensions [inch] A	B	C	L	Flow cell material	Weight forged [lb]	Weight welded [lb]	Length
3"	DN 80	20.3543	16.6142	5.7874	12.5984	LTCS/SS	102.63	-	4D
4"	DN 100	21.4961	16.9685	6.0236	15.7480	LTCS/SS	133.42	-	4D
6"	DN 150	22.4409	16.9291	7.2441	17.7165	LTCS/SS	184.55	-	3D
8"	DN 200	24.6063	17.7953	8.0709	23.6220	LTCS/SS	295.20	-	3D
10"	DN 250	26.7717	18.7795	9.9213	29.5276	LTCS/SS	430.12	-	3D
12"	DN 300	29.4094	19.8819	11.0236	35.4331	LTCS/SS	616.85	-	3D
14"	DN 350	31.5748	21.0630	12.2047	41.3386	LTCS/SS	-	544.41	3D
16"	DN 400	33.8189	22.0866	13.2283	47.2441	LTCS/SS	-	751.47	3D
18"	DN 450	35.5512	23.0709	13.0315	53.1496	LTCS/SS	-	774.79	3D
20"	DN 500	37.8346	24.0551	14.0157	59.0551	LTCS/SS	-	984.76	3D
24"	DN 600	42.0866	26.0630	16.0236	70.8661	LTCS/SS	-	1513.69	3D
30"	DN 750	48.4252	29.0551	19.3701	88.5827	LTCS/SS	-	1722.58	3D
32"	DN 800	50.9449	30.0787	20.8661	94.4882	LTCS/SS	-	2048.14	3D
36"	DN 900	55.0787	32.0472	22.9921	106.2992	LTCS/SS	-	2985.76	3D
40"	DN 1000	59.4488	34.0551	25.3937	118.1102	LTCS/SS	-	3638.29	3D

Flange rating ANSI 300 metric

Meter size [inch]	Meter size [mm]	Dimensions [mm] A	B	C	L	Flow cell material	Weight forged [kg]	Weight welded [kg]	Length
3"	DN 80	527	422	147	320	LTCS/SS	51	-	4D
4"	DN 100	558	431	153	400	LTCS/SS	70	-	4D
6"	DN 150	589	430	184	450	LTCS/SS	101	-	3D
8"	DN 200	643	452	205	600	LTCS/SS	155	-	3D
10"	DN 250	700	477	252	750	LTCS/SS	226	-	3D
12"	DN 300	765	505	280	900	LTCS/SS	320	-	3D
14"	DN 350	827	535	310	1050	LTCS/SS	-	319	3D
16"	DN 400	884	561	336	1200	LTCS/SS	-	430	3D
18"	DN 450	941	586	356	1350	LTCS/SS	-	473	3D
20"	DN 500	999	611	388	1500	LTCS/SS	-	591	3D
24"	DN 600	1120	662	457	1800	LTCS/SS	-	911	3D
30"	DN 750	1284	738	546	2250	LTCS/SS	-	1252	3D
32"	DN 800	1339	764	575	2400	LTCS/SS	-	1575	3D
36"	DN 900	1449	814	635	2700	LTCS/SS	-	2159	3D
40"	DN 1000	1485	865	619	3000	LTCS/SS	-	2096	3D

Flange rating ANSI 300 imperial

Meter size [inch]	Meter size [mm]	Dimensions [inch] A	B	C	L	Flow cell material	Weight forged [lb]	Weight welded [lb]	Length
3"	DN 80	20.7480	16.6142	5.7874	12.5984	LTCS/SS	112.06	-	4D
4"	DN 100	21.9685	16.9685	6.0236	15.7480	LTCS/SS	154.06	-	4D
6"	DN 150	23.1890	16.9291	7.2441	17.7165	LTCS/SS	221.76	-	3D
8"	DN 200	25.3150	17.7953	8.0709	23.6220	LTCS/SS	341.47	-	3D
10"	DN 250	27.5591	18.7795	9.9213	29.5276	LTCS/SS	499.02	-	3D
12"	DN 300	30.1181	19.8819	11.0236	35.4331	LTCS/SS	706.47	-	3D
14"	DN 350	32.5591	21.0630	12.2047	41.3386	LTCS/SS	-	702.53	3D
16"	DN 400	34.8031	22.0866	13.2283	47.2441	LTCS/SS	-	947.79	3D
18"	DN 450	37.0472	23.0709	14.0157	53.1496	LTCS/SS	-	1043.18	3D
20"	DN 500	39.3307	24.0551	15.2756	59.0551	LTCS/SS	-	1302.87	3D
24"	DN 600	44.0945	26.0630	17.9921	70.8661	LTCS/SS	-	2008.74	3D
30"	DN 750	50.5512	29.0551	21.4961	88.5827	LTCS/SS	-	2761.20	3D
32"	DN 800	52.7165	30.0787	22.6378	94.4882	LTCS/SS	-	3472.04	3D
36"	DN 900	57.0472	32.0472	25.0000	106.2992	LTCS/SS	-	4760.79	3D
40"	DN 1000	58.4646	34.0551	24.3701	118.1102	LTCS/SS	-	4621.40	3D

Flange rating ANSI 600 metric

Meter size [inch]	Meter size [mm]	Dimensions [mm] A	B	C	L	Flow cell material	Weight forged [kg]	Weight welded [kg]	Length
3"	DN 80	527	422	147	320	LTCS/SS	53	-	4D
4"	DN 100	568	431	153	400	LTCS/SS	82	-	4D
6"	DN 150	608	430	185	500	LTCS/SS	134	-	3.33D
8"	DN 200	662	452	210	600	LTCS/SS	200	-	3D
10"	DN 250	731	477	254	750	LTCS/SS	312	-	3D
12"	DN 300	784	505	280	900	LTCS/SS	424	-	3D
14"	DN 350	837	535	310	1050	LTCS/SS	-	455	3D
16"	DN 400	903	561	343	1200	LTCS/SS	-	641	3D
18"	DN 450	957	586	372	1350	LTCS/SS	-	666	3D
20"	DN 500	1018	611	407	1500	LTCS/SS	-	853	3D
24"	DN 600	1132	662	470	1800	LTCS/SS	-	1311	3D
30"	DN 750	1304	738	565	2250	LTCS/SS	-	1932	3D
32"	DN 800	1361	764	597	2400	LTCS/SS	-	2266	3D
36"	DN 900	1472	814	657	2700	LTCS/SS	-	2956	3D
40"	DN 1000	1526	865	661	3000	LTCS/SS	-	3334	3D

Flange rating ANSI 600 imperial

Meter size [inch]	Meter size [mm]	Dimensions [inch] A	B	C	L	Flow cell material	Weight forged [lb]	Weight welded [lb]	Length
3"	DN 80	20.7480	16.6142	5.7874	12.5984	LTCS/SS	116.93	-	4D
4"	DN 100	22.3622	16.9685	6.0236	15.7480	LTCS/SS	179.79	-	4D
6"	DN 150	23.9370	16.9291	7.2441	19.6850	LTCS/SS	295.42	-	3.33D
8"	DN 200	26.0630	17.7953	8.2677	23.6220	LTCS/SS	441.85	-	3D
10"	DN 250	28.7795	18.7795	10.0000	29.5276	LTCS/SS	688.08	-	3D
12"	DN 300	30.8661	19.8819	11.0236	35.4331	LTCS/SS	934.56	-	3D
14"	DN 350	32.9528	21.0630	12.2047	41.3386	LTCS/SS	-	1002.31	3D
16"	DN 400	35.5512	22.0866	13.5039	47.2441	LTCS/SS	-	1412.90	3D
18"	DN 450	37.6772	23.0709	14.6457	53.1496	LTCS/SS	-	1467.93	3D
20"	DN 500	40.0787	24.0551	16.0236	59.0551	LTCS/SS	-	1879.99	3D
24"	DN 600	44.5669	26.0630	18.5039	70.8661	LTCS/SS	-	2890.37	3D
30"	DN 750	51.3386	29.0551	22.2441	88.5827	LTCS/SS	-	4259.22	3D
32"	DN 800	53.5827	30.0787	23.5039	94.4882	LTCS/SS	-	4995.65	3D
36"	DN 900	57.9528	32.0472	25.8661	106.2992	LTCS/SS	-	6515.85	3D
40"	DN 1000	60.0787	34.0551	26.0236	118.1102	LTCS/SS	-	7349.42	3D

Flange rating ANSI 900 metric

Meter size [inch]	Meter size [mm]	Dimensions [mm] A	B	C	L	Flow cell material	Weight forged [kg]	Weight welded [kg]	Length
3"	DN 80	542	422	147	320	LTCS/SS	62	-	4D
4"	DN 100	576	431	153	400	LTCS/SS	89	-	4D
6"	DN 150	620	430	190	600	LTCS/SS	167	-	4D
8"	DN 200	687	452	235	800	LTCS/SS	281	-	4D
10"	DN 250	750	477	273	750	LTCS/SS	360	-	3D
12"	DN 300	810	505	305	900	LTCS/SS	508	-	3D
14"	DN 350	856	535	321	1050	LTCS/SS	-	561	3D
16"	DN 400	913	561	323	1200	LTCS/SS	-	726	3D
18"	DN 450	980	586	394	1350	LTCS/SS	-	896	3D
20"	DN 500	1040	611	429	1500	LTCS/SS	-	1148	3D
24"	DN 600	1183	662	521	1800	LTCS/SS	-	1918	3D
30"	DN 750	1354	738	616	2250	LTCS/SS	-	2929	3D
32"	DN 800	1421	764	657	2400	LTCS/SS	-	3444	3D
36"	DN 900	1545	814	731	2700	LTCS/SS	-	4493	3D
40"	DN 1000	1621	865	756	3000	LTCS/SS	-	5135	3D

Flange rating ANSI 900 imperial

Meter size [inch]	Meter size [mm]	Dimensions [inch] A	B	C	L	Flow cell material	Weight forged [lb]	Weight welded [lb]	Length
3"	DN 80	21.3386	16.6142	5.7874	12.5984	LTCS/SS	136.00	-	4D
4"	DN 100	22.6772	16.9685	6.0236	15.7480	LTCS/SS	196.83	-	4D
6"	DN 150	24.4094	16.9291	7.4803	23.6220	LTCS/SS	367.29	-	4D
8"	DN 200	27.0472	17.7953	9.2520	31.4961	LTCS/SS	619.68	-	4D
10"	DN 250	29.5276	18.7795	10.7480	29.5276	LTCS/SS	792.98	-	3D
12"	DN 300	31.8898	19.8819	12.0079	35.4331	LTCS/SS	1120.68	-	3D
14"	DN 350	33.7008	21.0630	12.6378	41.3386	LTCS/SS	-	1235.87	3D
16"	DN 400	35.9449	22.0866	12.7165	47.2441	LTCS/SS	-	1599.61	3D
18"	DN 450	38.5827	23.0709	15.5118	53.1496	LTCS/SS	-	1974.57	3D
20"	DN 500	40.9449	24.0551	16.8898	59.0551	LTCS/SS	-	2530.18	3D
24"	DN 600	46.5748	26.0630	20.5118	70.8661	LTCS/SS	-	4228.09	3D
30"	DN 750	53.3071	29.0551	24.2520	88.5827	LTCS/SS	-	6457.76	3D
32"	DN 800	55.9449	30.0787	25.8661	94.4882	LTCS/SS	-	7593.07	3D
36"	DN 900	60.8268	32.0472	28.7795	106.2992	LTCS/SS	-	9905.28	3D
40"	DN 1000	63.8189	34.0551	29.7638	118.1102	LTCS/SS	-	11320.72	3D

Material specifications ANSI 1500 (flow cell)

LTCS forging	ASTM A350-LF2 Cl.1
LTCS welding	ASTM A333 grade 6 / ASTM A350-LF2 Cl.1
SS forging	ASTM A182-F316
SS welding	ASTM A312-TP316L / ASTM A182-F316L

Material certificate 3.1

Flange rating ANSI 1500 metric

Meter size [inch]	Meter size [mm]	Dimensions [mm] A	B	C	L	Flow cell material	Weight forged [kg]	Weight welded [kg]	Length
3"	DN 80	555	422	147	400	LTCS/SS	77	-	5D
4"	DN 100	586	431	155	500	LTCS/SS	114	-	5D
6"	DN 150	628	430	198	600	LTCS/SS	203	-	4D
8"	DN 200	695	452	243	800	LTCS/SS	342	-	4D
10"	DN 250	770	477	293	1000	LTCS/SS	555	-	4D
12"	DN 300	842	505	338	1200	LTCS/SS	832	-	4D
14"	DN 350	910	535	375	1450	LTCS/SS	-	1055	4D
16"	DN 400	973	561	413	1600	LTCS/SS	-	1390	4D
18"	DN 450	1043	586	458	1800	LTCS/SS	-	1724	4D
20"	DN 500	1104	611	493	2000	LTCS/SS	-	2166	4D
24"	DN 600	1247	662	585	2400	LTCS/SS	-	3526	4D

Flange rating ANSI 1500 imperial

Meter size [inch]	Meter size [mm]	Dimensions [inch] A	B	C	L	Flow cell material	Weight forged [lb]	Weight welded [lb]	Length
3"	DN 80	21.8504	16.6142	5.7874	15.7480	LTCS/SS	170.29	-	5D
4"	DN 100	23.0709	16.9685	6.1024	19.6850	LTCS/SS	251.04	-	5D
6"	DN 150	24.7244	16.9291	7.7953	23.6220	LTCS/SS	448.11	-	4D
8"	DN 200	27.3622	17.7953	9.5669	31.4961	LTCS/SS	753.21	-	4D
10"	DN 250	30.3150	18.7795	11.5354	39.3701	LTCS/SS	1224.09	-	4D
12"	DN 300	33.1496	19.8819	13.3071	47.2441	LTCS/SS	1834.07	-	4D
14"	DN 350	35.8268	21.0630	14.7638	55.1181	LTCS/SS	-	2326.87	4D
16"	DN 400	38.3071	22.0866	16.2598	62.9921	LTCS/SS	-	3063.59	4D
18"	DN 450	41.0630	23.0709	18.0315	70.8661	LTCS/SS	-	3801.59	4D
20"	DN 500	43.4646	24.0551	19.4094	78.7402	LTCS/SS	-	4775.87	4D
24"	DN 600	49.0945	26.0630	23.0315	94.4882	LTCS/SS	-	7772.84	4D

Material specifications ANSI 2500 (flow cell)

LTCS forging	ASTM A350-LF2 Cl.1
SS forging	ASTM A182-F316

Material certificate 3.1

Flange rating ANSI 2500 metric

Meter size [inch]	Meter size [mm]	Dimensions [mm] A	B	C	L	Flow cell material	Weight forged [kg]	Weight welded [kg]	Length
3"	DN 80	595	422	162	480	LTCS/SS	131	-	6D
4"	DN 100	630	452	178	600	LTCS/SS	194	-	6D
6"	DN 150	694	452	243	750	LTCS/SS	411	-	5D
8"	DN 200	752	477	275	1000	LTCS/SS	650	-	5D
10"	DN 250	840	502	338	1250	LTCS/SS	1127	-	5D
12"	DN 300	910	530	380	1500	LTCS/SS	1596	-	5D

Flange rating ANSI 2500 imperial

Meter size [inch]	Meter size [mm]	Dimensions [inch] A	B	C	L	Flow cell material	Weight forged [lb]	Weight welded [lb]	Length
3"	DN 80	23.4252	17.4016	6.3780	18.8976	LTCS/SS	288.23	-	6D
4"	DN 100	24.8031	17.7953	7.0079	23.6220	LTCS/SS	427.08	-	6D
6"	DN 150	27.3228	17.7953	9.5669	29.5276	LTCS/SS	906.06	-	5D
8"	DN 200	29.6063	18.7795	10.8268	39.3701	LTCS/SS	1432.67	-	5D
10"	DN 250	33.0709	19.7638	13.3071	49.2126	LTCS/SS	2485.60	-	5D
12"	DN 300	35.8268	20.8661	14.9606	59.0551	LTCS/SS	3518.00	-	5D

Technical data

Measurement principle	Ultrasonic transit time measurement
Sizes	3" to 56" (DN 80 to DN 1400)
Pressure range	Atmospheric to 420 barg (2175 psig), minimum pressure depending on size and gas composition
Process temperature ranges [4]	Standard: -40 °C to +85 °C (-40 °F to +185 °F) Extended: -50 °C to +85 °C (-58 °F to +185 °F) MID: -40 °C to +55 °C (-40 °F to +131 °F)
Ambient temperature ranges [4]	Standard: -40 °C to +60 °C (-40 °F to +140 °F) Extended: -50 °C to +60 °C (-58 °F to +140 °F) MID: -40 °C to +55°C (-40 °F to +131 °F)
Repeatability	0.05% [1]
Typical uncertainty	0.5% of reading after dry calibration [2] 0.2% of reading after flow calibration [2] 0.1% of reading after flow calibration and linearization [2]
Body materials	Low-temperature carbon steel ≤ 12": ASTM A350-LF2 Cl.1 ≥ 14": ASTM A333 grade 6 / ASTM A350-LF2 Cl.1 Stainless steel ≤ 12": ASTM A182-F316 ≥ 14": ASTM A312-TP316L / ASTM A182-F316L Other materials on request
Material certificate	EN 10204 3.1 (3.2 on request)
Body construction details	≤ 16": reduced bore, tapering angle 7° ≥ 18": full bore
Pressure reference points	½" NPT (G½ on request)
Electronic enclosure material	Cast aluminium alloy. Optional stainless steel.
Power supply	Nominal 24 V DC (18 – 30 V DC), 10 – 20 W (depending on installed optional cards)
Local display	GUI, 4.3" (10.9 cm) widescreen graphical colour display with 7 capacitive soft keys (touch), LEDs for power and status
Interfaces	- 2 serial ports (RS 232/485 configurable) - 1 Ethernet port / high speed VDSL (VDSL option replaces Ethernet port) - 2 frequency outputs, 0 to 3 kHz - 2 digital outputs[3] - 2 analogue outputs[3] - 1 USB port (device)
Communications protocol	- Modbus (ASCII, RTU, TCP/IP) - UNIFORM - UNIFORM Series V 4-path compatibility mode - MMS (Manufacturing Message Specification) - Built-in web server
Metrological approval	MID T10335 (optional)
MID Accuracy Class	Class 1.0
Hazardous area approvals	ATEX: Ⓔx II 2 G Ex d ia [ia] IIB+H2 T6 Gb IECEx: Ex d ia [ia] IIB+H2 T6 Gb FM: Class I, Division 1, Group A to D T6 CSA: (pending) Class I, Division 1, Groups B, C and D; Ex d ia [ia] IIB+H2 T6
Ingress protection	IP 66 / IP67 /NEMA Type 4X

1) Q_t to Q_{max}
2) Q_t to Q_{max} with straight inlet/outlet spool of 10D/3D
3) Analogue outputs and digital outputs sharing the terminal clamps
4) Ranges: subject to application and (hazardous area) approval.

Your contacts

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QSonicPlus EN04
A05.09.2013

73030073

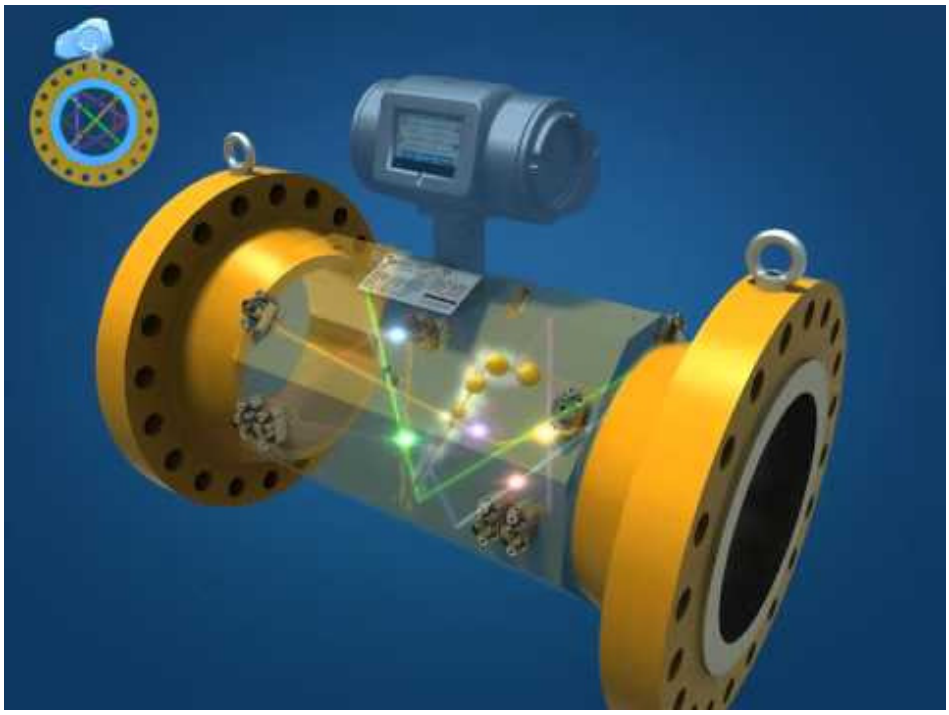
ATTACHMENT 3

Q.Sonic Plus Photograph 1


vline
4.015533 m/s
qline
243.342407 m³/h
elster
Q.Sonic plus
elster
Instromet

ATTACHMENT 4

Q.Sonic Plus Photograph 2




elster
Q.Sonic plus

ATTACHMENT 5

Q.Sonic Plus Pigsar Calibration Certificate

pigsar ™

Operator of German National Standards
for volume of high-pressure natural gas

Calibration Certificate

Number 11330/2012
Date 2012-10-16

Applicant	Name:	Elster NV/ SA
	Order no.	3471418/9510
Meter under test	Description:	Ultrasonic meter
	Manufacturer:	Elster NV/SA
	Type:	Q.Sonic Plus
	Serial number:	05759 - forward
	Nominal size:	8"
	Range of flowrate:	30...3990 m³/h
	Year of manufacture:	2012
	Nominal diameter of meter:	200 mm
	Nominal diameter of flange:	200 mm
	Nominal flange pressure:	ANSI 600 # RF
Date of test	2012-10-16	
Results	The results of the calibration are presented on page 3.	
Test procedure	PTB-Prüfregeln Band 30, Messgeräte für Gas, Hochdruckprüfung von Gaszählern Physikalisch-Technische Bundesanstalt, Braunschweig und Berlin, 2003	
Test facility	*pigsar* represents the National Standard of the Federal Republic of Germany for the unit of volume for high pressure natural gas under supervision of PTB. *pigsar* disseminates the harmonised values for the unit of volume for high pressure gas flow measurements of the Federal Republic of Germany, France and The Netherlands. *pigsar* is accredited according to EN ISO 17025.	
Traceability	The presented results of the calibration are based on the unified Dutch-French-German reference values for the unit of volume for high-pressure gas flow measurements. On June-02-1999, PTB (Physikalisch-Technische Bundesanstalt) and VSL (formerly NMi-VSL, Netherlands Measurement Institute - Van Swinden Laboratorium) and later on May-04-2004 LNE (The Laboratoire national de métrologie et d'essais) have joined the harmonization (unification) procedure and the use of these reference values, see page 2.	

Dorsten, 2012-10-16

Operator of German National Standards for Volume of High Pressure Natural Gas
pigsar ™
High Pressure Gas Meter
Calibration Facility
Accredited to
ISO/IEC 17025

The presented results of the calibration are based on the harmonized Dutch-French-German reference values for the unit of Volume for High Pressure Natural Gas flow measurements. In Paris, on 2004-May-4, PTB (Physikalisch-Technische Bundesanstalt), VSL (Van Swinden Laboratorium) and LNE (The Laboratoire national de métrologie et d'essais) have agreed on the harmonization and the use of these reference values.

The Physikalisch-Technische Bundesanstalt (PTB) in Braunschweig and Berlin is the national institute for science and technology and the highest technical authority of the Federal Republic of Germany for the field of metrology and certain sectors of safety engineering. The PTB comes under the auspices of the Federal Ministry of Economics. It meets the requirements for calibration and testing laboratories as defined in the EN ISO/IEC 17025.

It is the fundamental task of the PTB to realize and maintain the legal units in compliance with the International System of Units (SI) and to disseminate them, above all within the framework of legal and industrial metrology. The PTB thus is on top of the metrological hierarchy in Germany.

This certificate is consistent with the Calibration and Measurement Capabilities (CMCs) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures (CIPM). Under the MRA, all participating institutes recognize the validity of each other's calibration and measurement certificates for the quantities, ranges and measurement uncertainties specified in Appendix C (for details see http://www.bipm.org).

VSL is the National Metrology Institute of The Netherlands and is part of the Holland Metrology Group (formerly known as NMi Group). VSL is appointed by the Dutch Government as the national institute for developing and maintaining the national measurement standards.

VSL makes an important contribution towards the reliability, quality and innovation of products and processes, both in business and society at large and provides a direct link to international accepted measurement standards in order to achieve traceability for measurement results of companies, laboratories and organisations.

VSL is accredited by RvA (Raad voor Accreditatie,"Board of Accreditation") to perform calibrations conform ISO17025 and is accredited to perform initial verification services for and on behalf of NMi Certin B.V.

The Laboratoire national de métrologie et d'essais (LNE) is the company designated by the French government as responsible of policy in terms of metrology in replacement of BNM (Bureau National de Métrologie) since January 2005.

The LNE is also designated by the French government as the Legal Metrology Service to perform type approvals and verifications. Thus, it is the fundamental task of the LNE to realize, develop and maintain the national primary standards and to insure the traceability of industries and users to the S.I units by the realization of specific instrumentation and calibration benches.

Certificate Number: 11330/2012
Date: 2012-10-16

Applicant Elster NV/ SA

Meter under Test

Type	Ultrasonic meter Q.Sonic Plus
Manufacturer	Elster NV/SA
Serial number	05759 - forward
Nominal Size	8"
Year of manufacture	2012

Test Conditions

Test medium	Natural gas		CO_2	1,3	mole %
Pressure, absolute	50,9	bar	H_2	0,0	mole %
Gas Temperature	18	°C	Calorific value,s	10,03	kWh/m³
Gas density (p, T)	43,1	kg/m³	Density,normal	0,8316	kg/m³
Dyn. viscosity (p, T)	1,30E-5	Pa s	Normal conditions (273,15 K; 101,325 kPa)		

Results (as left)

Qi / Qmax	Qi (m³/h)	Reynoldsnumber	Deviation (%)	Utot (%)
0,02	80,45	0,47 *10⁶	0,21	0,17
0,10	403,30	2,39 *10⁶	-0,10	0,14
0,20	803,16	4,74 *10⁶	-0,05	0,14
0,41	1622,89	9,59 *10⁶	0,03	0,14
0,70	2798,33	16,35 *10⁶	0,00	0,14
1,00	3980,03	22,51 *10⁶	0,19	0,21

Weighted mean error, with continuous and linear decrease of weighing factor between 0,7 Qmax and Qmax: 0,04 %.

The *deviation* is defined as: $$Deviation = \frac{(Indicated\ Value - Reference\ Value)}{(Reference\ Value)} \cdot 100\,\%$$

where the reference volume refers to the conditions at the meter under test. The reported values of this deviation are the arithmetical means of *n* single repeat measurements at each flow-rate.

The reported *total uncertainty* is defined as: $$U_{tot} = \sqrt{U^2_{harmonized} + U^2_{meter}}$$

where $U_{harmonized}$ is the expanded uncertainty of the harmonized reference value, stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, and U_{meter} is the expanded standard uncertainty of the meter under test, determined on the base of n repeats at each flow-rate, multiplied by Student-t-factor (n) / $n^{0,5}$, with a probability of 95%.

Remarks Security marks are applied

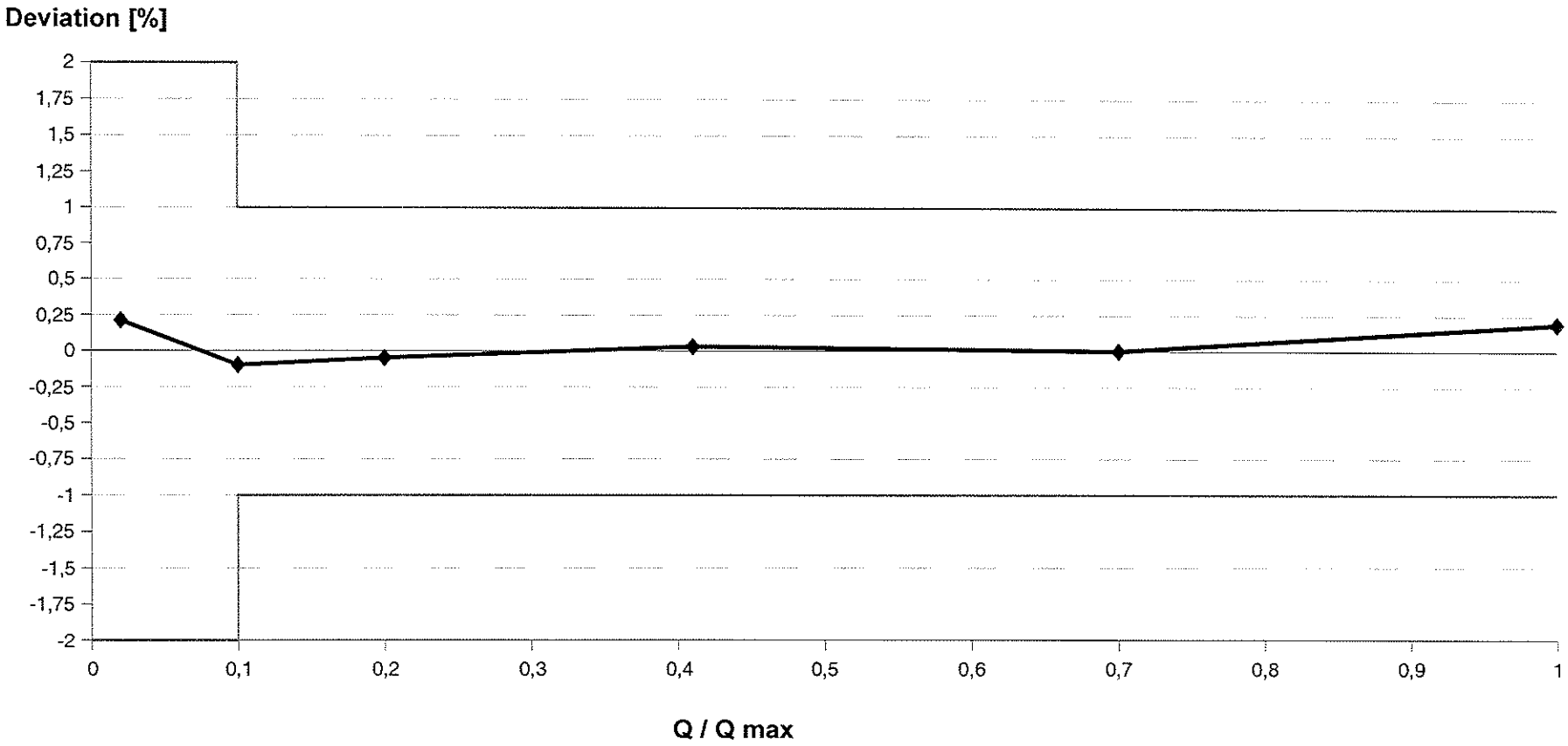
The calibrati

Flowconditioner(SN 2236) – upstream pipe (LI1): 2000 mm – meter – downstream pipe (LI1): 800 mm
The temperature was measured 400 mm behind the meter.
Flowconditioner and pipes were provided by the manufacturer/customer and are part of the meter.

Tested in Dorsten at *pigsar*, on 2012-10-16 Hüwener

Error Curve

Type of meter:	Ultrasonic meter	Customer:	Elster NV/ SA	DN:	200 mm	p(abs):	51	bar	HF	2250.00	pulses / m³
Meter no:	05759 - forward	Manufacturer:	Elster NV/SA	Size:	8"	Q max:	3990	m³/h	-	-	pulses / m³
Date:	2012-10-16	Gear 1:	-			Q min:	30	m³/h	-	-	pulses / m³
Inspector:	Hüwener	Gear 2:	-			-	-	pulses / m³	-	-	pulses / m³



Certificate Number **11330/2012**
Date **2012-10-16**

Following parameters have been used during the calibration.

sonic Explorer

Sonic Explorer Configuration Report for meter 5759 - 10/16/2012 2:48:08 PM

Meter Identification

Instrument Type	Q.Sonic plus
Meter Serial Number	05759
Meter Name	5759
Meter IP Address	192.168.1.110

DSP

	Value	Unit
Burst Start Frequency	223	Hz
Burst Stop Frequency	86	Hz
Burst Number SB Pulses	1	
Burst Number Frequencies	12	
Burst Number Transition Frequencies	0	
Burst Number CMB Pulses	60	
Burst Number Repetitions	1	
Measurement Sample Rate	23	
Measurement Cycle	3600	
SNR Limit	7.5	
Transit Time Filter Mode	MEDIAN FILTERING	

Detection Settings

Path	Zero Cross	Inverted	Detec. Threshold (%)	Detec. Method	Detec. Criteria (%)	Timing Constant
B1CW	Detect Second ZC	Positive Signal	140	Q-Sonic 4	200	27173
B1CCW	Detect Second ZC	Positive Signal	140	Q-Sonic 4	200	26903
A1	Detect Second ZC	Positive Signal	140	Q-Sonic 4	200	27703
A2	Detect Second ZC	Positive Signal	140	Q-Sonic 4	200	28642
B2CW	Detect Second ZC	Positive Signal	140	Q-Sonic 4	200	26374
B2CCW	Detect Second ZC	Positive Signal	140	Q-Sonic 4	200	26054

Certificate Number **11330/2012**
Date **2012-10-16**

Spoolpiece Parameters

Spoolpiece Diameter	0.19004 m	
Path	Length [m]	Angle [°]
B1CW	0.55819	62.2
B1CCW	0.55819	62.2
A1	0.49611	50
A2	0.4961	50
B2CW	0.55825	62.2
B2CCW	0.55824	62.2

V_module Parameters

Speed of Sound	Value	Unit
	300	m/s
	500	m/s
Velocity of Gas		
	-50	m/s
	50	m/s

Profile Correction

Coefficient	Axial	Swirl	Half-Square	Custom
P0	3792	3401	0	0
P1	26	66	0	0
P2	0.7502	1.0037	0	0
P3	0.98299	1.00192	0	0
P4	0.0324	0.0204	0	0
P5	-3.3193	-3.2056	0	0

Certificate Number **11330/2012**
Date **2012-10-16**

Body Temperature & Pressure

Temperature

	Value	Unit
Out of service	False	
Lower limit measured value	-10	
Upper limit measured value	60	

Pressure

Out of service	False	
Setpoint min. voltage	0	v
Setpoint max. voltage	0.05	v
Setpoint physical value at min.	0	bar-a
Lower limit measured value	1	bar-a
Upper limit measured value	120	bar-a

Density Viscosity

	Value	Unit
Density & Viscosity Mode	Static	
Static density	45	kg/m³
Static viscosity	1.3E-05	Pa s
Pressure & Temperature Mode	Static	
Static pressure	1.01315	bar-a
Static temperature	20	°C

Certificate Number **11330/2012**
Date **2012-10-16**

Adjustment and Linearization Parameters

Adjust Factor Parameters

	Value	Unit
k-adjust FWD	1	
k-adjust REV	1	
V_offset	0	m/s
Low Flow Threshold	0.03	m/s
Low Pressure Threshold	1.01315	bar-a

Linearization

Linearization Mode LINEAR

Mode 1

	Fwd.	Rev.
b0	0	0
b1	1	1
b2	0	0

Mode 2

Index	Fw Quant [m³/hr]	Fw Error [%]	Rev Quant [m³/hr]	Rev Error [%]
1	78.92	-0.05	0	0
2	394.32	0.54	0	0
3	2782.61	0.43	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0

Combination Parameters

Combination Method FIXED

Weighting Factors

Path Type	Value	FT Factors	Value
A Ax	0.15	C0	0
B Sw	0.85	C1	0
C HS	0	C2	0
D Cu	0		

Certificate Number **11330/2012**
Date **2012-10-16**

Gain Parameters

Path	Value	A->B [db]	B->A [db]
B1CW	AUTOMATIC	0	1
B1CCW	AUTOMATIC	0	0
A1	AUTOMATIC	3.75	0
A2	AUTOMATIC	1.25	0
B2CW	AUTOMATIC	0	0
B2CCW	AUTOMATIC	0	0

ComPort

Name	COM1	COM2
Line mode	RS485	RS485
Baudrate	9600	9600
Data bits	8	8
Parity	None	None
Stop bits	1	1

Frequency Output

Frequency Output On/Off	ON	ON
Name	Frequency Output 1	Frequency Output 2
Physical quantity	Volumetric Flowrate	PhVolFlowrate
Physical Unit	m³/hr	m³/hr
Frequency	0	0
Adjusted frequency	0	0
Maximum frequency	0	0
Setpoint min. frequency	0	0
Setpoint max. frequency	3000	3000
Setpoint output assign at min. frequency	0	0
Setpoint output assign at max. frequency	4800	-4800

Geometry correction

Geometry Correction	OFF
Geometry Correction Mode	Operating Conditions
Wall thickness	0.025
Body material Young's modulus	210000
Body thermal expansion coefficient	1.3E-05
Poisson's ratio body material	0.28

ATTACHMENT 6

Q.Sonic Plus Recklinghausen Calibration Certificate

Test centre for measuring instruments for gas at ELSTER GmbH Recklinghausen

The standards used for the measurements are traceable to the national standards of the Physikalisch-Technische Bundesanstalt PTB Germany.

Calibration Certificate

Number	**R 2609 / 2012**
Object	**Q.Sonic Plus**
Serial Number	4976
Manufacturer	Elster NV/SA
Applicant	Elster NV/SA
Number of pages of the appendix	1
Date of Calibration	2012-05-31
Test procedure	PTB Prüfregel Band 30, Messgeräte für Gas, Hochdruckprüfung von Gaszählern Physikalisch Physikalisch Technische Bundesanstalt, 2003
Tracebility	The presented results of the calibration are based on the unified Dutch-French-German reference values for the unit of volume for high pressure gas flow measurements. On June-02-1999 PTB (Physikalisch -Technische Bundesanstalt) and NMI VSL (Netherlands Measurement Institute Van Swinden Laboratorium) and later on May-04-2004 LNE (Laboratoire national de metrologie et d'essais) have joined the harmonisation procedure and use these reference values.

Calibration certificates without signature and stamp are not valid.
This calibration certificate may only be reproduced in unchanged form.

Recklinghausen, 2012-05-31 Stamp Signature

ISO 9001 ELSTER GmbH Recklinghausen elster

Stephan Toepper
Deputy Head of
Calibration Laboratory

Test center for gas measurement at ELSTER GmbH
Alte Grenzstrasse 33, D-45665 Recklinghausen
Tel.: +49 2361 9842085, Fax: +49 2361 9842451, Internet: www.elster.com

Additional data concerning the object

Meter Size 12"

Flow Range 66 - 7760 m³/h

Year of Construction 2012

Nominal Diameter DN 300

Pressure class Class 600

Adjust Factor 0,9948

Meter Factor 1125 Imp/m³

Test Procedure
Test in accordande PTB-Testing Instructions Volume 30, gas flow measurements, Physikalisch-Technische Bundesanstalt, 2003

.

Test Medium **Natural Gas**

Gas analysis CH4 = 92,16 %; CO2 = 0,83 %; N2 = 0,82 %; dv = 0,609; Ho,n = 11,612 kWh/m³

Results (Average of the repeats):

Q/Qmax	Flow rate *m³/h*	Reynolds Number *Re*	Error *fp %*	Uncertainty of measurement *Ufp %*
0,0085	66,7	2,75E+05	-0,02	0,20
0,05	389,5	1,60E+06	-0,21	0,18
0,10	779,0	3,17E+06	-0,04	0,18
0,20	1537,8	6,18E+06	-0,05	0,18
0,56	4350,9	1,66E+07	0,06	0,20

Verification Point:

Q/Qmax	Flow rate *m³/h*	Reynolds Number *Re*	Error *fp %*	Uncertainty of measurement *Ufp %*
0,20	1539,5	6,29E+06	-0,08	0,18

WME (Weighted Mean Error) 0,00 % **Pressure (absolute):** 47,2 bar **Temperature:** 11,6 °C
Acc. OIML R137

The error values are defined:: $fp = \left(\frac{Vp}{Vref} - 1\right) * 100\%$

fp = dev
Vp = measured volume by the meter to be tested
Vref = reference volume at the meter to be tested

End of Addendum

Test performed by

Recklinghausen, 2012-05-31

Stephan Toepper
Deputy Head of
Calibration Laboratory

Messunsicherheit
Uncertainty of measurement

Angegeben ist die erweiterte Messunsicherheit, die sich aus der Standardmessunsicherheit durch Multiplikation mit dem Erweiterungsfaktor $k = 2$ ergibt. Sie wurde gemäß „Leitfaden zur Angabe von Unsicherheit beim Messen"(GUM) ermittelt. Der Wert der Messgröße liegt dann im Regelfall mit einer Wahrscheinlichkeit von annähernd 95% im Falle der Normalverteilung im zugeordneten Überdeckungsintervall.
Stated are the extended uncertainty of the measurement, arose by the standard uncertainty by multiplication with extension factor K=2. It was determined acc.„Leitfaden zur Angabe von Unsicherheit beim Messen" (GUM). The value is normally by nearly 95% probability within the corresponding overlapping interval in case of standard distribution.

Hinweise
Notes

Der in kursiv geschriebene Text ist eine Übersetzung ins Englische. Im Zweifelsfall gilt der deutsche Originaltext.
The text in italic letters is a translation into the English language. In case of doubt, the original German text is valid.

Die dargestellten Messergebnisse der Kalibrierung basieren auf dem vereinheitlichten ("harmonisierten") Referenzwert für die Volumeneinheit von Hochdruck-Erdgas-Durchflussmessungen der Bundesrepublik Deutschland, Frankreich und den Niederlanden. Am 4.April 2004 vereinbarten die PTB (Physikalisch-Technische Bundesanstalt), NMI VSL (Netherlands Measurement Institute Van Swinden Laboratorium und LNE (Laboratoire national de metrologie et d'essais) in einem gemeinsamen Abkommen die einheitliche Anwendung dieses harmonisierten Referenzwertes.
The presented results of the calibration are based on the unified Dutch-French-German reference values for the unit of volume for high pressure gas flow measurements. On May-04-2004 PTB (Physikalisch-Technische Bundesanstalt), NMI VSL (Netherlands Measurement Institute Van Swinden Laboratorium) and LNE (Laboratoire national de metrologie et d'essais) have joined the harmonisation procedure and use these reference values.

Ende der Anlage
End of addendum

ATTACHMENT 7

Q.Sonic Plus NMi Calibration Certificate

CERTIFICATE

Applicant	Elster NV/SA Rijkmakerlaan 9 (Poort1) 2910 ESSEN Belgium
Submitted	Ultrasonic Gas Meter

Manufacturer	:	Elster Instromet
Type	:	Q Sonic-plus
Serial number	:	4980

Calibration method	The deviation of the meter under test is established with the master meter method. The conditions at the meter under test are converted to conditions at the references using the pressure and temperature measurements at the meter under test and the references. In the determination of the flow, the pressure measurement point noted as P_r or P_m is used. The references that are used are part of the National standard of gas flow measurement.
Date of calibration	See page 2.
Results	The results of the calibration are presented on page 2. The reported measurement uncertainty is based on the standard uncertainty of measurement multiplied by a coverage factor *k=2*, which for a normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has to be determined in accordance with the 'Guide to the Expression of Uncertainty in Measurement' (GUM).
Traceability	The results of the calibration services of NMi Nederland B.V. are traceable to primary and/or (inter)nationally accepted measurement standards.

NMi Nederland B.V.
3 October 2012

dr.ir. Jos G.M. van der Grinten
Metrology Manager EuroLoop

Mailing address:
NMi EuroLoop
Petroleumweg 36
3196 KD Rotterdam
The Netherlands
T +31 (0)10 216 03 11
E info@nmi-euroloop.nl
I www.nmi-euroloop.nl

CERTIFICATE

Device under test

Manufacturer	:	Elster Instromet	Adjust factor (forward)	:	1.0000
Meterkind	:	Ultrasonic gas meter			
Type	:	Q Sonic-plus	Pulses per m^3		
Serial number	:	4980	High Frequency 1	:	450.000
Year of construction	:	2012			
Nominal diameter	:	400 mm	Seals	:	NMi
Q_{max}/Q_{min}	:	20100 / 190 m^3/h			
P_{max}	:	93.0 bar			

Location	Date	Medium	P_{amb} [mbar]	T_{amb} [°C]	P_{gas} [bar(e)]	T_{gas} [°C]	Density [kg/m^3]
EuroLoop	27 Sep 2012	natural gas	1000	15	59	15	52,3

Results

Q_i/Q_{max} [%]	Q_i [m^3/h]	Reynolds number	Deviation [%]	CMC [%]	U_{tot} [%]
85	17101	6.41E+7	-0.10	0.24	0.27
69	13934	5.23E+7	-0.04	0.25	0.29
40	8109	3.04E+7	0.00	0.20	0.20
25	5044	1.89E+7	0.01	0.20	0.21
10	2027	7.60E+6	-0.05	0.20	0.23
5	1004	3.77E+6	-0.08	0.33	0.36

Q_i is defined as the indicated flow-rate +/- 5% of at least 3 single measurements at each flow-rate.

The *deviation* is defined as:

$$\text{Deviation} = \frac{\text{Indicated volume} - \text{Reference volume}}{\text{Reference volume}} \times 100\%$$

The reported values of this deviation are the arithmetical means of at least 3 single measurements at each flow rate.

The total uncertainty is the root sum square of the CMC and the repeatability of the meter under test

The CMC (Calibration and Measurement Capability) is the uncertainty that is associated with the traceability of the defined test facility. The actual reference values and corresponding uncertainties are consistent with the "Harmonized Reference Values" and corresponding uncertainties, as agreed between VSL, PTB and LNE.

CALIBRATION
RvA K027

sonic Explorer

Sonic Explorer Configuration Report for meter 4980 - 9/27/2012 11:51:38 AM

Meter Identification

Instrument Type	Q.Sonic plus
Meter Serial Number	4980
Meter Name	4980
Meter IP Address	192.168.1.110

DSP

	Value	Unit
Burst Start Frequency	180	Hz
Burst Stop Frequency	180	Hz
Burst Number SB Pulses	3	
Burst Number Frequencies	12	
Burst Number Transition Frequencies	0	
Burst Number CMB Pulses	60	
Burst Number Repetitions	1	
Measurement Sample Rate	7	
Measurement Cycle	8000	
SNR Limit	7.5	
Transit Time Filter Mode	MEDIAN FILTERING	

Detection Settings

Path	Zero Cross	Inverted	Detec. Threshold (%)	Detec. Method	Detec. Criteria (%)	Timing Constant
B1CW	Detect Second ZC	Negative Signal	160	Q-Sonic 4	200	19684
B1CCW	Detect Second ZC	Negative Signal	160	Q-Sonic 4	200	18974
A1	Detect Second ZC	Negative Signal	160	Q-Sonic 4	250	17527
A2	Detect Second ZC	Positive Signal	160	Q-Sonic 4	250	17598
B2CW	Detect Second ZC	Positive Signal	160	Q-Sonic 4	200	18519
B2CCW	Detect Second ZC	Negative Signal	160	Q-Sonic 4	200	18969
		Negative Signal				

Spoolpiece Parameters

Spoolpiece Diameter	0.4778	m

Path	Length [m]	Angle [°]
B1CW	1.40338	62.2
B1CCW	1.40338	62.2
A1	1.24745	50
A2	1.24745	50
B2CW	1.40338	62.2
B2CCW	1.40338	62.2

V_module Parameters

Speed of Sound	Value	Unit
	300	m/s
	500	m/s

Velocity of Gas		
	-50	m/s
	50	m/s

Profile Correction

Coefficient	Axial	Swirl	Half-Square	Custom
P0	3792	3401	3792	3401
P1	26	66	26	66
P2	0.7502	1.0037	1.0814	1.0037
P3	0.98299	1.00192	1.000083	1.0137
P4	0.0324	0.0204	-0.21843	0.0204
P5	-3.3193	-3.2056	-0.99797	-3.2056

Body Temperature & Pressure

Temperature

	Value	Unit
Out of service	False	
Lower limit measured value	-10	
Upper limit measured value	60	

Pressure

Out of service	False	
Setpoint min. voltage	0	v
Setpoint max. voltage	0.05	v
Setpoint physical value at min.	0	bar-a
Lower limit measured value	1	bar-a
Upper limit measured value	120	bar-a

Density Viscosity

	Value	Unit
Density & Viscosity Mode	Static	
Static density	52.26	kg/m^2
Static viscosity	1.23E-05	Pa s
Pressure & Temperature Mode	Static	
Static pressure	1.01315	bar-a
Static temperature	20	°C

Gas Composition

Component	Value	Unit
C1	0	Mol %
N2	0	Mol %
CO2	0	Mol %
C2	0	Mol %
C3	0	Mol %
H2O	0	Mol %
H2S	0	Mol %
H2	0	Mol %
CO	0	Mol %
O2	0	Mol %
iC4	0	Mol %
nC4	0	Mol %
iC5	0	Mol %
nC5	0	Mol %
nC6	0	Mol %
nC7	0	Mol %
nC8	0	Mol %
nC9	0	Mol %
nC10	0	Mol %
He	0	Mol %
Ar	0	Mol %

Adjustment and Linearization Parameters

Adjust Factor Parameters

	Value	Unit
k-adjust FWD	1	
k-adjust REV	1	
V_offset	0	m/s
Low Flow Threshold	0.03	m/s
Low Pressure Threshold	1.01315	bar-a

Linearization

Linearization Mode	LINEAR

Mode 1

	Fwd.	Rev.
b0	0	0
b1	1	1
b2	0	0

Mode 2

Index	Fw Quant [m^3/hr]	Fw Error [%]	Rev Quant [m^3/hr]	Rev Error [%]
1	0	0	0	0
2	0	0	0	0
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	0	0	0

Combination Parameters

Combination Method	FIXED

Weighting Factors

Path Type	Value	FT Factors	Value
A Ax	0.15	C0	0
B Sw	0.85	C1	0
C HS	0	C2	0
D Cu	0		

Gain Parameters

Path	Value	A->B [db]	B->A [db]
B1CW	AUTOMATIC	0	1
B1CCW	AUTOMATIC	0	0
A1	AUTOMATIC	3.75	0
A2	AUTOMATIC	1.25	0
B2CW	AUTOMATIC	0	0
B2CCW	AUTOMATIC	0	0

ComPort

Name	COM1	COM2
Line mode	RS485	RS485
Baudrate	9600	9600
Data bits	8	8
Parity	None	None
Stop bits	1	1

Frequency Output

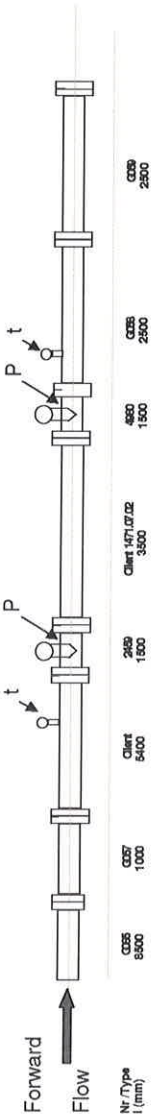
Frequency Output On/Off	ON	ON
Name	Frequency Output 1	Frequency
Physical quantity	Volumetric Flowrate	cy
Physical Unit	m^3/hr	Output
Frequency	0	2
Adjusted frequency	0	PhVolFl
Maximum frequency	0	owrate
Setpoint min. frequency	0	m^3/hr 0
Setpoint max. frequency	3000	0 0 0
Setpoint output assign at min. frequency	0	3000 0
Setpoint output assign at max. frequency	24000	-24000

Geometry correction

Geometry Correction	OFF
Geometry Correction Mode	Operating Conditions
Wall thickness	0.025
Body material Young's modulus	210000
Body thermal expansion coefficient	1.3E-05
Poisson's ratio body material	0.28

Elster Q.Sonic-5 20"600# nr: 2459 + Q.Sonic plus 20"600# nr: 4980

Calibration Configuration.



ATTACHMENT 8

Q.Sonic Plus CEESI Iowa Flow Calibration

CEESI Iowa Flow Calibration

CALIBRATION RESULTS

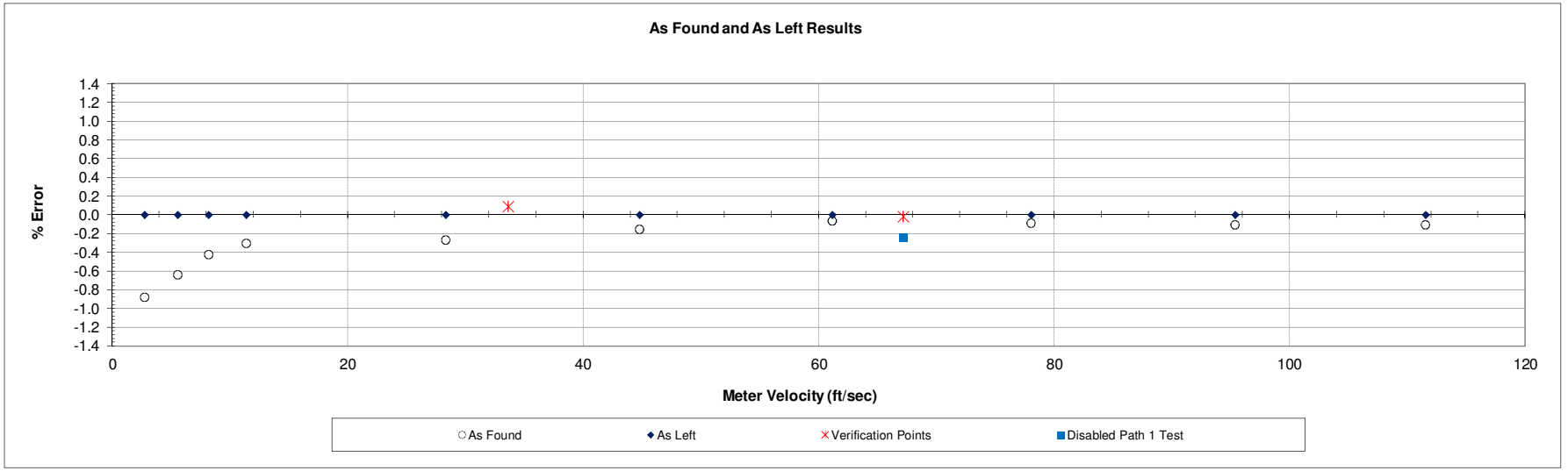
Customer : Elster - NNG
Serial Number : 05980
Device Type : Q.SonicPlus
Purchase Order # : 1166981
Flow Conditioning : CPA 50E
Date : 09/10/2013
Flow Direction = FORWARD

PRELIMINARY

Meter I.D. m	Meter I.D. in.	Pipeline in. (Nominal)
0.097028	3.82000	4.03000

Data Point	CEESI Calibration Factor	Flow Rate ft^3/hr Prover	Flow Rate ft^3/hr Meter	Flow Rate m^3/hr Prover	Flow Rate m^3/hr Meter	Velocity m/sec	Velocity ft/sec	Velocity m/sec V_m	Meter Velocity ft/sec V_m	Pipeline Velocity ft/sec V_m	As Found error %	Predicted As Left Error %	Verification Vel ft/sec	Verifcation Results %	Disabled Path 1 Test ft/sec	Disabled Path 1 Test Results %
1	1.0011	31997.6	31962	906.07	905.08	34.039	111.676	34.002	111.55	100.23	-0.11	0.000				
2	1.0011	27370.3	27340	775.04	774.19	29.116	95.526	29.084	95.42	85.74	-0.11	0.000				
3	1.0009	22385.9	22366	633.90	633.33	23.814	78.130	23.793	78.06	70.14	-0.09	0.000				
4	1.0007	17545.3	17533	496.83	496.48	18.665	61.236	18.652	61.19	54.98	-0.07	0.000	67.182	-0.020	67.263	-0.253
5	1.0016	12868.8	12848	364.40	363.82	13.690	44.914	13.668	44.84	40.29	-0.16	0.000				
6	1.0027	8150.1	8128	230.79	230.16	8.670	28.445	8.647	28.37	25.49	-0.27	0.000	33.652	0.090		
7	1.0031	3285.8	3276	93.04	92.76	3.495	11.468	3.485	11.43	10.27	-0.31	0.000				
8	1.0043	2366.1	2356	67.00	66.71	2.517	8.258	2.506	8.22	7.39	-0.43	0.000				
9	1.0065	1610.1	1600	45.59	45.30	1.713	5.619	1.702	5.58	5.02	-0.65	0.000				
10	1.0089	811.8	805	22.99	22.78	0.864	2.833	0.856	2.81	2.52	-0.88	0.000				
11																
12																
Sums		128391.75									-3.07					

Linearity (As Found) = ± 0.406 % Linearity = 1/2 Peak-to-Peak of Error Peak-to-Peak Error = 0.812%

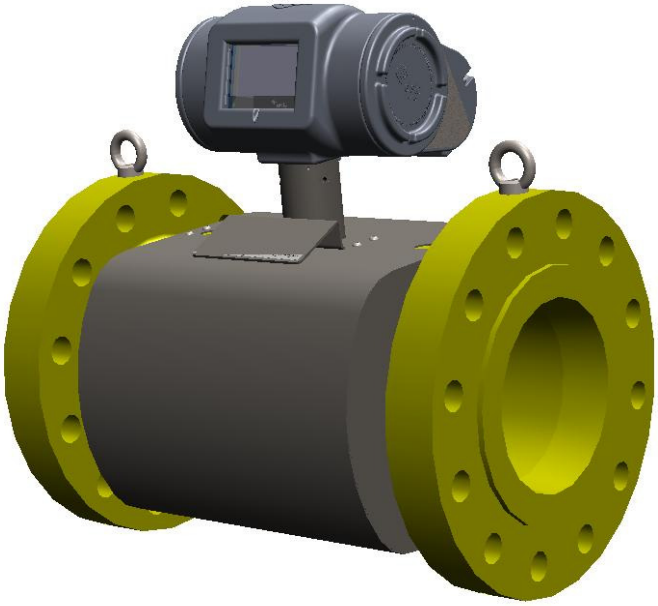


ATTACHMENT 9

Ultrasonic Flowmeter Series 6, Q.Sonic Plus Quick Start Manual

Ultrasonic Flowmeter Series 6,

Q.Sonic^{plus}



Quick start manual

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Tables

1 About this technical documentation

1.1 Introduction

This manual is a quick guide to the operation and maintenance of the Ultrasonic Flowmeter Series 6 gas flow meter, models Q.Sonic^{plus}. This manual together with 22.100.200.001.02/2, Ultrasonic Flowmeter Series 6 Safety Instructions, describes all essential information in compliance with applicable European Directives (e.g. ATEX, PED, EMC, MID) and international IECEx standard. The North American approvals (USA: FM, Canada: CSA) are pending.

It also contains important instructions to prevent accidents and serious damage before start-up, during operation, and to ensure trouble-free operation in the safest possible way. Before using the product read this manual carefully, familiarise yourself with the operation of the product, and strictly follow the instructions.

If you have any questions, or need further details of specific matters concerning this product, please do not hesitate to contact one of our staff members, email: sales@elster-instromet.com (See the address information on header).

This manual is based on the latest information. It is provided subject to alterations. We reserve the right to change the construction and/or configuration of our products at any time without obligation to update previously shipped equipment.

1.2 Warranty

The warranty provisions stipulated in the manufacturer's ***Terms of Delivery*** are applicable to the product. The manufacturer shall have no obligation in the event that:

- Repair or replacement of equipment or parts has been required through normal wear and tear, or by necessity in whole or part by catastrophe, or the fault or negligence of the purchaser.
- The equipment, or parts, have been maintained or repaired by other than an authorised representative of the manufacturer, or have been modified in any manner without prior express written permission of the manufacturer.
- Non-original parts are used.
- Equipment is used improperly, incorrectly, carelessly or not in line with its nature and/or purpose.
- The product is used with unauthorised equipment or peripherals, including, but not necessarily limited to, cables, testing equipment, computers, voltage, etc.

The manufacturer is not responsible for the incidental or consequential damages resulting from the breach of any express or implied warranties, including damage to property, and to the extent permitted by law, damage for personal injury.

1.3 Typographical Conventions

This manual employs consistent visual cues and some standard text formats to help you locate and interpret information easily.

Warning!

A warning indicates hazards or unsafe practices that could result in severe personal injury or death.

Caution!

A caution indicates hazards or unsafe practices that could result in minor personal injury or product or property damage.
A caution is also used to indicate operations or practices that may cause the product to operate in an undefined or unexpected way, or may produce non-specification results.

1.4 Abbreviations

ATEX	**At**mosphères **Ex**plosibles; European Directive 94/9/EC on equipment and protective systems intended for use in potentially explosive atmospheres
CSA	**C**anadian **S**tandards **A**ssociation International
DC	**D**irect **C**urrent
EC	**E**uropean **C**ommunity
EMC	**E**lectro**M**agnetic **C**ompatibility; European EMC Directive 2004/108/EC
IECEx	**I**nternational **E**lectrotechnical **C**ommission System for Certification to Standards Relating to Equipment for use in **Ex**plosive Atmospheres
FM	**F**actory **M**utual Approvals
MID	European Directive 2004/22/EC on measuring instruments
NMi	**N**ederlands **Meet**instituut
PED	**P**ressure **E**quipment **D**irective; European Directive 97/23/EC concerning pressure equipment
PC	**P**ersonal **C**omputer
PCB	**P**rinted **C**ircuit **B**oard
SPU	**S**ignal **P**rocessing **U**nit
UFM	**U**ltrasonic **F**low**M**eter

2 Ultrasonic Flowmeter Series 6 gas flow meter

2.1 General

The Ultrasonic Flowmeter Series 6 is a sophisticated, multi-path ultrasonic gas flow meter manufactured by Elster NV/SA. It has been specifically designed for custody transfer measuring applications that demand a high degree of accuracy and reliability.

2.2 Applicable standards

The Ultrasonic Flowmeter Series 6 flow meter is manufactured to be in accordance with European Directives: ATEX, PED, EMC and optionally MID.

If the meter is ordered for use at a location where European Directives are NOT mandatory, the meter can alternatively be manufactured with IECEx approval for use in hazardous area (FM and CSA approvals are still pending at the moment)

2.3 Configuration

On the flow cell of an Ultrasonic Flowmeter Series 6 several pairs of transducers are mounted. Each pair of transducers represents one individual measuring path. There are two measuring path types in the Ultrasonic Flowmeter Series 6: Axial (single bounce) and swirl (double bounce) these are shown in Figure 1.

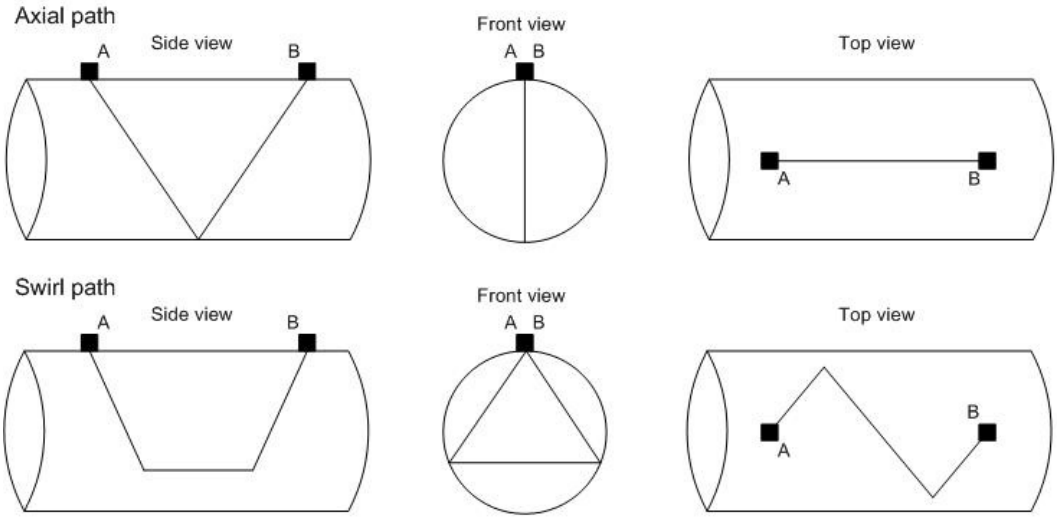


Figure 1: Path types

The Q.Sonic^{plus} path layout consists of 2 axial paths and 4 swirl paths. This combination results in a complete symmetrical path layout, ensuring the most optimal accuracy. Figure 2 shows the path layout of the Q.Sonic^{plus}.

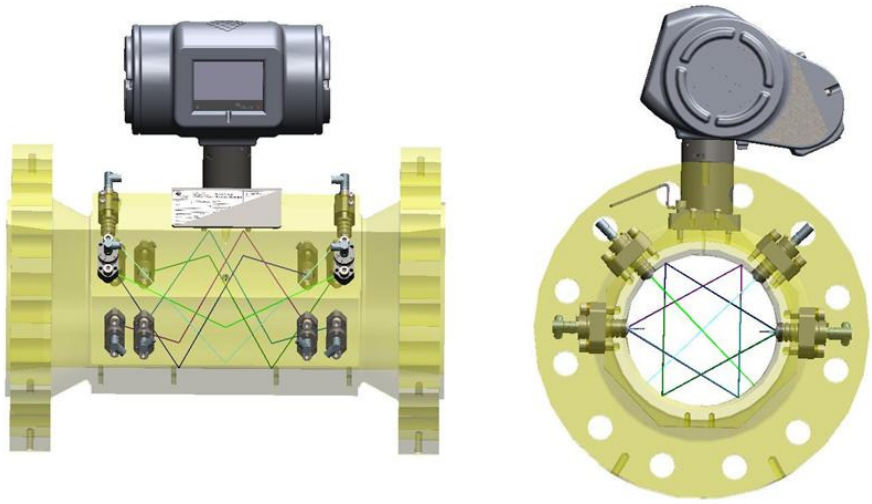


Figure 2: path layout Q.Sonic^{plus}

2.4 Calibration

When using the Ultrasonic Flowmeter Series 6, model Q.Sonic^{plus} in custody transfer applications, most countries demand (by law) a calibration from a certified calibration institute, supervised by an inspector of weights and measures. Examples of facilities generally used for calibrations are Euroloop in Rotterdam (NL), TransCanada Calibrations in Canada and PIGSAR GH45 of E.ON Ruhrgas AG in Dorsten (D).
If the Q.Sonic Series 6 has to be in accordance with MID, extra restrictions should be taken into account (see chapter 9.3).

3 Theory of operation

An ultrasonic flow meter is an inferential measurement device that consists of ultrasonic transducers that are typically located along a pipe's wall. The transducers are inserted into the piping using a gas tight mechanism. Ultrasonic pulses are alternately transmitted by one transducer and received by the other one. Figure 3 shows a simple geometry of two transducers, 'A' and 'B', at a sharp angle "φ" with respect to the axis of a straight cylindrical pipe with diameter "D". The Q.Sonic Series 6 employs reflection paths, where the acoustic pulses reflect one or more times off the pipe wall.

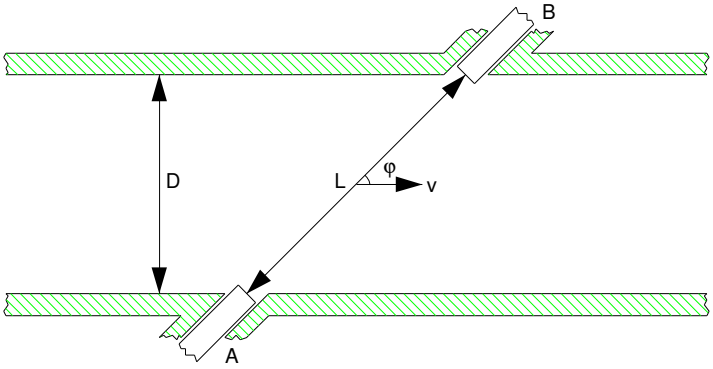


Figure 3: Ultrasonic measuring line

3.1 Flow velocity measurement

The acoustic pulses are crossing the pipe like a ferryman crossing a river. Without flow, they propagate with the same speed in both directions. If the gas in the pipe has a flow velocity different from zero, pulses travelling downstream with the flow will move faster, while those travelling upstream against the flow will move slower. Thus, the downstream travel times "t_{ab}" will be shorter, while the upstream ones "t_{ba}" will be longer as compared when the gas is not moving. Equation 1 illustrates the computation of these times:

$$VoG_{raw_n} = \frac{L_n}{2 \cdot \cos(\varphi_n)} \cdot \left(\frac{1}{tab_n} - \frac{1}{tba_n} \right)$$

Equation 1: raw gas velocity

where:

t_{abn} the downstream travel time of path n.

t_{ban} the upstream travel time of path n.

L_n the straight line length of the acoustic path between the two transducers.

$VoGraw$ is the average uncorrected (raw) gas velocity.

φ_n the angle between the gas flow and ultrasonic signal.

The raw gas velocity is corrected by a Reynolds flow profile correction. This correction is depending on the path type. Also the contribution of the gas velocity of each path to the combined gas velocity is depending on the path type.

3.2 Correction after calibration

After flow calibration the meter can be adjusted either through an adjust factor or through linearization. How the meter is adjusted can be visualized at the display (see chapter 6.1).

3.3 Volume flow at line conditions

The volume flow at line conditions Q_{Line} is the (adjusted) profile-corrected gas velocity V_{line} multiplied by the internal cross section A of the flow cell:

$$Q_{line} = V_{line} \cdot A \cdot t$$
$$= V_{line} \cdot \frac{\pi \cdot D^2}{4} \cdot 3600 \left[m^3 / h \right]$$

Equation 2: calculation of the line volume flowrate

where:
Q_{Line} the volume flow at line conditions
V_{line} the adjusted profile-corrected gas velocity
D the internal diameter of the meter

4 System description

4.1 Flow cell

The flow cell is the part of the Ultrasonic Flowmeter Series 6 that is mounted in the piping system. All components making the Ultrasonic Flowmeter Series 6 (SPU, transducers, type plates and optional pressure and temperature sensors) are mounted on the flow cell, see Figure 4.

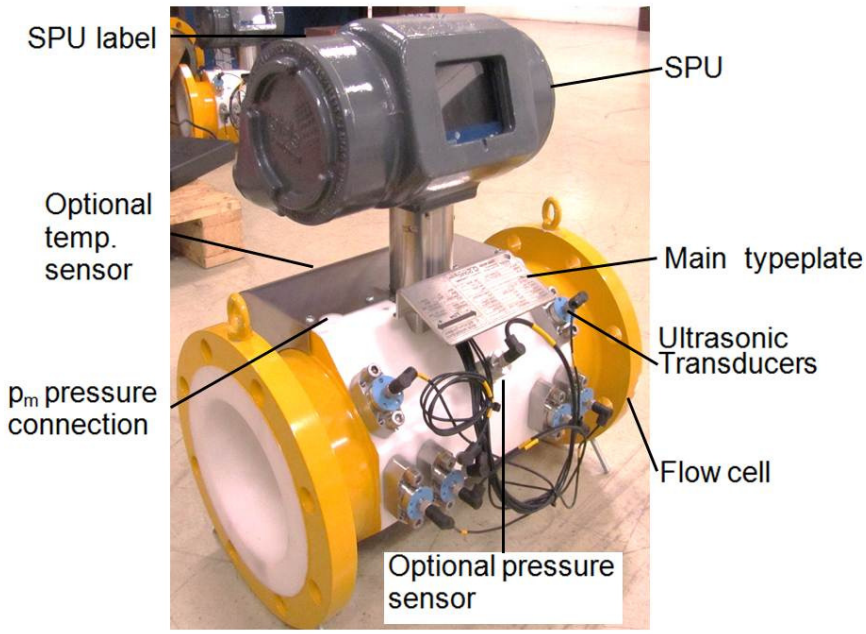


Figure 4: Example of an Elster-Instromet Ultrasonic gas flowmeter

4.2 Signal processing unit

The SPU is mounted in an explosion proof housing. The box consists of two separate compartments; a main and a rear compartment (see Figure 5).

The main compartment can be opened from the side of the SPU and contains the main circuit boards. The main compartment also comprises intrinsically safe connections for the ultrasonic transducers and optional temperature and pressure sensors. All data processing from excitation of the transducers to calculating the flow rate is handled by the electronics in this compartment.

To prevent the box from opening by vibration, the covers on the side need to be firmly tightened and secured with the lock screw in the cover, see Figure 6. When closing the back compartment ensure all screws are used.

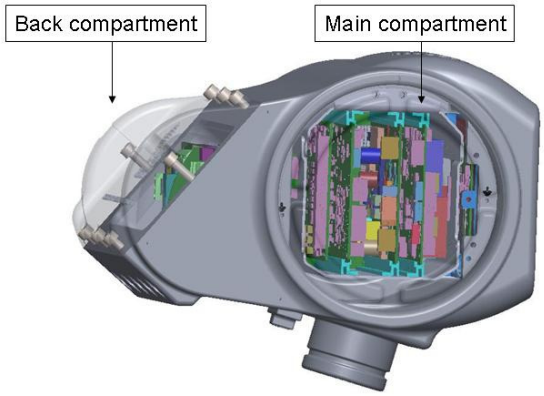


Figure 5: SPU compartments

Figure 6: SPU cover

The rear compartment comprises a field terminal board used for connecting the Ultrasonic Flowmeter Series 6. For detailed information about this see chapter 5.3.

4.3 Transducers

The ultrasonic signals required for the flow measurement are generated and received by ultrasonic transducers.
Piezoelectric transducers employ crystals or ceramics that are set into vibration when an alternating voltage is applied to the piezoelectric element. The vibrating element generates sound waves in the gas. Since the piezoelectric effect is reversible, the element will become electrically polarised and produce voltages related to the mechanical strain, when the crystal is distorted by the action of incident sound waves. Because the acoustic impedance of the gas is much smaller as the acoustic impedance of the piezoelectric element, and to maximise the acoustic efficiency, a matching layer is employed between the gas and the piezoelectric element.
The transducers used on the Ultrasonic Flowmeter Series 6 are type 'NG', see Figure 7. Figure 8 visualises the NG transducer with the mounting boss.

Figure 7: NG transducer

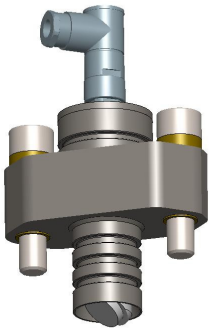


Figure 8: NG transducer with the mounting boss

4.4 Flow cell optional pressure sensor

As an optional feature the UFM can be equipped with a pressure sensor. This pressure sensor is used for:

- The Reynolds flow profile correction

- Compensation of the flow cell expansion due to gas pressure

Caution!
The pressure sensor is not used for Volume conversion

4.5 Flow cell optional temperature sensor

As an optional feature the UFM might be equipped with a temperature sensor. The temperature sensor is used for:

- The Reynolds flow profile correction
- Compensation of the flow cell expansion due to flow cell (gas) temperature

Caution!.
The temperature sensor is not used for volume conversion.

4.6 Labels and nameplates

Nameplates and labels are used to identify the product and to provide details on the specific product. Together with the product manual it specifies how to use the product is certified and designed.

- The main plate provides information on mechanical design conditions as well as flow related information such as meter factor and range, see Figure 9.
- Refer to the type plate on the SPU for the applicable hazardous area approval. This could be according to ATEX, IECEx, FM or CSA, see Figure 10 to Figure 13.

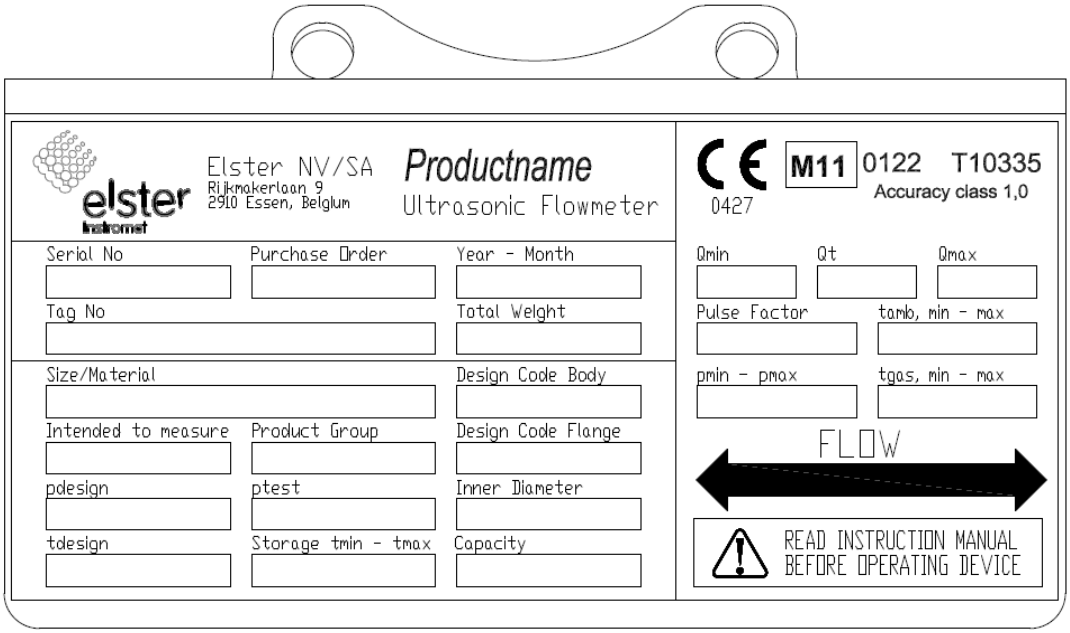


Figure 9: example main plate

4.6.1. ATEX certified

The explosion proof housing has following ATEX certification:

- Classification: Ex d ia [ia] IIB+H2 T6 Gb IP66

- -50 °C ≤ Tamb ≤ +60 °C
- ATEX markings: Ⓔx II 2 G CE 0344
  - 0344 is the NoBo no. of DEKRA Certification B.V.
- ATEX certificate reference: DEKRA 11ATEX0170 X

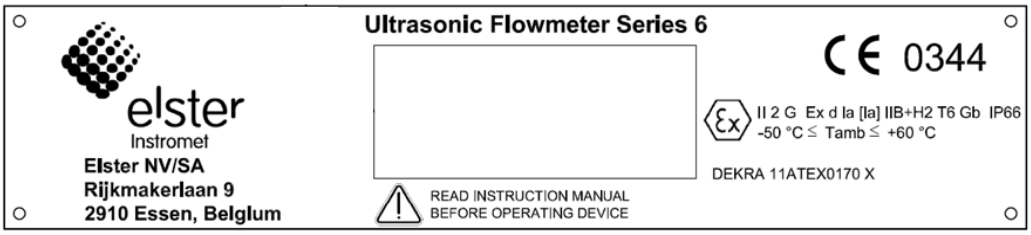


Figure 10: example ATEX label

4.6.2. IECEx certified

The explosion proof housing has following IECEx certification

- Classification: Ex d ia [ia] IIB+H2 T6 Gb IP66
- -40 °C ≤ Tamb ≤ +60 °C
- IECEx certificate reference: IECE DEK11.0062 X

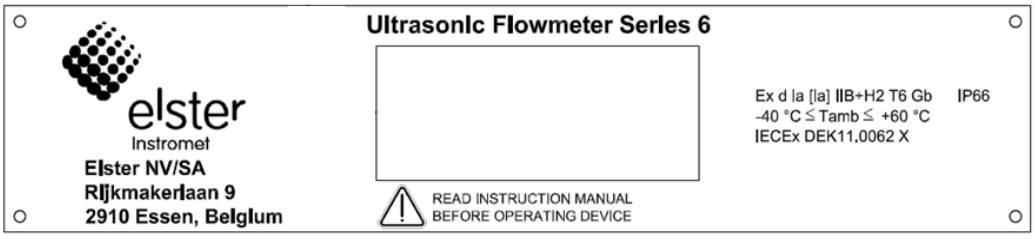


Figure 11: example IECEx label

4.6.3. FM certified

This certification is still pending and is expected to be as followed:

The explosion proof housing has following FM certification

- Classification: Class I, Division 1, Group A to D T6
- -40 °C ≤ Tamb ≤ +60 °C
- NEMA 4X
- "FM approved" mark
- Installation requirements according to the FM approval
  - Refer to control drawing: 03.304.001.003.05/2
  - Seal all conduits within 1.50" of enclosure in GROUP A, B &C

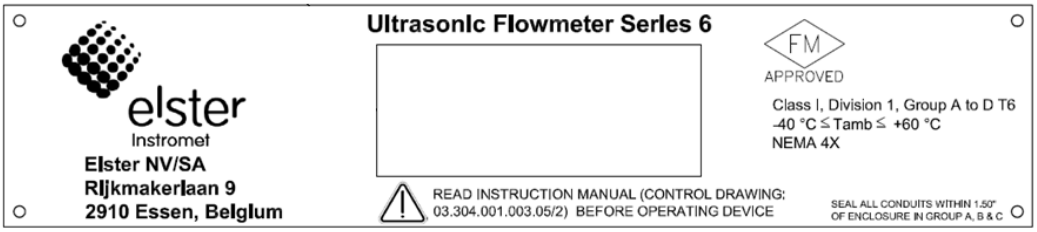


Figure 12: example FM label

4.6.4. CSA certified

This certification is still pending and is expected to be as followed:
The explosion proof housing has following CSA certification

- Classification: Class I, Division 1, Group B, C & D T6
- Ex d [ia] IIC T6
- -50°C ≤ Tamb ≤ +60°C
- NEMA 4X / IP66
- CSA approval mark
- Installation requirements according to the CSA approval
  - Refer to control drawing: 03.304.001.003.05/2
  - Seal all conduits within 1.50" of enclosure in GROUP B &C

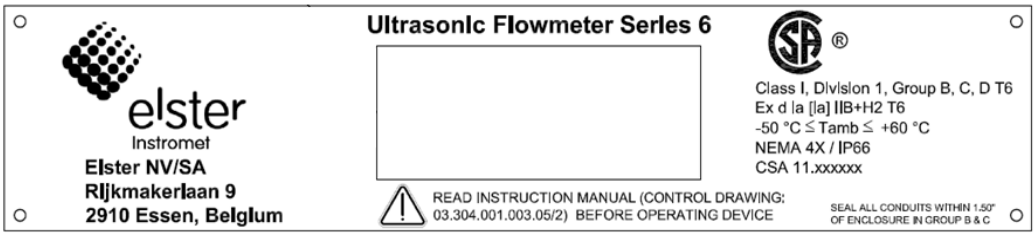


Figure 13: example CSA label

4.7 Sealing

This chapter describes the important sealing locations.

4.7.1. Main plate

Figure 14 shows how the main plate is sealed to the flow cell.

Figure 14: sealing main plate

4.7.2. SPU

The SPU in the main compartment of the flameproof certified box is sealed on 2 locations.

- By means of the PCB sealing bracket the SPU electronics is sealed to the flameproof certified Box, see Figure 15.

Figure 15: Example PCB sealing bracket

- The meter should be protected from undesired changes in the software. Therefore a hardware switch is placed on the main board. This hardware switch can be reached through a hole in the back panel. The hole in the back panel is protected with a transparent cap (see Figure 16). Towards
  If the both pins on the switch are up the meter is sealed and the parameter settings of the meter is locked from editing. If both pins are down the meter is unsealed and parameter settings can be altered, when using the right software (see chapter 6.3).
  Sealing of the switch itself should be done with the screw socket on the protective cap.

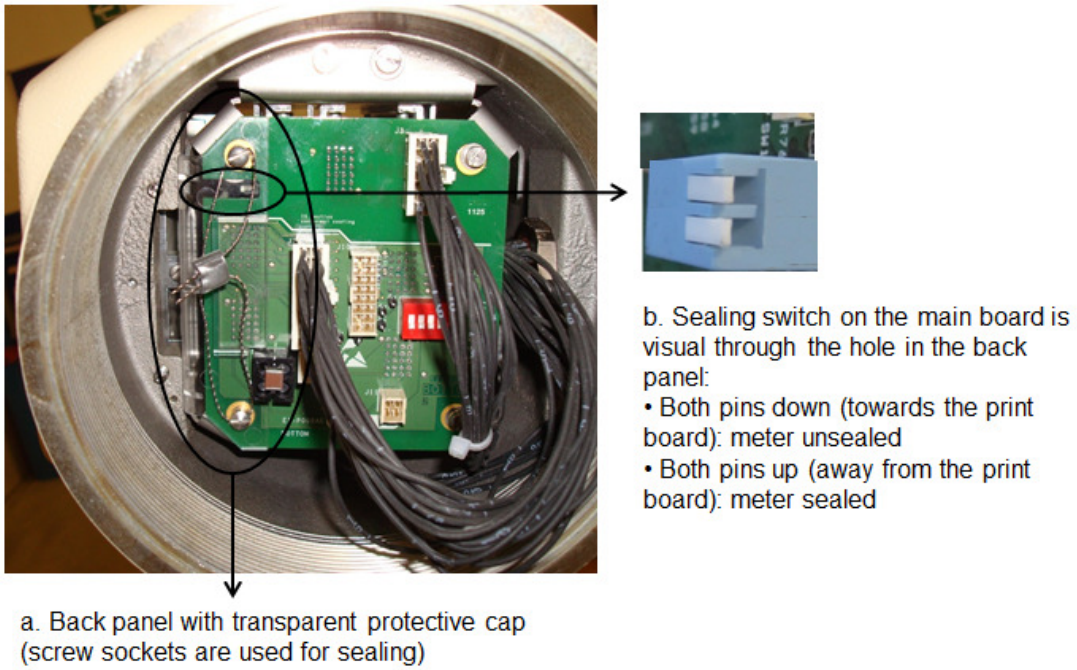


Figure 16: hardware protection on the main board

5 Installation and commissioning

5.1 Introduction

It is very important to check the shipment of your ultrasonic flow meter equipment. At least a visual inspection of surfaces, flanges and transducer cables should be performed. In case of damage, contact Elster NV/SA immediately.

Also verify if all the necessary documentation is available as well. At least you should have:

- Safety instructions (doc. Code: 22 100 200 001/02/2 latest valid version)
- Operation and maintenance manual (doc. Code: 22.100.200.002.02/2/ latest valid revision)

Also look at your project data to see if extra documentation is required and delivered. If documentation is missing, contact Elster NV/SA or your local agent immediately.

5.2 Installation requirements flow cell

The Ultrasonic Flowmeter Series 6 (flow cell, transducers and SPU) is shipped in a wooden box. Remove the top panel nails or the marked screws and disassemble the box. Remove the transport straps from the flow cell, and then move the ultrasonic flow meter (using the lifting lugs provided on the flow cell) to the installation site. Install the meter according to end-user's company regulations and applicable local and national requirements. To ensure optimal performance of the UFM, comply with the up- and downstream spool requirements specified for your particular UFM (see your order documentation).

Warning!

To avoid possible strain, make sure the lifting equipment is suitable for the weight of the Ultrasonic Flowmeter Series 6. Always use the lifting lugs and make sure lifting equipment is certified and shows no damage or wear.

Be aware!

Special attention needs to be taken when the Ultrasonic Flowmeter Series 6 has to be installed in accordance with MID (see chapter 9.4).

5.3 Wiring instructions

This chapter provides a guideline on how to wire the Ultrasonic Flowmeter Series 6. If more detailed information is required, refer the Ultrasonic Flowmeter Series 6 wiring instructions (document code 03.302.101.003.07/2/ last valid revision).

5.3.1. General specifications

The SPU box contains 2 separated compartments; a main and a rear compartment (see Figure 5). The main compartment can be opened from the side of the SPU and contains the most important circuit boards. However all connections are factory set and shouldn't be

adjusted on site. Therefore it is strongly advised to only open this compartment after consultation with Elster NV/SA.

All connections on the meter should be made at the rear compartment. Five connection holes are provided; the thread type can be either M20 or ½" NPT. Unused holes are equipped with certified stopping plugs. The client is responsible to provide suitable glands, with regards to e.g. thread type and hazardous area certification.

For wiring the meter suited armoured shielded cables must used (communication cables should also be twisted), whereby the cables are protected from mechanical damaged as well as electrical interference. In addition ensure length, diameter, core and resistance of the cables provide a most optimal match for the particular application. Use Table 1 to assist selecting a suitable cable.

Be aware!

For wiring reliable and durable connections it is highly recommended to use insulated wire end terminals.
To prevent the ending of the flow measurement as result of a power failure; it is recommended to connect the UFM to an Uninterruptible Power Supply (UPS). For MID compliance this is required, as stated in chapter 9.4.

Warning!

For compliance with EN-IEC 61010 (also harmonized under EU Low Voltage directive 2006/95/EC) the SPU requires an external limited-energy power supply (max. 8 A) with double or reinforced insulation between primary and secondary circuit.
Disconnecting means from supply source shall be provided in the end use.

Power wiring (TB1)		
	Maximum cable core	2.5 mm^2
	Recommended voltage at the field terminal board	24VDC (18 – 30 VDC)
	Power consumption	20 Watt
Signal and communication wiring (TB2 – TB5 and optional J4)		
	Maximum cable core	1.5 mm^2

Table 1: Wiring specifications

5.3.2. Field terminal connections

The rear compartment is equipped with the field terminal board (see Figure 17). On this PCB all connections for external wiring are placed. There are no external connections in the main compartment. Please see Table 2 to Table 6 for wiring.

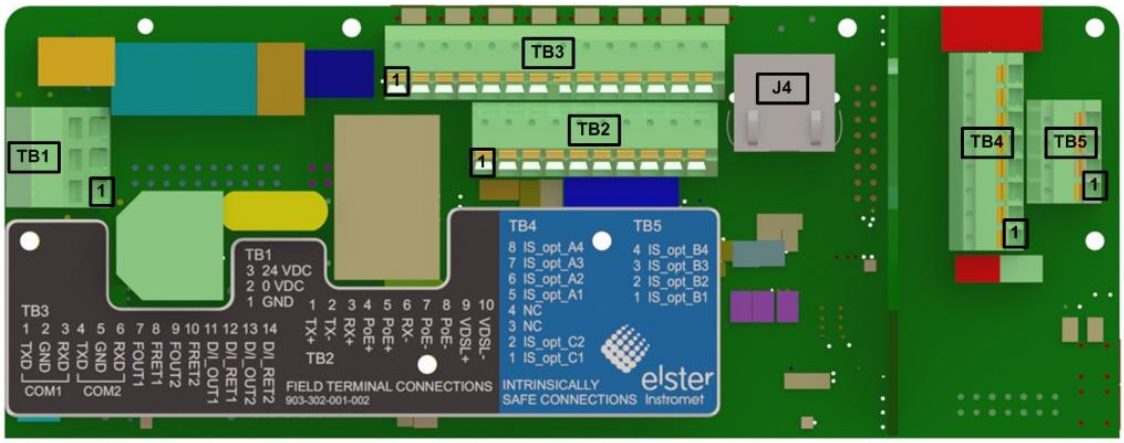


Figure 17: Field terminal board

TB1 (power connection)

Pin number	Signal name	Description
3	24 VDC	DC power input 24V nominal
2	0 VDC	DC power ground
1	GND	Power earth*

* If meter is cathodic protected the grounding should not be connected

Table 2: Field terminal board, TB1

TB2 (DSL / Ethernet terminal block connections)

Pin number	Signal name	Description
10	VDSL -	DSL -
9	VDSL +	DSL +
8	PoE -	Power over Ethernet (Power -)*
7	PoE -	Power over Ethernet (Power -)*
6	RX-	Ethernet receive -
5	PoE +	Power over Ethernet (Power +)*
4	PoE +	Power over Ethernet (Power +)*
3	RX+	Ethernet receive +
2	TX-	Ethernet transmit -
1	TX+	Ethernet transmit +

* When using power over Ethernet (POE), it shall be supplied by an external power supply, limited-energy (max. 48 Vdc max. 3 A). Reinforced insulation is provided between input and output by safety trans-former and distances on PCB

Table 3: Field terminal board, TB2

Power over Ethernet (POE) shall be supplied by an external power supply, limited-energy (max. 48 Vdc max. 3 A) , reinforced insulation is provided between input and output by safety trans-former and distances on PCB

TB3 (I/O)

Pin number	Signal name	Description
14	D/I_RET2	Digital output 2 / current output 2 return
13	D/I_OUT2	Digital output 2 (open collector) / current output 2

12	D/I_RET1	Digital output 1 / current output 1 return
11	D/I_OUT1	Digital output 1 (open collector) / current output 1
10	FRET2	Frequency output 2 (return)
9	FOUT2	Frequency output 2 (open collector)
8	FRET1	Frequency output 1 (return)
7	FOUT1	Frequency output 1 (open collector)
6	RXD COM2	Serial port 2 RS232 receive / RS485
5	GND COM2	Serial port 2 RS232 ground
4	TXD COM2	Serial port 2 RS232 transmit / RS485
3	RXD COM1	Serial port 1 RS232 receive / RS485
2	GND COM1	Serial port 1 RS232 ground
1	TXD COM1	Serial port 1 RS232 transmit / RS485

Table 4: Field terminal board, TB3

J4 (Ethernet RJ45 connection)

Pin number	**Signal name**	**Description**
8	PoE Power -	RJ45 Power over Ethernet (Power -)
7	PoE Power -	RJ45 Power over Ethernet (Power -)
6	Receive - / PoE Receive -	RJ45 Ethernet receive -
5	PoE Power +	RJ45 Power over Ethernet (Power +)
4	PoE Power +	RJ45 Power over Ethernet (Power +)
3	Receive + / PoE Receive +	RJ45 Ethernet receive +
2	Transmit - / PoE Transmit -	RJ45 Ethernet transmit -
1	Transmit + / PoE Transmit +	RJ45 Ethernet transmit +

Table 5: Field terminal board, J4

TB4 and TB5 are connections for an Intrinsically Safe optional board. If this board is not fitted in your SPU, these connections should not be used. If used, the intrinsically safe connections must comply with the applicable intrinsic safety approval; for more information see 22.100.200.001.02/2, Ultrasonic Flowmeter Series 6 Safety Instructions, Chapter 3 “Electrical parameters”.
These connections are not in the scope of the MID approval.

TB4 (IS connection 1)		**TB5 (IS connection 2)**	
Pin number	**Signal name**	**Pin number**	**Signal name**
8	IS_opt_A4	4	IS_opt_B4
7	IS_opt_A3	3	IS_opt_B3
6	IS_opt_A2	2	IS_opt_B2
5	IS_opt_A1	1	IS_opt_B1
4	NC		
3	NC		
2	IS_opt_C2		
1	IS_opt_C1		

Table 6: Field terminal board, IS connections (TB4 and TB5)

5.4 SPU configuration

When the meter is installed and correctly wired, it's advisable to read out the parameter settings of the meter. If the meter had been calibrated before, the parameter set-up should be compared to the one of the calibration.

The parameter set-up can be read with the software package 'SonicExplorer'. Connection should be made through the Ethernet or DSL communication, more detailed information about this matter can be found in the manual of the software packages. When mismatches are detected; contact Elster NV/SA or your local representative immediately.

Warning**!**

When opening the SPU (either main – or rear compartment), obey the rules and regulations that apply to hazardous area operations.

The electronics and the type plate of the UFM should be sealed. The sealing should be done by either the calibration facility or by Elster NV/SA. This should be done according to chapter 4.7; any mismatch has to be reported to Elster NV/SA immediately.

5.5 Cold commissioning

During cold commissioning the meter is pressurized with a known gas composition, at a known temperature and pressure, because in most cases the UFM will not be able to measure under atmospheric conditions.

A thorough functional test is performed by means of a PC and diagnostic software package ('SonicExplorer'). Diagnostics and status per measuring line and the zero flow can be checked, assuming there is sufficient pressure in the meter. A technician of Elster NV/SA will, if this has been agreed, verify measurements and check the system performance.

5.6 Hot commissioning

The hot commissioning is in most cases the last test of the UFM and can be witnessed by a representative of the client and, if required, by an inspector of weights and measures for the official sealing. Under this condition there is process gas in the pipe and a flow test is being performed. The performance, AGC Levels/Limits and zero flow are checked again. If possible, the gas flow running through the UFM will be compared to another flowmeter in the line. Most UFM are calibrated gas flow meters, so the measured value is reliable without exception. Furthermore, the interaction with the flow computer can be tested.

6 Operation

This chapter describes how the Ultrasonic Flowmeter Series 6 can be operated through the front panel on the meter. For more detail information, see the Q.Sonic Series 6 operation and maintenance manual (document code: 22.100.200.002.02/2/ last valid revision).

6.1 LED at display

2 LED's are visual on the display; they provide an overall status indication of the meter.

- Power LED (LED 1 at Figure 18):

LED status	Description
Off	Power off
Green	Power on

Table 7: Power LED

- Status LED (LED 2 at Figure 18)

LED status	Description
Off	Power off
Red, flashing	A red flashing light appears during the start-up phase after a power failure.
Orange, permanently illuminated	The device's legally relevant functionalities are running error-free.
orange, flashing	An error is pending that affects the legally relevant functionalities

Table 8: Status LED

Figure 18: LED at display

6.2 Front panel

The SPU contains a front panel, showing the most important measurements (line flow, gas velocity, speed of sound). It contains a touch screen with 7 touch area's (see Figure 19).

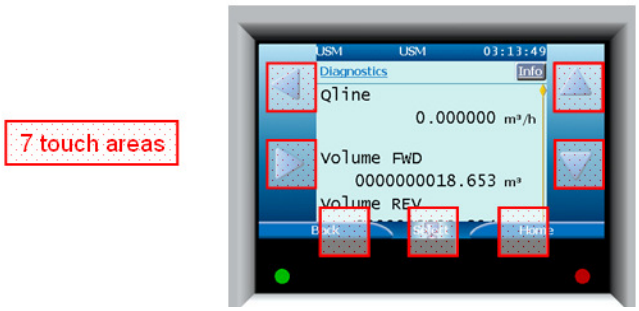


Figure 19: Front panel

Some important parameters (e.g.: Pulse factor, Alarm acknowledgement, Totalizers) can be visualized through the front panel. Also the software version with their checksum of all components can be verified through the screen. Figure 20 shows how this should be done.

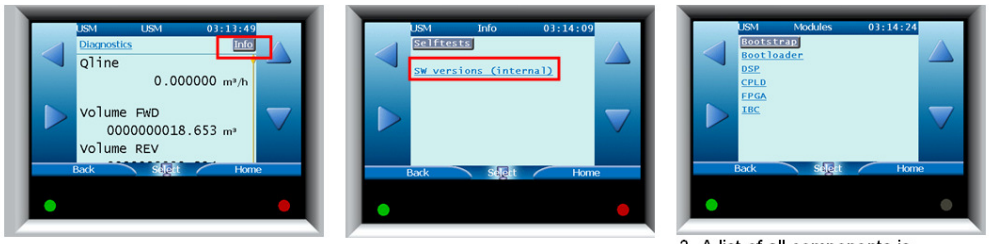


Figure 20: checking software versions and checksum through the front panel

Display test of the screen can be carried out as followed, see Figure 21.

Figure 21: Display test

It's also possible to visualize the front panel on your PC for which you need to connect the ethernet cable at the field terminal board (see chapter 5.3). Go to the internet browser of the PC and type following internet address: http://X/frontpanel.html (where X stands for IP-address of the meter).

6.3 Software package

For configuration and monitoring the Ultrasonic Flowmeter Series 6 Elster NV/SA has software package 'Sonic Explorer'. This program is specially designed to perform advanced monitoring of the Ultrasonic Flowmeter Series 6.
For more information about these programs, please contact Elster NV/SA.

7 Maintenance, service and repair

7.1 Introduction

The Ultrasonic Flowmeter Series 6 ultrasonic gas flow meter contains no moving parts. The transducers and internal pressure sensor are the only components that are in contact with the gas medium. The materials used for the transducers are selected for the measuring conditions that were clearly specified for the instrument. As a result the transducers and the electronics are virtually maintenance free. However, Elster NV/SA recommends inspection of the Ultrasonic Flowmeter Series 6 at regular intervals, for example every week or month. In case of degradation of the meter, appropriate measures can be taken on time.

For detailed information about maintenance, please refer to operation and maintenance manual (doc. code: 22.100.200.002.02/2/ last valid revision).

7.2 Exchanging components

Different parts of the Ultrasonic Flowmeter Series 6 metering system like transducers, electronic boards, etc can be exchanged easily. The digital programmed pulse shape and pulse identification of the meter is always identical. Therefore the electronic- and transducer products need no adjustment. This means that re-programming or re-calibration of the meter after exchanging any identical part of the Ultrasonic Flowmeter Series 6 metering system is not necessary.

Spare parts of the Ultrasonic Flowmeter Series 6 metering system must be supplied by Elster NV/SA. After exchanging parts of the Q.Sonic Series 6 metering system the present “calibration” sealing must be renewed, see the chapter 4.7.

Caution!

Before exchanging any components verify with your local metrology authority on proper procedures. It may be required that the operation needs to be witnessed by a representative of the local authority.

Warning!

Exchanging of components should only be done with the same type and model; unless otherwise specified by Elster NV/SA.

7.2.1. Pressure sensors exchange

The meter might be equipped with an optional pressure sensor for internal use (see chapters 4.4). As the pressure sensors are specially designed for the Ultrasonic Flowmeter Series 6, they may only be exchanged with sensors from Elster NV/SA.

Warning!

For the pressure sensor it's necessary to **depressurize** the line before exchanging.

7.2.2. Temperature sensors exchange

The meter might be equipped with an optional temperature sensor for internal use (see chapters 4.5). As the temperature sensors are specially designed for the Ultrasonic Flowmeter Series 6, they may only be exchanged with sensors from Elster NV/SA.
As the temperature sensor only measures the flow cell temperature and is not in contact with the gas in the pipe, exchanging can be done under pressure.

7.2.3. Transducer exchange

Each transducer is a separate component of the Ultrasonic Flowmeter Series 6 that can be exchanged independently. This can be done without degradation of the measuring properties and accuracy (thus the calibration) of the Ultrasonic Gas Flow Meter.
However, as the transducers are paired up during production, Elster NV/SA always recommends changing both transducers of an acoustic path, if possible.

Warning**!**

Obey the rules and regulations that apply to hazardous area operations and those with respect to custody transfer regulations (sealing).

Exchanging a transducer can take place when the line with the Ultrasonic Flowmeter Series 6 is **depressurized**:

Refer to specific installation instructions delivered with the transducers: Transducer exchange at atmospheric conditions (Document code: 03.200.001.001/02/2/ last valid revision).

Optionally exchanging a transducer can be done when the line with the Ultrasonic Flowmeter Series 6 is **pressurized**:

A special tool is required for this: the 'retraction tool NG transducers'. Please familiarise yourself with the documentation regarding this special tool: Retraction tool NG transducers (document code: 03.203.101.001.02/2/ last valid revision).

7.2.4. SPU exchange

Parts of the SPU can be exchanged without problems, provided that the appropriate hardware and software versions are used. The product numbers can be found on the PCB and have following structure xxx-xxx-xxx-xxx. The software version and its checksums can be checked through the front panel (see chapter 6.1).
This will not affect the measuring characteristics and the accuracy (and as a consequence the calibration) of the Ultrasonic Flowmeter Series 6 ultrasonic gas flow meter. However if the board is sealed after calibration, please contact Elster NV/SA or your local representative before proceeding with the exchange.

When exchanging the SPU (or parts of the SPU), refer to specific manual delivered with the component, the Ultrasonic Flowmeter Series 6 Exchange Signal Process Unit (document code: 03.303.201.001.02/2/ last valid revision).

8 Storage and shipping

As the Ultrasonic Flowmeter Series 6 is a delicate instrument, care should be taken to carefully handle and store the flowmeter in a proper way. Improper handling, shipping or storing may void its warranty.

The Ultrasonic Flowmeter Series 6 should be stored in indoor conditions, with a low humidity; storage temperature should remain between -20 °C and +60 °C. Please refer to our 'Ultrasonic Flowmeter Series 6 shipping and storage manual' (document code: 22.100.200.000.35/2/ last valid revision) for more detailed information about this.

9 MID requirements

9.1 General

This chapter is only applicable when the Ultrasonic Flowmeter Series 6, models Q.Sonic^{plus} needs to be in accordance with European Directive 2004/22/EC on measuring instruments (MID) as stated in EC-type Examination Certificate T10335.
The Ultrasonic Flowmeter Series 6 can be used legally for fiscal metering based on European Directive 2004/22/EC, Annex MI-002.

9.2 EC declaration of conformity

Elster NV/SA ultrasonic gas flowmeters will be manufactured in accordance with applicable Directives, with respect to:

- Pressure Equipment Directive (PED)
- Equipment and Protective systems intended for use in potential Explosive Atmospheres (ATEX) Directive
- ElectroMagnetic Compatibility (EMC) Directive
- Measuring Instrument Directive (MID)

In compliance with the applicable directives the meters are supplied with the CE mark and the EC Declaration of Conformity. This declaration is part of your flow meter documentation since it also contains important details of your particular flow meter (e.g. PED category, ATEX markings).

9.3 Calibration

An MID compliant meter is accompanied by a copy of the EC Declaration of Conformity stating compliance with Measuring Instruments Directive 2004/22/EC Annex MI-002, based on:

- EC-Type examination certificate T10335 according MID Annex B and
- a certificate of conformity from a Notified Body according to MID Annex F.

9.4 Installation requirements

Special attention needs to be taken so that the Ultrasonic Flowmeter Series 6 and its in- and outlet spools are mounted according to EC examination Certificate T10335 (last valid version).
Note that parameters stated in certificate T10335 may indicate a limit or limits of a range. The values and ranges applicable to your flowmeter may be different.
The UFM needs to be powered by an Uninterruptible Power Supply (UPS).

Appendix I. Safety prescriptions

This chapter describes important safety prescriptions for the Ultrasonic Flowmeter Series 6. At dispatch the latest version of the safety prescriptions for Ultrasonic Flowmeter Series 6 (code: 22.100.200.001.02/2/ last valid revision) is attached to the meter.

- Maintenance and replacement may only be carried out by qualified personnel under safe conditions.
- Always use a gas detector during servicing of the meter!
- Obey the rules and regulations that apply to hazardous area operations and those with respect to custody transfer regulations (sealing).
- Pressurized part involved. When executing any work, comply with the regulations that are specifically stipulated applicable to pressurized installations in a possible explosive danger area (as the case may be).
- Explosion proof box with the electronics inside may never be opened when meter is energized.
- Do not open the enclosure when explosive atmosphere may be present (see label & manual).
- Use the Ultrasonic meter only for intended application. Restrict to media and pressure & temperature limits. Never use US meter outside of these limits (for information see tag plate).
- It is not allowed to perform repair and maintenance activities on an operating US meter. The meter is pressurized and is used for dangerous media. Removing / exchanging parts during operation can cause severe harm or even death.
- When a non-retractable transducer needs to be taken out of the flow cell, the meter and the process line must be de-pressurized and have ambient temperature suitable to handle.

  In case of retractable transducers, it is only allowed to exchange these retractable transducers during operation of the meter when the procedure for exchanging transducers, as described in the manual from the manufacturer, is strictly followed.

  Be careful when removing transducers, media from the process line may still come out. This media can be poisonous, inflammable or dangerous in a different kind. To avoid these dangerous situations precautions need to be taken.

  (In any doubt about the type of transducers / manual → contact manufacturer: “sales@elster-instromet.com” or your local agent).
- When the meter needs to be taken out of the process line, this process line must be de-pressurized.
- The meter can be used for media with high or low temperatures, within specified range. Any contact with the meter can cause severe harm.
- Always use the correct tools and parts. Never use pneumatically powered tools, electrically powered tools or hydraulically powered tools to perform retraction of an Ultrasonic Transducer.
- Always leak test the meter after installation.
- Take care of proper grounding of the meter.
- To prevent water entering the flameproof certified box, firmly tighten the box when closing.
- Take care of preventive inspection of the meter (environment - & weather influence).

Appendix II. References

All references below can be obtained at Elster NV/SA.

[1] MID certificate T10335 (last valid version)
Doc.-No.:T10335_certificate

[2] Ultrasonic Flowmeter Series 6 operation and maintenance manual
Doc.-No.: 22.100.200.002.02/2/ last valid revision

[3] Ultrasonic Flowmeter Series 6 wiring instructions
Doc.-No.: 03.302.101.003.07/2/ last valid revision

[4] Transducer exchange at atmospheric conditions
Doc.-No.: 03.200.001.001/02/2/ last valid revision

[5] Retraction tool NG transducers
Doc.-No.: 03.203.101.001.02/2/ last valid revision

[6] Ultrasonic Flowmeter Series 6 Exchange Signal Process Unit
Doc.-No.:03.303.201.001.02/2/ last valid revision

[7] Ultrasonic Flowmeter Series 6 shipping and storage manual
Doc.-No.: 22.100.200.000.35/2/ last valid revision

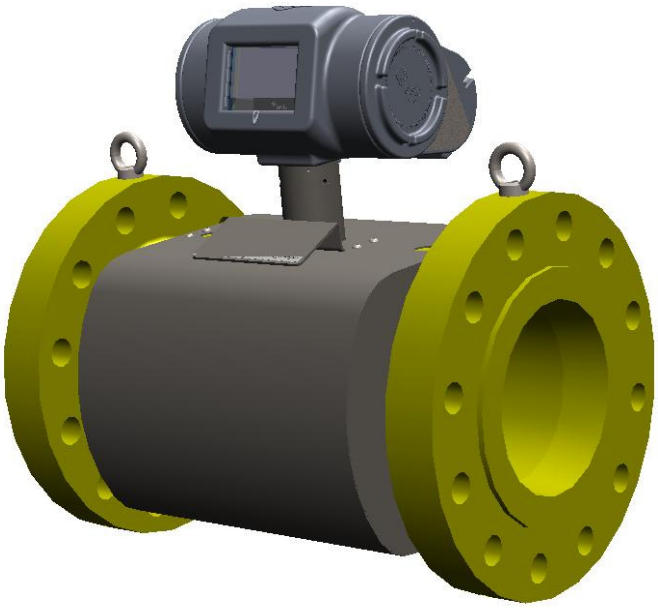
[8] Ultrasonic Flowmeter Series 6 Safety instructions
Doc.-No.: 22.100.200.001.02/2/ last valid revision

ATTACHMENT 10

Ultrasonic Flowmeter Series 6 Wiring Instructions

Ultrasonic Flowmeter Series 6

Wiring instructions



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Preface

This manual is based on the latest information. It is provided subject to alterations. We reserve the right to change the construction and/or configuration of our products at any time without obligation to update previously shipped equipment.

The warranty provisions stipulated in the manufacturer's ***Terms of Delivery*** are applicable to the product. The manufacturer shall have no obligation in the event that:

- Repair or replacement of equipment or parts has been required through normal wear and tear, or by necessity in whole or part by catastrophe, or the fault or negligence of the purchaser;
- The equipment, or parts, have been maintained or repaired by other than an authorised representative of the manufacturer, or have been modified in any manner without prior express written permission of the manufacturer;
- Non-original parts are used;
- Equipment is used improperly, incorrectly, carelessly or not in line with its nature and/or purpose;
- Use of this product with unauthorised equipment or peripherals, including, but not necessarily limited to, cables, testing equipment, computers, voltage, etc.

The manufacturer is not responsible for the incidental or consequential damages resulting from the breach of any express or implied warranties, including damage to property, and to the extent permitted by law, damage for personal injury.

1 Introduction

1.1 General

This document provides detailed information about wiring an ultrasonic flowmeter series 6. For general information about the ultrasonic flow meter series 6, please read the quick start manual (doc. code: 22.100.200.000.02/2 latest valid version). Before performing any activity on the ultrasonic flowmeter, please familiarize yourself with the safety instructions (doc. code: 22.100.200.001.02/2 latest valid version).

1.2 Overview SPU

The SPU box contains 2 separated compartments; a main and a rear compartment (see Figure 1 and Figure 2). The main compartment can be opened from the side of the SPU and contains the most important circuit boards. All connections herein are factory set and shouldn't be adjusted on site. Therefore it is strongly advised to only open this compartment after consultation with Elster NV/SA.

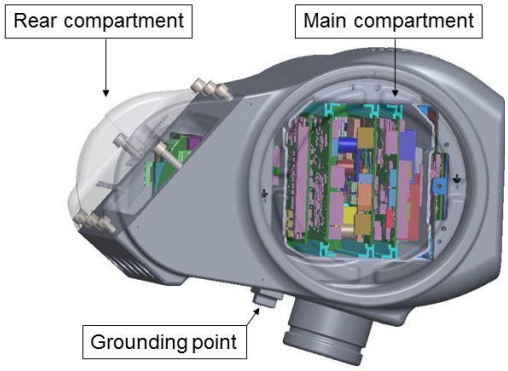

Figure 1: SPU compartments

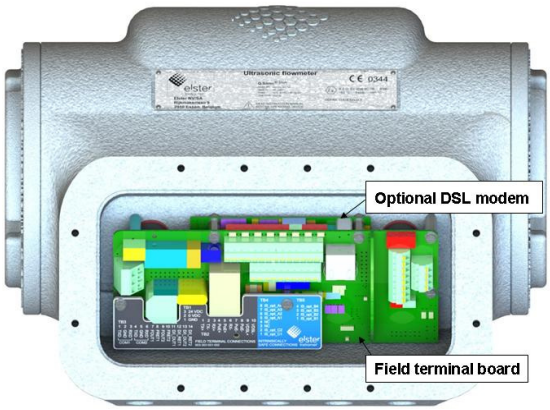

Figure 2: Rear Compartment

All connections on the meter should be made at the rear compartment (see Figure 2). Five connection holes are provided; the thread type can be either M20 or ½" NPT. Unused holes shall be equipped with certified stopping plugs; non-certified plugs (e.g. used for transport or storage) shall also be replaced by certified plugs. The client is responsible to provide suitable glands and stopping plugs, with regards to e.g. thread type, hazardous area certification, ingress protection.

The rear compartment is equipped with the field terminal board (see Figure 3). On this PCB all connections for external wiring are placed, therefore connecting to a flow computer only the connection on this PCB should be used.
Optional a DSL modem is placed behind the field terminal board. This is for a long distance network connection.

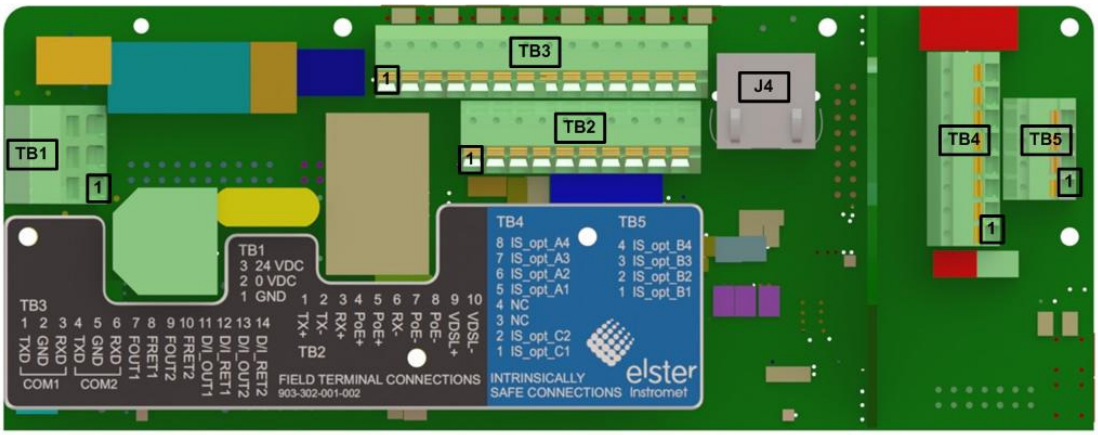

Figure 3: Field terminal board

1.3 Overall instructions

For wiring the meter suited armoured shielded cables must be used (communication cables should also be twisted), whereby the cables are protected from mechanical damages as well as electrical interference. In addition ensure length, diameter, core and resistance of the cables provide a most optimal match for the particular application.

Be aware!

Special attention needs to be taken when the Ultrasonic Flowmeter Series 6 has to be installed in accordance with MID (see quick start manual (doc. code: 22.100.200.000.02/2 latest valid version).
For FM Approved Ultrasonic Flowmeter series 6 see also the control drawing and installation remarks in the Safety Instructions (doc. code: 22.100.200.001.02/2 latest valid version).

For wiring reliable and durable connection it is highly recommended to use insulated wire end terminals.
To avoid cables ‘hanging’ in the glands; all cables must be ‘’clamped and cleated’ properly and close to the UFM connections.
The SPU can rotate almost 360°, keep this in mind for the length of the cables. Ensure they can rotate as well, if needed.

2 Power connection (TB1)

In Table 1 an overview is given of the power connections of the Ultrasonic Flowmeter Series 6. The position of the power connection is stated in Figure 3.

Pin number	Signal name	Description
3	24 VDC	DC power input 24V nominal
2	0 VDC	DC power ground
1*	EARTH	Power earth

* **Be aware!**

In case the ultrasonic flow meter body is connected to a cathodic protection system, leave pin number 1 unconnected; as in that case the 'earth' of the external power supply should NOT BE CONNECTED.

Table 1: Power connections (TB1)

For choosing the correct cable for wiring the power connection, please refer to the general instruction in chapter 1.3 and specific instruction in Table 2. When wiring the meter ensure all requirements are fulfilled. In case of accidental overvoltage the UFM contains a built-in surge protection.

Maximal cable core	2.5 mm^2
Maximal cable length	700 m (max. 5 ohm / wire)
Voltage at the field terminal board	18 – 30 VDC (24 V nominal)
Nominal power consumption	20 Watt

Table 2: Power connection, wire specification

To prevent the ending of the flow measurement as result of a power failure; it is recommended to connect the UFM to an Uninterruptible Power Supply (UPS). If MID applies, the UFM needs to be powered by an Uninterruptible Power Supply (UPS).

Warning!

For compliance with EN-IEC 61010 (also harmonized under EU Low Voltage directive 2006/95/EC) the SPU requires an external power supply, limited-energy (< 30 Vdc max. 8A), reinforced insulation is provided between input and output by safety transformer and distances on PCB.

Disconnecting means from supply source shall be provided in the end use.

Depending on the switch 'SW4' it is also possible to power the meter through the ethernet connections, for more detailed information please see chapters 3.1.1 and 4.1.3.

3 Communication connections

This chapter provides detailed information on communication wiring of the Ultrasonic Flowmeter Series 6. For choosing the correct cables, do not only follow the specification of this chapter, but also refer to the general instruction in chapter 1.3.

3.1 Network (TB2 and J4)

Only with Elster software package 'SonicExplorer' it is possible to perform any parameterization on the meter. Both software packages can only connect with the meter through a network connection. This network connection can be either Ethernet or DSL.

It is only possible to connect through DSL when the field terminal board is equipped with the optional DSL modem print board (see Figure 4). With DSL it is possible to get a network communication over a total maximum length of 1 km.

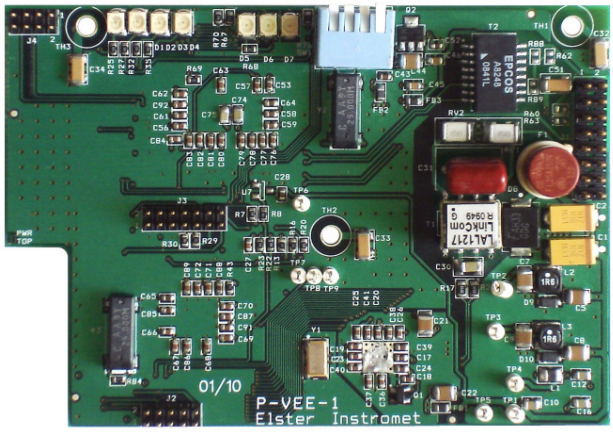

Figure 4: Optional DSL modem print board

When connecting through DSL, certain switches on the field terminal board need to be aligned, see chapter 4.1.2. With the switches on the DSL modem itself, it's possible to fine tune the quality of the communication, see chapter 5.

3.1.1. Connector TB2

Table 3 shows an overview of the connections on TB2. Maximum cable core is 1.5 mm².

Pin number	Signal name	Description
10	VDSL -	DSL - *
9	VDSL +	DSL + *
8	PoE -	Power over Ethernet (Power -) **
7	PoE -	Power over Ethernet (Power -) **
6	RX-	Ethernet receive - ***
5	PoE +	Power over Ethernet (Power +) **
4	PoE +	Power over Ethernet (Power +) **
3	RX+	Ethernet receive + ***
2	TX-	Ethernet transmit - ***
1	TX+	Ethernet transmit + ***

* Only possible with the optional DSL modem print board

** Power over Ethernet (POE) requires an external power supply, limited-energy (max. 48 Vdc max. 3 A), reinforced insulation is provided between input and output by safety transformer and distances on PCB. Power over ethernet complies with IEEE 802.3af

*** Cable must be UTP, STP or FTP with category 5E or 6. Maximum cable length is 100 meter.

Table 3: Communication connector, TB2

3.1.2. Connector J4 (Ethernet RJ45 connection)

Table 4 shows an overview of the connections on J4.

Pin number	Signal name	Description
8	Unused / PoE Power -	RJ45 Power over Ethernet (Power -) *
7	Unused / PoE Power -	RJ45 Power over Ethernet (Power -) *
6	Receive - / PoE Receive -	RJ45 Ethernet receive - **
5	Unused / PoE Power +	RJ45 Power over Ethernet (Power +) *
4	Unused / PoE Power +	RJ45 Power over Ethernet (Power +) *
3	Receive + / PoE Receive +	RJ45 Ethernet receive + **
2	Transmit - / PoE Transmit -	RJ45 Ethernet transmit - **
1	Transmit + / PoE Transmit +	RJ45 Ethernet transmit + **

* Power over ethernet (POE) complies with IEEE 802.3af. It requires an external power supply, limited-energy (max. 48 Vdc max. 3 A), reinforced insulation is provided between input and output by safety transformer and distances on PCB.

** Cable must be UTP, STP or FTP with category 5E or 6. Maximum cable length is 100 meter.

Table 4: Communication connector, J4

3.2 Communication connector TB3

Besides a network connection, the Ultrasonic Flowmeter Series 6 is capable of communicating through:

- serial communication (either RS232 or RS485), protocol U_DATA or ModBus
  - Cable cross-sectional size area (CSA) min 0.5 mm²
  - RS232: 3 x 2 cable max. 15m and 2.5ohm/wire
  - RS485: 2 x 2 cable max. 700m
- frequency output
  - Externally powered: 24 VDC, 10 kOhm pull-up resistor (max 30VDC @ 12mA)
  - Range programmable up to 5kHz
  - Possible outputs can be selected with ‘SonicExplorer’.
- analogue output
  - Internally powered (active): 24VDC, 40 mA maximum
  - Possible outputs can be selected with ‘SonicExplorer’.
- digital output
  - Externally powered: 24 VDC, 10 kOhm pull-up resistor
  - Can be set as ‘Low frequency’ or as a status output (e.g. data valid, flow direction)
  - Possible outputs can be selected with ‘SonicExplorer’.

All these communication possibilities are located on the TB3 connector. Maximum cable core is 1.5 mm². Table 5 shows an overview of the connections

Pin number	Signal name	Description
14	D/I_RET2	Digital output 2 / current output 2 return
13	D/I_OUT2	Digital output 2 (open collector) / current output 2
12	D/I_RET1	Digital output 1 / current output 1 return
11	D/I_OUT1	Digital output 1 (open collector) / current output 1
10	FRET2	Frequency output 2 (return)
9	FOUT2	Frequency output 2 (open collector)
8	FRET1	Frequency output 1 (return)
7	FOUT1	Frequency output 1 (open collector)
6	RXD COM2	Serial port 2 RS232 receive / RS485 B
5	GND COM2	Serial port 2 RS232 ground
4	TXD COM2	Serial port 2 RS232 transmit / RS485 A
3	RXD COM1	Serial port 1 RS232 receive / RS485 B
2	GND COM1	Serial port 1 RS232 ground
1	TXD COM1	Serial port 1 RS232 transmit / RS485 A

Table 5: Field terminal board, TB3

TB3 is factory set according to Elster-Instroment's standard settings (see Table 6), unless for a specific order otherwise has been agreed. The user can change the settings with "SonicExplorer" software through a network connection (see chapter 3.1).

Pin numbers	Signal type	Description
13 - 14	Digital output 2	Flow direction Open: Flow direction positive Closed: Flow direction negative
11 - 12	Digital output 1	Partial Failure Open: Performance of at least one path is below 10% Closed: Performance of all paths are above 10%
9 - 10	Frequency output 2*	Q-line Reverse flow, 0 – 3000 Hz
7 - 8	Frequency output 1	Q-line Positive flow, 0 – 3000 Hz
4 - 6	Serial comm. 2	RS 485, U_DATA, Baudrate 4800
1 - 3	Serial comm. 1	RS 485, ModBus RTU, Baudrate 9600

* It is also possible to 'link' the second frequency to the first, then it has the same setting, but only 90° phase shifted.

Table 6: Standard factory settings of communication connector TB3

Factory settings can be changed by using software package 'SonicExplorer'. Communication between the meter and 'SonicExplorer' can only be made through a network connection (see chapter 3.1).

4 Switches and LED indication

4.1 Switches on the field terminal board

The field terminal board contains four switches, SW1 to SW4 (see Figure 5), to control communication lines and power input.

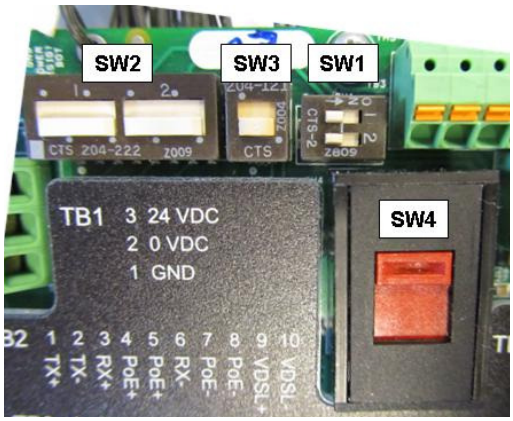

Figure 5: switches on the flied terminal board

4.1.1. SW1

This switch is placed for the line termination of the serial communication lines (see Table 5). Every transmission line has to be terminated with the right impedance. Certainly with long lines, like with RS 485 connections, a correct line termination is important. In transmission lines without termination, the signal reflects at the end of the cable. This reflection interferes with the original signal so a cacophony of signals is seen at the receiver.

In practice the line is terminated at the last meter in the RS485 multidrop network with a resistor. The 'SW1' switch has two separate line terminations, one for each RS 485 port.

- 'SW1-1': is the line termination of port 1: (pin number 1-3 of TB3, see Table 5).
- 'SW1-2': is the line termination of port 2: (pin number 4-6 of TB3, see Table 5).

The line termination is enabled when the switch is placed to the 'ON' position.

4.1.2. SW2 and SW3

'SW2' and 'SW3' are both used to switch the communication of the meter from Ethernet to DSL. 'SW2' consists of 2 separate switches; together with 'SW3' they all should be aligned the same (either up or down).

- For communication through DSL: 'SW2' and 'SW3' should be up. Communication should now be taken at pin number 9 -10 of TB2, see Table 3.
- For communication through ethernet: 'SW2' and 'SW3' should be down. Communication should now be taken at TB2 or J4, see Table 3 and Table 4.

Please keep in mind, that it is not possible to have communication with the Ultrasonic Flowmeter Series 6 through ethernet and DSL at the same time.

4.1.3. SW4

This switch controls if the meter needs to be powered through TB1 or through the ethernet connection.

- If the switch is up: the power should be foreseen through TB1 connector (see Table 1).
- If the switch is down: the power should be foreseen through the ethernet connection (see Table 3 and Table 4).

4.2 LED indication at the display

The display at the front of the SPU contains LED's to visualize the status of the power, connection and performance of the meter. Detailed information can be found in the quick start manual (doc. code: 22.100.200.000.02/2 latest valid version).

5 Optional DSL modem

For DSL communication the SPU must be equipped with the optional DSL modem (Figure 4) behind the field terminal board (see Figure 3). Wiring of the DSL communication at the UFM should be done as described in Table 3.
At the 'control room', it's recommended to use Elster NV/SA own designed VDD DSL modem. Detailed information about this modem can be found in doc: 03.302.101.050.07/2 (latest valid version).

5.1 Switches

The DSL modem contains 4 DIP switches (see Figure 6), whereby the DSL communication can be fine-tuned and aligned. The external VDD DSL modem also contains these 4 DIP switches. For optimal communication ensure both modems are aligned, as described below.

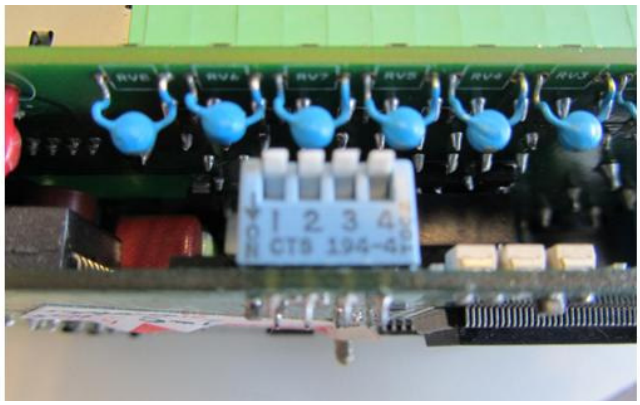

Figure 6: Switches on optional DSL modem

5.1.1. DIP switch 1

This switch is to set the modem configuration:

- ON, RT/CPE: DSL modem acts as Remote type / Customer premise equipment side (slave).
- OFF, OT/CO: DSL modem acts as Office type / Central office side (master).

The setting of this switch must be the opposite as on the modem on the other side of the communication line.

5.1.2. DIP switch 2

This switch is to set the data transmission mode:

- ON, Fast mode: Direct data transmitting with latency less than 1 ms.
- OFF, Interleave mode: Provides communication protection for up to 250 ms impulse noise with latency less than 6 ms.

Switch is only relevant if this modem is the master modem (see chapter 5.1.1)

5.1.3. DIP switch 3

This switch is to set the Band plan:

- ON, 998 ISDN: DSL modem acts as per 998 ISDN band plan.
- OFF, 997 symmetric ISDN: DSL modem acts as per 997 symmetric band plan.

Switch is only relevant if this modem is the master modem (see chapter 5.1.1)

5.1.4. DIP switch 4

This switch is to set the noise reduction level:

- ON, 6dB SNR: Standard noise reduction level (6 dB).
- OFF, 9dB SNR: Higher noise reduction level (9 dB)

Switch is only relevant if this modem is the master modem (see chapter 5.1.1)

5.2 LED indication

The DSL modem contains contains LED's that provide communication status information. Figure 7 shows the position of the LED's on the modem. The first 4 LED's are regarding the VDSL connection. The last 3 LED's are regarding the internal LAN connection. Table 7 shows their functionality.

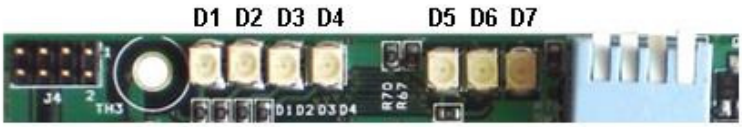

Figure 7: LED indication on the DSL modem

LED	ON	OFF	Flashing
D1	Power ON	Power OFF	(Not applicable)
D2	Slave (see chapter 5.1.1)	Master (see chapter 5.1.1)	(Not applicable)
D3	VDSL connection established and OK (it can blink occasionally when data is transferred)	VDSL link fail	- Slow flashing: VDSL connection is IDLE, system start-up - Fast flashing: establishing VDSL connection
D4	(Not applicable)	No VDSL link	Number of blinks after each other shows the speed of the VDSL connection. (For example: - blinking 6 times: speed 50 – 60M - blinking 9 times: speed 80 – 90M)
D5	LAN link ok	LAN link fail	TX/RX activity
D6*	100M speed	10M speed	(Not applicable)
D7*	LAN connection: Full duplex (4-wire connection)	LAN connection: Half duplex (2-wire connection)	LAN connection: Collision (communication fail)

* Only applicable when LAN connection is good (LED D5 is ON or blinking)

Table 7, Led indication on the DSL modem

6 IS connections TB4, TB5

IS connections TB4, TB5 are described below in Table 8 and Table 9. Use these tables together with the instruction on chapter 1.3, to choose the correct cable. Maximum cable core is 1.5mm².
TB4 and TB5 are connections for an Intrinsically Safe optional board. These connections are not in the scope of the MID approval.
If this board is not fitted in your SPU, these connections should not be used. If used, the intrinsically safe connections must comply with the applicable intrinsic safety approval. For more information see 22.100.200.001.02/2, Ultrasonic Flowmeter Series 6 Safety Instructions, which also includes the Control drawing required for FM Approved flow meters.

TB4 (IS connections 1)

Pin number	Signal name	Description
8	IS_opt_A4 *	PT 100 I-
7	IS_opt_A3 *	PT 100 U-
6	IS_opt_A2 *	PT 100 U+
5	IS_opt_A1 *	PT 100 I+
4	NC	Not Connected
3	NC	Not Connected
2	IS_opt_C2 **	Analogue input 4-20 mA - / HART
1	IS_opt_C1 **	Analogue input 4-20 mA + / HART

* 4-wire PT 100 (external) temperature sensor input with label “IS_opt_A1”, “IS_opt_A4” ,“IS_opt_A2” and “IS_opt_A3” circuit (terminals I+, I-, U+ and U-):

In type of protection intrinsic safety, with the following maximum values:

Uo = 5.9 V
Io = 9.8 mA
Po = 15 mW
Lo = 10 mH
Co = 0.5 µF

** 4-20 mA connection with HART, label “IS_opt_C1” and “IS_opt_C2” circuit (terminals P+ and P-; for Pm flow pressure sensor):

In type of protection intrinsic safety, with the following maximum values:

Uo = 23.1 V
Io = 109 mA
Po = 629 mW
Lo = 1 mH
Co = 0.1 µF

Table 8: Field terminal board, TB4

TB5 (IS connections 2)

Pin number	Signal name	Description
4	IS_opt_B4	IS pulse input 2 + (Z2+)
3	IS_opt_B3	IS pulse input 1 - (Z1-)
2	IS_opt_B2	IS pulse input 2 - (Z2-)
1	IS_opt_B1	IS pulse input 1 + (Z1+)

Namur pulse input #1 and pulse input #2, with label “IS_opt_B1”, “IS_opt_B3”, “IS_opt_B2” and “IS_opt_B4” circuit (terminals respectively Z1+, Z1-, Z2- and Z2+):

In type of protection intrinsic safety, with the following maximum values:

Uo = 9.1 V

Io = 37 mA

Po = 84 mW

Lo = 10 mH

Co = 0.5 µF

Table 9: Field terminal board, TB5