

### Portable Ultrasonic Flow Measurement of Gas

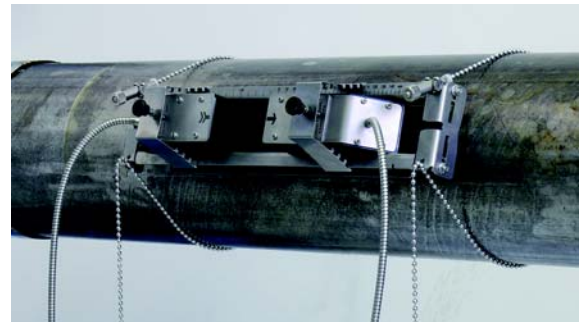
Portable instrument for non-invasive, quick ultrasonic flow measurement with clamp-on technology

#### Features

- Non-invasive measurement using the clamp-on technology for precise, bi-directional and highly dynamic flow measurements
- Portable, easy-to-use transmitter with 2 flow channels, multiple inputs & outputs and an integrated data logger with a serial interface
- Automatic loading of calibration data and transducer detection, reduces set-up time and provides precise, long-term stable results
- Li-Ion battery provides up to 14 hours of measurement
- Transducers available for a wide range of inner pipe diameters (0.3 to 63 in) and fluid temperatures (-40 to +338 °F)
- Transducers resistant to dust and humidity
- Probe for wall thickness measurement available
- Ruggedized housing is resistant against water, dust, and oil
- Robust, water-tight (NEMA 6) transport case with comprehensive accessories
- QuickFix for fast mounting of the transmitter in difficult conditions



FLUXUS G601 supported by handle



Measurement with transducers mounted by the portable Variofix VP

#### Applications

Designed for industrial use in harsh environments such as gas processing, natural gas extraction, chemical industry and petroleum industry.

Practical applications:

- Measurement on natural gas pipelines and in natural gas storage installations
- Measurement of synthesized gas and injection gas
- Measurement for the gas supply industry
- Supervision of permanently installed meters, service and maintenance



Measurement equipment in transport case

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## Function

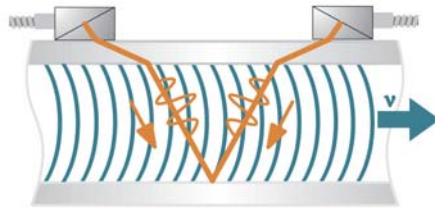
### Measurement Principle

In order to measure the flow of a medium in a pipe, ultrasonic signals are used which employ the transit time difference principle. Ultrasonic signals are emitted by a transducer installed on one side of the pipe, reflected by the opposite pipe wall, and received by a second transducer. These signals are emitted alternately in the flow direction and then against it.

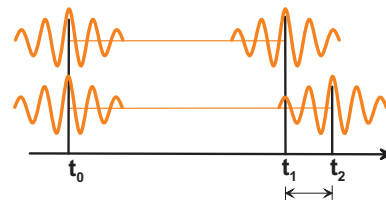
As the medium in which the signals propagate is flowing, the transit time of the ultrasonic signals in the flow direction is shorter than against the flow direction.

The transit time difference,  $\Delta t$ , is measured and allows the transmitter to determine the average flow velocity along the propagation path of the ultrasonic signals. A flow profile correction is then performed in order to obtain the area averaged flow velocity, which is proportional to the volumetric flow rate.

Two integrated microprocessors control the entire measurement process. This allows the transmitter to remove disturbance signals, and to check each received ultrasonic wave for its validity which reduces noise.



Path of the ultrasonic signal



Transit time difference  $\Delta t$

### Calculation of Volumetric Flow Rate

$$Q = k_{Re} \cdot A \cdot k_a \cdot \Delta t / (2 \cdot t_{fl})$$

where:

- Q - volumetric flow rate
- $k_{Re}$  - fluid mechanics calibration factor
- A - cross-sectional area of the pipe
- $k_a$  - acoustical calibration factor
- $\Delta t$  - transit time difference
- $t_{fl}$  - transit time in the medium

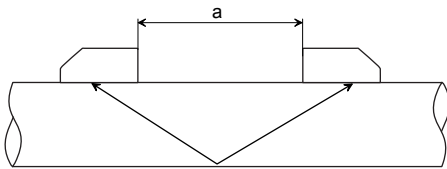
### Number of Sound Paths

The number of sound paths is the number of transits of the ultrasonic signal through the medium in the pipe. Depending on the number of sound paths, the following methods of installation exist:

- **reflect mode**  
The number of sound paths is even. Both of the transducers are mounted on the same side of the pipe. Correct positioning of the transducers is easier.
- **diagonal mode**  
The number of sound paths is odd. Both of the transducers are mounted on opposite sides of the pipe.
- **direct mode**  
Diagonal mode with 1 sound path. This should be used in the case of high signal attenuation by the medium, pipe or coatings.

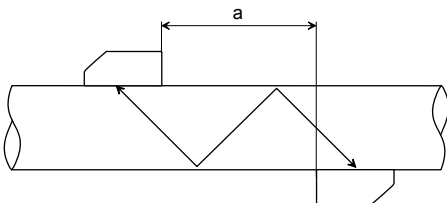
The preferred method of installation depends on the application. While increasing the number of sound paths increases the accuracy of the measurement, signal attenuation increases as well. The optimum number of sound paths for the parameters of the application can be determined automatically by the transmitter.

As the transducers can be mounted with the supplied transducer mounting fixture in reflect or diagonal mode, the number of sound paths can be adjusted optimally for almost any application.

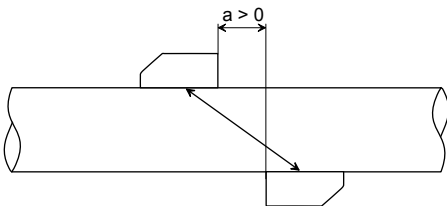


Reflect mode, number of sound paths: 2

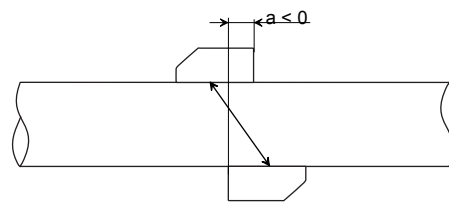
a - transducer distance



Diagonal mode, number of sound paths: 3

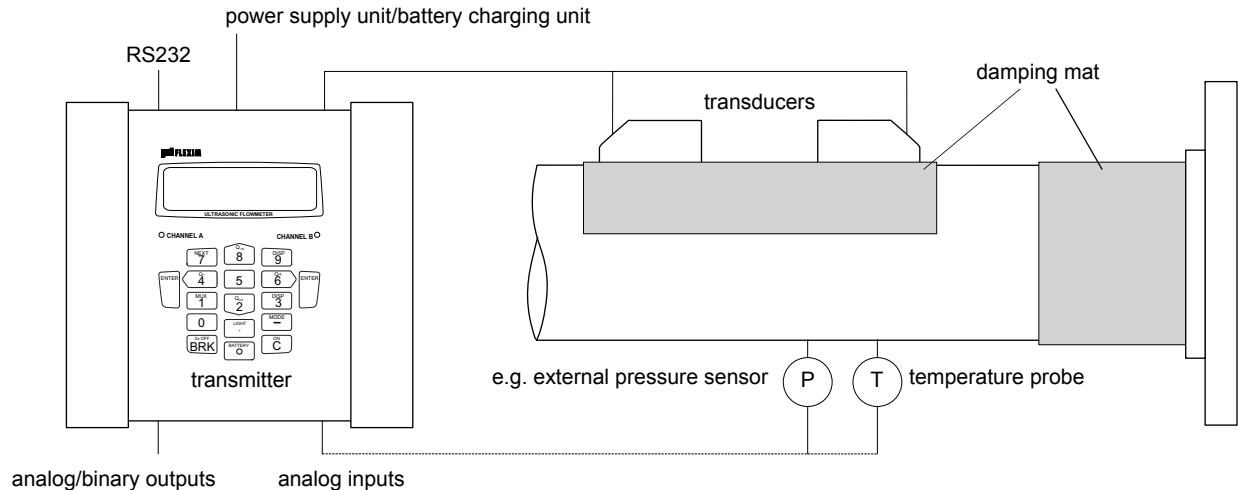


Direct mode , number of sound paths: 1



Direct mode , number of sound paths: 1,  
negative transducer distance

## Typical Measurement Setup



Example of a measurement setup in reflect mode with connection of the inputs to an external process pressure and process temperature measurement for standard volumetric flow rate calculation

## Standard Volumetric Flow Rate

The standard volumetric flow rate can be selected as physical quantity to be measured. It will be calculated internally by:

$$Q_N = Q \cdot p/p_N \cdot T_N/T \cdot 1/K$$

where:

- $Q_N$  - standard volumetric flow rate
- $Q$  - operational volumetric flow rate
- $p_N$  - standard pressure (absolute value)
- $p$  - operational pressure (absolute value)
- $T_N$  - standard temperature in K
- $T$  - operational temperature in K
- $K$  - gas compressibility factor

The operational pressure  $p$  and the operational temperature  $T$  of the medium will be entered directly as fixed values into the transmitter.

Or:


If inputs are installed (optional), pressure and temperature can be measured by the customer and fed in the transmitter.

The gas compressibility factor  $K$  will be entered in the transmitter:

- as fixed value or
- as approximation according to e.g. AGA8 or GERG

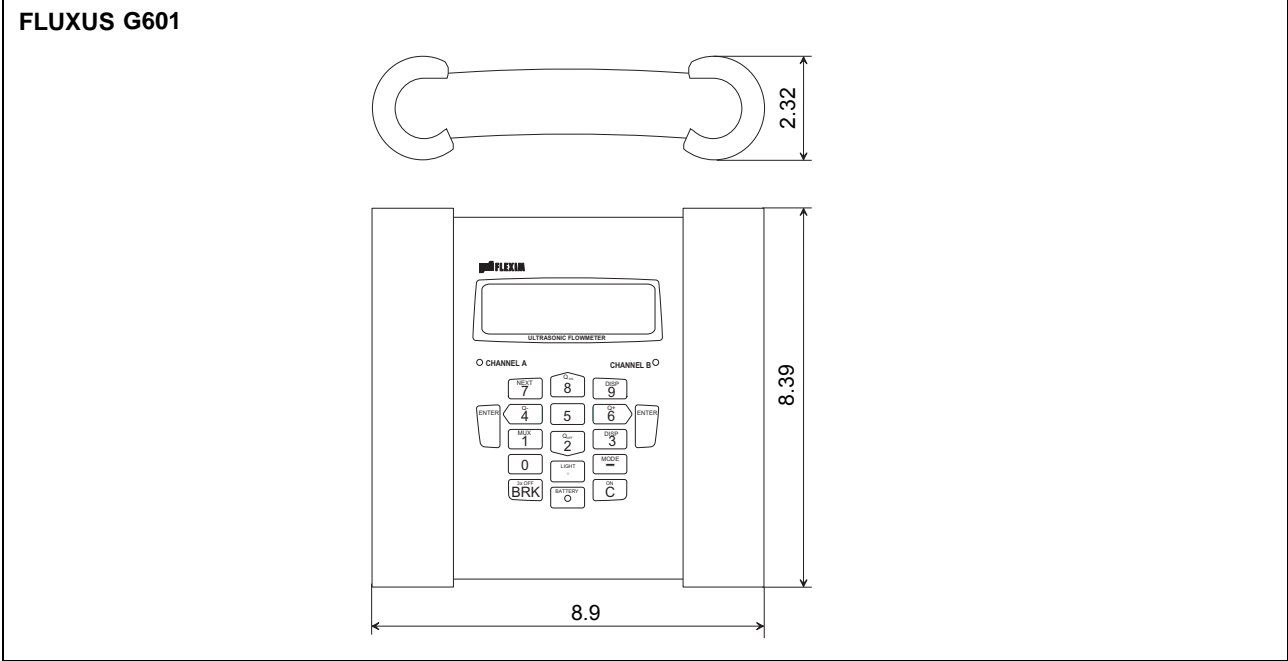
## Flow Transmitter

### Technical Data

FLUXUS	G601
design	portable
	
<b>measurement</b>	
measuring principle	transit time difference correlation principle
flow velocity	0.03 to 115 ft/s, pipe diameter dependent
repeatability	0.15 % of reading $\pm 0.03$ ft/s
medium	gases with a ratio of the characteristic acoustic impedances of pipe wall and gas < 3000, e.g. nitrogen, air, oxygen, hydrogen, argon, helium, ethylene, propane
temperature compensation	corresponding to the recommendations in ANSI/ASME MFC-5M-1985
<b>accuracy</b>	
- volumetric flow rate	$\pm 1$ to 3 % of reading $\pm 0.03$ ft/s depending on application $\pm 0.5$ % of reading $\pm 0.03$ ft/s with field calibration
<b>flow transmitter</b>	
power supply	100 to 240 V/50 to 60 Hz (power supply unit), 10.5 to 15 V DC (socket at transmitter ) or integrated battery
battery	Li-Ion, 7.2 V/4.5 Ah operating time (without outputs, inputs and backlight): > 14 h
power consumption	< 6 W
number of flow measuring channels	2
signal attenuation	0 to 100 s, adjustable
measuring cycle (1 channel)	100 to 1000 Hz
response time	1 s (1 channel), optional: 70 ms
housing material	PA, TPE, AutoTex, stainless steel
degree of protection	NEMA 4
weight	4.2 lb
fixation	QuickFix pipe mounting fixture
operating temperature	14 to 140 °F
display	2 x 16 characters, dot matrix, backlit
menu language	English, German, French, Dutch, Spanish
<b>measuring functions</b>	
physical quantities	operational volumetric flow rate, standard volumetric flow rate, mass flow rate, flow velocity
totalizers	volume, mass
calculation functions	average, difference, sum
diagnostic functions	sound velocity, signal amplitude, SNR, SCNR, standard deviation of amplitudes and transit times
<b>data logger</b>	
loggable values	all physical quantities, totalized values and diagnostic values
capacity	> 100 000 measured values

<b>FLUXUS</b>	<b>G601</b>
<b>communication</b>	
interface	RS232/USB
<b>serial data kit</b>	
software (all Windows™ versions)	- FluxData: download of measured data, graphical presentation, conversion to other formats (e.g. for Excel™) - FluxKoeff: creating medium data sets
cable	RS232
adapter	RS232 - USB
<b>transport case</b>	
dimensions	19.7 x 15.7 x 7.5 in
<b>outputs</b>	
	The outputs are galvanically isolated from the transmitter.
number	see standard scope of supply on page 9, max. on request
accessories	output adapter (if number of outputs > 4)
<b>current output</b>	
range	0/4 to 20 mA
accuracy	0.1 % of reading ±15 µA
active output	$R_{ext} < 200 \Omega$
passive output	$U_{ext} = 4 \text{ to } 16 \text{ V}$ , dependent on $R_{ext}$ $R_{ext} < 500 \Omega$
<b>frequency output</b>	
range	0 to 5 kHz
open collector	24 V/4 mA
<b>binary output</b>	
optorelay	26 V/100 mA
binary output as alarm output - functions	limit, change of flow direction or error
binary output as pulse output - pulse value - pulse width	0.01 to 1000 units 1 to 1000 ms
<b>inputs</b>	
	The inputs are galvanically isolated from the transmitter.
number	see standard scope of supply on page 9, max. 4
accessories	input adapter (if number of inputs > 2)
<b>temperature input</b>	
designation	Pt100/Pt1000
connection	4-wire
range	-238 to +1040 °F
resolution	0.01 K
accuracy	±0.01 % of reading ±0.03 K
<b>current input</b>	
accuracy	0.1 % of reading ±10 µA
passive input	$R_i = 50 \Omega$ , $P_i < 0.3 \text{ W}$
- range	-20 to +20 mA
<b>voltage input</b>	
range	0 to 1 V
accuracy	0.1 % of reading ±1 mV
internal resistance	$R_i = 1 \text{ M}\Omega$

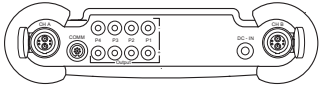
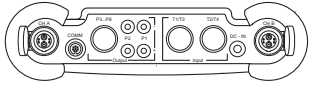
**Dimensions**



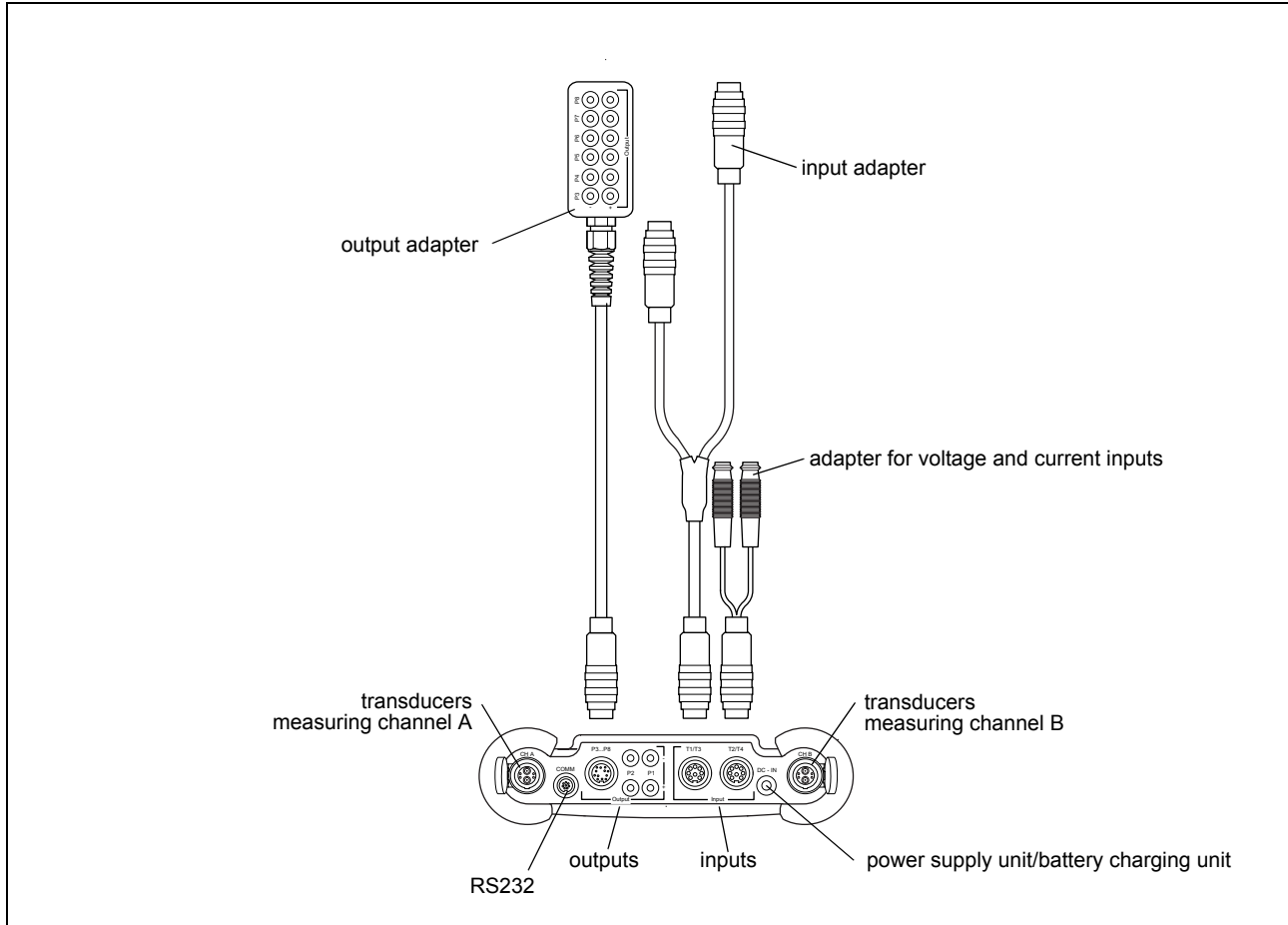
in inch



### Standard Scope of Supply

	G601 Standard	G601 Multifunctional
application	all flow measurements on gas	sophisticated measuring tasks, e.g. temporary substitute of other flowmeters with use of actual physical quantities (e.g. pressure, temperature) for calculation of the standard volumetric flow rate and simultaneous measured value output
<b>outputs</b>		
passive current output	2	2
binary output	2	2
frequency output	-	1
<b>inputs</b>		
temperature input	-	1
passive current input	-	2
voltage input	-	1
<b>accessories</b>		
transport case	x	x
power supply unit, power cable	x	x
battery	x	x
output adapter	-	x
input adapter	-	2
adapter for voltage or current inputs	-	3
QuickFix pipe mounting fixture for transmitter	x	x
serial data kit	x	x
measuring tape	x	x
damping mats with installation kit	x	x
wall thickness probe	-	x
user manual, Quick Start Guide	x	x
connector board at the upper side of the transmitter		

### Connection of Adapters



### Example for the Equipment of a Transport Case

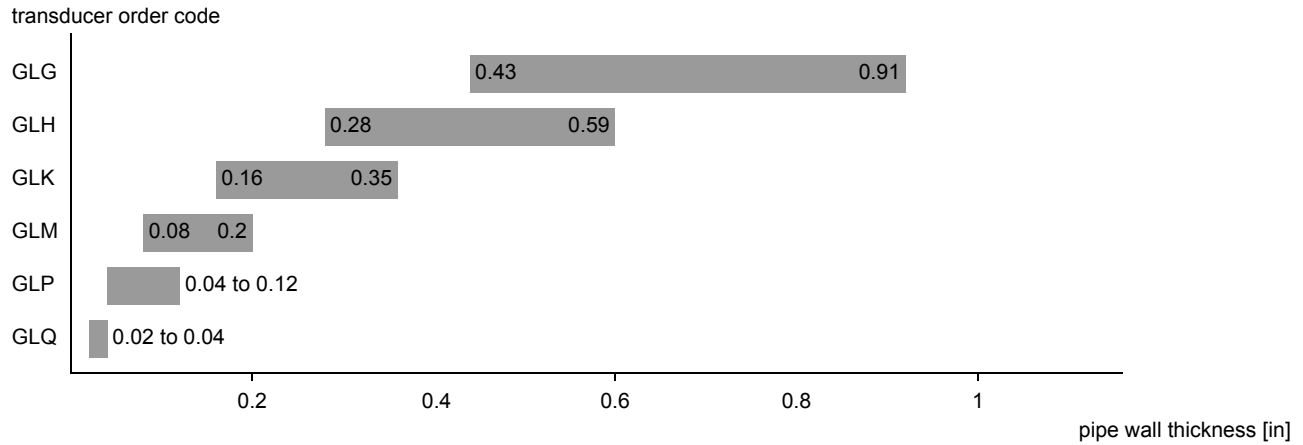


## Transducers

### Transducer Selection

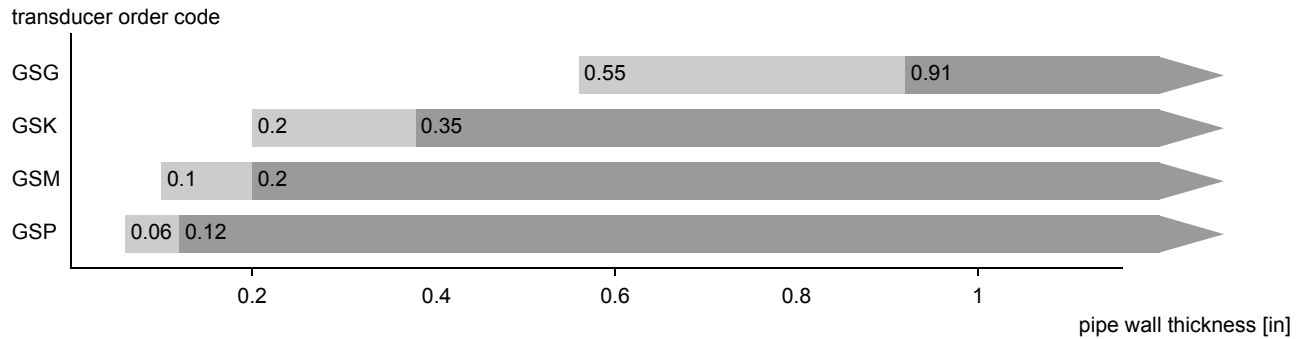
#### Step 1a

Select a Lamb wave transducer:



#### Step 1b

If the pipe wall thickness is not in the range of the Lamb wave transducers, select a shear wave transducer:



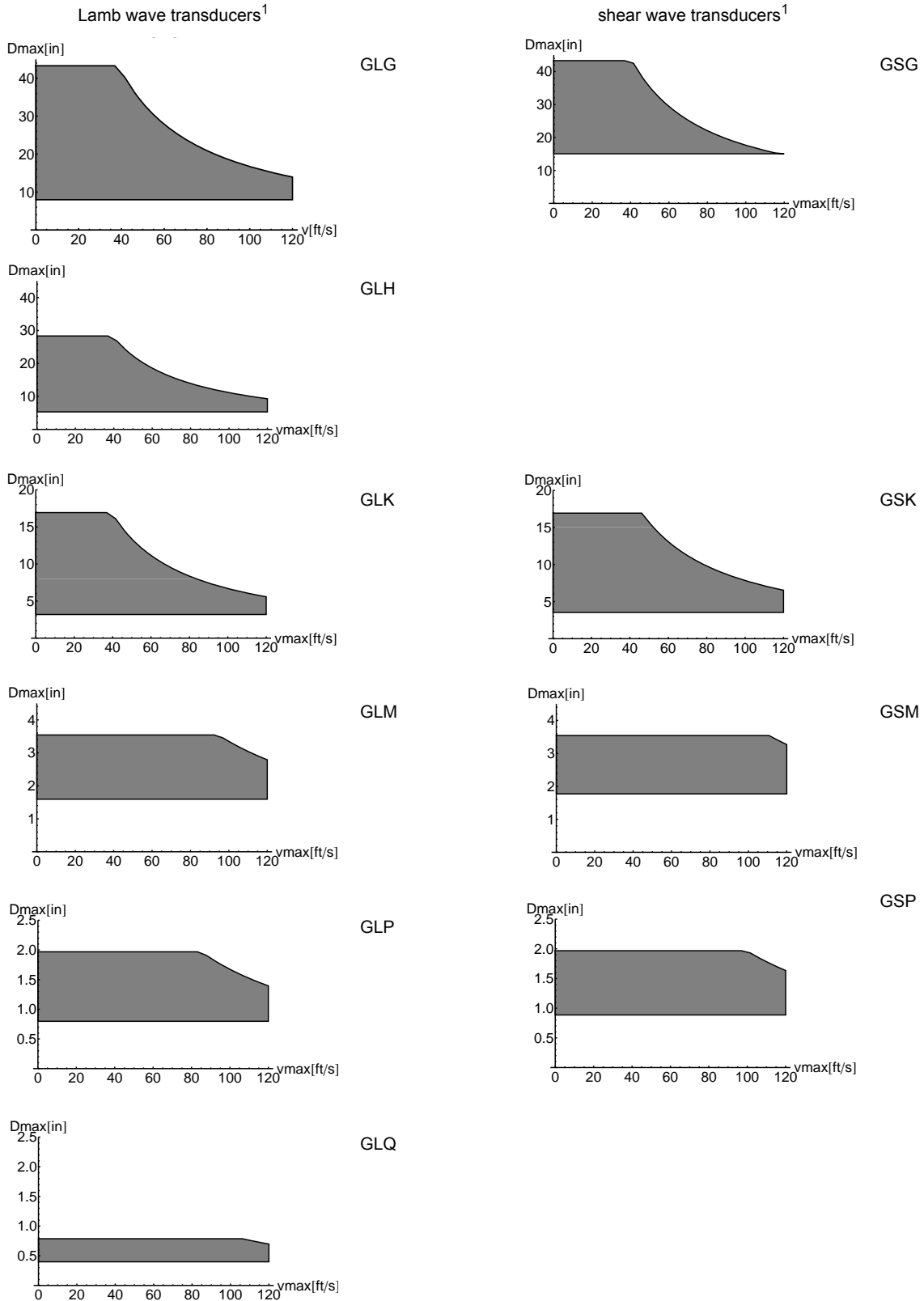
recommended
  possible

#### Step 2

inner pipe diameter  $d$  dependent on the flow velocity  $v$  of the medium in the pipe

The transducers are selected from the characteristics (see next page). Lamb wave transducers are selected from the left column, shear wave transducers from the right column.

Lamb wave transducers: If the values  $d$  and  $v$  are not in the range, diagonal mode with 1 sound path may be used, i.e. the same characteristics can be used with doubling the inner pipe diameter. If the values are still not in the range, shear waves transducers regarding the pipe wall thickness have to be selected in step 1b.



<sup>1</sup> inner pipe diameter and max. flow velocity for a typical application with natural gas, nitrogen, oxygen in reflect mode with 2 sound paths (Lamb wave transducers)/1 sound path (shear wave transducers)

**Step 3**

min. medium pressure

Lamb wave transducers			
transducer order code	medium pressure <sup>1</sup> [ psi ]		
	metal pipe		plastic pipe
	min.	min. extended	min.
GLG	218	145	15
GLH	218	145	15
GLK	218 (d > 4.7 in) 145 (d < 4.7 in)	145 (d > 4.7 in) 73 (d < 4.7 in)	15
GLM	145 (d > 2.4 in) 73 (d < 2.4 in)	-	15
GLP	145 (d > 1.4 in) 73 (d < 1.4 in)	-	15
GLQ	145 (d > 0.59 in) 73 (d < 0.59 in)	-	15

shear wave transducers			
transducer order code	medium pressure <sup>1</sup> [ psi ]		
	metal pipe		plastic pipe
	min.	min. extended	min.
GSG	435	290	15
GSK	435	290	15
GSM	435	290	15
GSP	435	290	15

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

d - inner pipe diameter

**Examples**

step						
1	pipe wall thickness selected transducer	in	0.47 GLG or GLH	0.47 GLG or GLH	0.47 GLG or GLH	1.2 GS
2	inner pipe diameter max. flow velocity selected transducer	in ft/s	31.5 49 GLG	23.6 49 GLG or GLH	31.5 98 values not in the range of the characteristics, but by using diagonal mode with 1 sound path, the inner pipe diameter in the characteristics is doubled: GLG	11.8 49 GSK
3	min. medium pressure selected transducer	psi	247 GLG	247 GLG or GLH influence of acoustic noise is reduced with increased transducer frequency, thus recommended: GLH	247 GLG	508 GSK

**Step 4**

for determination of characters 4 to 11 of the transducer order code (temperature, explosion protection, connection system, extension cable) see page 15

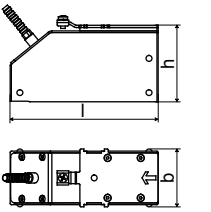
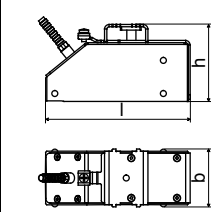
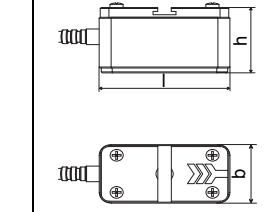
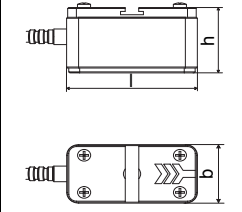
**Step 5**

for the technical data of the selected transducer see page 16 et seqq.

### Transducer Order Codes

1, 2	3	4	5, 6	7, 8	9 to 11	no. of character		
transducer	transducer frequency	-	temperature	explosion protection	connection system	-	extension cable	
							description	
GL								set of ultrasonic flow transducers for gas measurement, Lamb wave
GS								set of ultrasonic flow transducers for gas measurement, shear wave
	G							0.2 MHz
	H							0.3 MHz (Lamb wave only)
	K							0.5 MHz
	M							1 MHz
	P							2 MHz
	Q							4 MHz (Lamb wave only)
			N					normal temperature range
				NN				not explosion proof
					NL			with Lemo connector
						XXX		cable length in m, for max. length of extension cable see page 24
example								
GL	K	-	N	NN	NL	-	000	Lamb wave transducer 0.5 MHz, normal temperature range, connection system NL with Lemo connector
		-				-		

### Technical Data Shear Wave Transducers

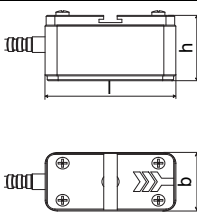
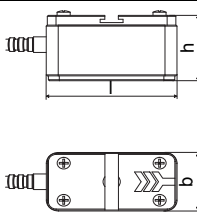
technical type		GDG1NZ7	GDK1NZ7	GDM1NZ7	GDP1NZ7
order code		<b>GSG-NNNNL</b>	<b>GSK-NNNNL</b>	<b>GSM-NNNNL</b>	<b>GSP-NNNNL</b>
transducer frequency		MHz 0.2	0.5	1	2
<b>medium pressure<sup>1</sup></b>					
min. extended		psi metal pipe: 290	metal pipe: 290	metal pipe: 290	metal pipe: 290
min.		psi metal pipe: 435 plastic pipe: 15	metal pipe: 435 plastic pipe: 15	metal pipe: 435 plastic pipe: 15	metal pipe: 435 plastic pipe: 15
<b>inner pipe diameter d<sup>2</sup></b>					
min. extended		in 9.8	2.8	1.2	0.59
min. recommended		in 15	3.1	1.6	0.79
max. recommended		in 31.9	19.7	3.1	1.6
max. extended		in 43.3	28.3	4.7	2.4
<b>pipe wall thickness</b>					
min.		in 0.55	0.2	0.1	0.06
max.		in -	-	-	-
<b>material</b>					
housing		PEEK with stainless steel cap 304	PEEK with stainless steel cap 304	stainless steel 304	stainless steel 304
contact surface		PEEK	PEEK	PEEK	PEEK
degree of protection		NEMA 6	NEMA 6	NEMA 6	NEMA 6
<b>transducer cable</b>					
type		1699	1699	1699	1699
length		ft 16	16	13	13
<b>dimensions</b>					
length l		in 5.1	4.98	2.36	2.36
width b		in 2.01	2.01	1.18	1.18
height h		in 2.64	2.66	1.32	1.32
dimensional drawing					
<b>operating temperature</b>					
min.		°F -40	-40	-40	-40
max.		°F +266	+266	+266	+266
temperature compensation		x	x	x	x

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> shear wave transducers:  
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request  
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 49 ft/s



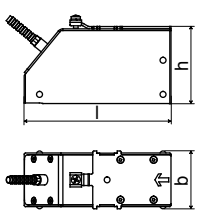
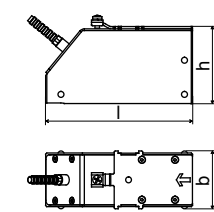
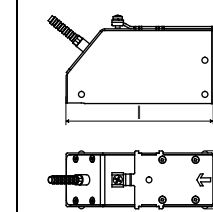
**Shear Wave Transducers (extended temperature range)**

technical type		GDM1EZ7		GDP1EZ7	
order code		<b>GSM-ENNNL</b>		<b>GSP-ENNNL</b>	
transducer frequency		MHz	1		2
<b>medium pressure<sup>1</sup></b>					
min. extended		psi	metal pipe: 290 metal pipe: 435 plastic pipe: 15	metal pipe: 290	
min.				metal pipe: 435 plastic pipe: 15	
<b>inner pipe diameter d<sup>2</sup></b>					
min. extended		in	1.2	0.59	
min. recommended		in	1.6	0.79	
max. recommended		in	3.1	1.6	
max. extended		in	4.7	2.4	
<b>pipe wall thickness</b>					
min.		in	0.1	0.06	
max.		in	-	-	
<b>material</b>					
housing		stainless steel 304		stainless steel 304	
contact surface		Sintimid		Sintimid	
degree of protection		NEMA 4		NEMA 4	
<b>transducer cable</b>					
type		1699		1699	
length		ft	13	13	
<b>dimensions</b>					
length l		in	2.36	2.36	
width b		in	1.18	1.18	
height h		in	1.32	1.32	
dimensional drawing					
<b>operating temperature</b>					
min.		°F	-22	-22	
max.		°F	+392	+392	
temperature compensation		x		x	

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> shear wave transducer:  
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request  
pipe diameter min. recommended/max. recommended/max. extended: in diagonal mode and for a flow velocity of 49 ft/s

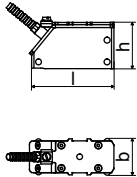
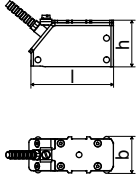
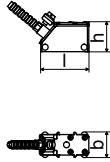
**Lamb Wave Transducers**

technical type		GRG1NC3	GRH1NC3	GRK1NC3
order code		<b>GLG-NNNNL</b>	<b>GLH-NNNNL</b>	<b>GLK-NNNNL</b>
transducer frequency	MHz	0.2	0.3	0.5
<b>medium pressure<sup>1</sup></b>				
min. extended	psi	metal pipe: 145	metal pipe: 145	metal pipe: 145 (d > 4.7 in) 73 (d < 4.7 in)
min.	psi	metal pipe: 218 plastic pipe: 15	metal pipe: 218 plastic pipe: 15	metal pipe: 218 (d > 4.7 in) 145 (d < 4.7 in) plastic pipe: 15
<b>inner pipe diameter d<sup>2</sup></b>				
min. extended	in	7.5	4.7	2.4
min. recommended	in	8.7	5.5	3.1
max. recommended	in	35.4	23.6	11.8
max. extended	in	63	39.4	19.7
<b>pipe wall thickness</b>				
min.	in	0.43	0.28	0.16
max.	in	0.91	0.59	0.35
<b>material</b>				
housing		PPSU with stainless steel cap 304	PPSU with stainless steel cap 304	PPSU with stainless steel cap 304
contact surface		PPSU	PPSU	PPSU
degree of protection		NEMA 4	NEMA 4	NEMA 4
<b>transducer cable</b>				
type		1699	1699	1699
length	ft	16	16	16
<b>dimensions</b>				
length l	in	5.06	5.06	5.06
width b	in	2.01	2.01	2.01
height h	in	2.66	2.66	2.66
dimensional drawing				
<b>operating temperature</b>				
min.	°F	-40	-40	-40
max.	°F	+338	+338	+338
temperature compensation		x	x	x

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> Lamb wave transducers:  
 typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request  
 pipe diameter min. recommended/max. recommended: in reflect mode and for a flow velocity of 49 ft/s  
 pipe diameter max. extended: in diagonal mode and for a flow velocity of 82 ft/s

### Lamb Wave Transducers

technical type		GRM1NC3	GRP1NC3	GRQ1NC3
order code		<b>GLM-NNNNL</b>	<b>GLP-NNNNL</b>	<b>GLQ-NNNNL</b>
transducer frequency		MHz 1	2	4
<b>medium pressure<sup>1</sup></b>				
min. extended	psi	-	-	-
min.	psi	metal pipe: 145 (d > 2.4 in) 73 (d < 2.4 in) plastic pipe: 15	metal pipe: 145 (d > 1.4 in) 73 (d < 1.4 in) plastic pipe: 15	metal pipe: 145 (d > 0.59 in) 73 (d < 0.59 in) plastic pipe: 15
<b>inner pipe diameter d<sup>2</sup></b>				
min. extended	in	1.2	0.59	0.28
min. recommended	in	1.6	0.79	0.39
max. recommended	in	3.5	2	0.87
max. extended	in	5.9	2.8	1.4
<b>pipe wall thickness</b>				
min.	in	0.08	0.04	0.02
max.	in	0.2	0.12	0.04
<b>material</b>				
housing		PPSU with stainless steel cap 304	PPSU with stainless steel cap 304	PPSU with stainless steel cap 304
contact surface		PPSU	PPSU	PPSU
degree of protection		NEMA 4	NEMA 4	NEMA 4
<b>transducer cable</b>				
type		1699	1699	1699
length	ft	13	13	9
<b>dimensions</b>				
length l	in	2.91	2.91	1.65
width b	in	1.26	1.26	0.87
height h	in	1.59	1.59	1
dimensional drawing				
<b>operating temperature</b>				
min.	°F	-40	-40	-40
max.	°F	+338	+338	+338
temperature compensation		x	x	x
remark				on request

<sup>1</sup> depending on application, typical absolute value for natural gas, nitrogen, compressed air

<sup>2</sup> Lamb wave transducers:

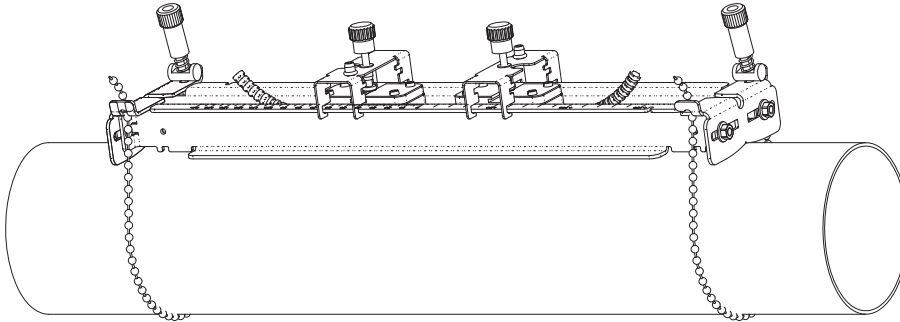
typical values for natural gas, nitrogen, oxygen, pipe diameters for other gases on request  
 pipe diameter min. recommended/max. recommended: in reflect mode and for a flow velocity of 49 ft/s  
 pipe diameter max. extended: in diagonal mode and for a flow velocity of 82 ft/s

## Transducer Mounting Fixtures

### Order Codes

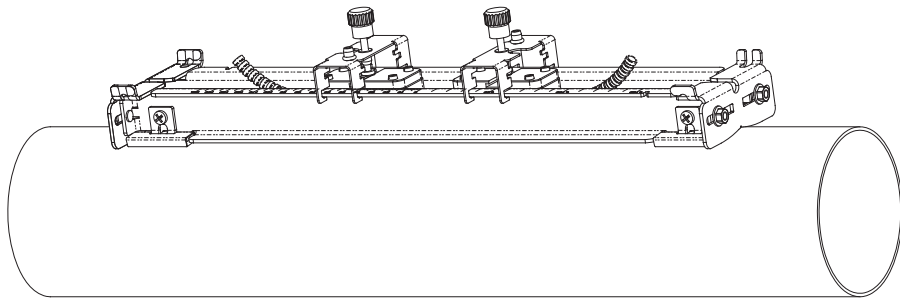
1, 2	3	4	5	6	7 to 9	no. of character		
transducer mounting fixture	transducer	-	measuring mode	size	-	fixation	outer pipe diameter	description
VP								portable Variofix
TB								tension belts
	A							all transducers
			D					reflect mode or diagonal mode
			R					reflect mode
				M				medium
						C		chains
						N		without fixation
							055	0.39 to 21.7 in
							150	2 to 59.1 in
							210	2 to 82.7 in
example								
VP	A	-	D	M	-	C	055	portable Variofix and chains
		-			-			

**Portable Variofix VP and Chains (optional)**



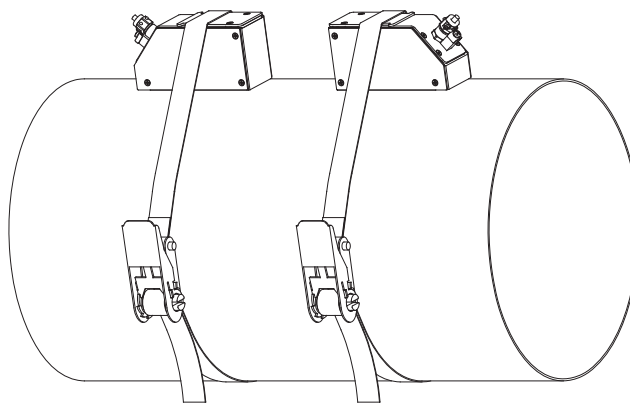
material: stainless steel 304,  
301, 303  
dimensions:  
16.3 x 3.31 x 1.97 in  
chain length: 6 ft

**Portable Variofix VP and Magnets (optional)**



material: stainless steel 304,  
301, 303  
dimensions:  
16.3 x 3.31 x 1.77 in

**Tension Belts TB (optional)**



material: steel, powder coated  
and textile belt  
length: 16/22 ft  
temperature: max. 140 °F  
outer pipe diameter:  
max. 59.1/82.7 in

## Coupling Materials for Transducers

	normal temperature range (4th character of transducer order code = N)		extended temperature range (4th character of transducer order code = E)	
	< 212 °F	212 to 338 °F	< 302 °F	302 to 392 °F
< 2 h	coupling compound type N	coupling compound type E	coupling compound type E	coupling compound type E or H
< 24 h	coupling compound type N	coupling compound type E	coupling compound type E	coupling foil type VT
< 3 months	coupling compound type N	coupling compound type E	coupling foil type VT	coupling foil type VT

## Technical Data

type	order code	temperature °F	material	remark
coupling compound type N	990739-1	-22 to +266	mineral grease paste	
coupling compound type E	990739-2	-22 to +392	silicone paste	
coupling compound type H	990739-3	-22 to +482	fluoropolymer paste	
coupling foil type VT	990739-0	14 to 302, short-time peak max. 392	fluoroelastomer	for transducers with transducer frequency G, H, K
	990739-6			for shear wave transducers with transducer frequency M, P
	990739-14			for IP68 shear wave transducers and Lambwave transducers with transducer frequency M, P
	990739-15			for shear wave transducers with transducer frequency Q
	990739-5			for Lambwave transducers with transducer frequency Q

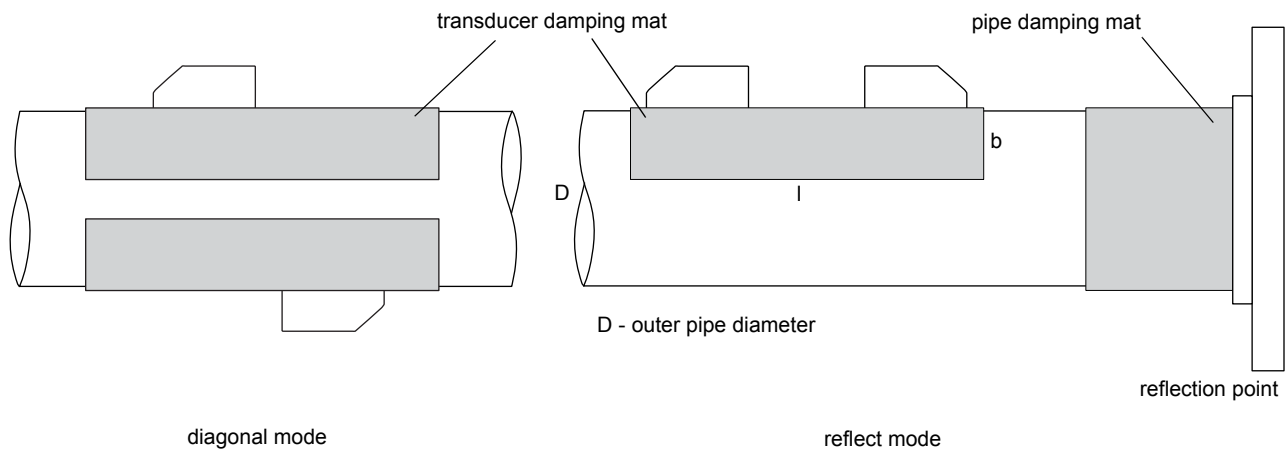
coupling foil not to be used for transducer mounting fixture with magnets

### Damping Mats (optional)

Damping mats will be used for the gas measurement to reduce acoustic noise influences on the measurement.

**Transducer damping mats** will be installed below the transducers.

**Pipe damping mats** will be installed at reflection points, e.g. flange, weld.



### Selection of Damping Mats

type	description	outer pipe diameter	dimensions l x b x h	transducer frequency (3rd character of transducer order code)						technical type	temperature	remark
				G	H	K	M	P	°F			
<b>transducer damping mat</b>												
D	for temporary installation (multiple use), fixed with coupling compound	< 3.1	17.72 x 4.53 x 0.02	-	-	-	x	x	D20S3	-13 to +140		
		≥ 3.1	35.43 x 9.06 x 0.02	-	-	x	x	-	D20S2			
			35.43 x 9.06 x 0.05	x	x	-	-	-	D50S2			
<b>pipe damping mat</b>												
A	for temporary installation (multiple use), fixed with coupling compound	< 11.8	11.81 x 4.53 x 0.02	x	x	x	x	x	A20S4	-13 to +140	for quantity see table below	
B	self-adhesive	≥ 11.8	l x 3.94 x 0.04	x	x	x	x	x	B35R2	-31 to +122	l - see table below	

### Quantity for Pipe Damping Mat - Type A

(depending on the outer pipe diameter)

outer pipe diameter D in	transducer frequency	
	G, H	K, M, P
3.9	12	6
7.9	24	12
11.8	32	16

### Length of Pipe Damping Mat - Type B

(length l depending on transducer frequency and outer pipe diameter)

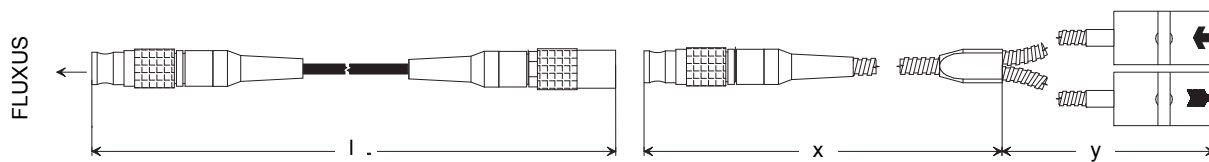
outer pipe diameter D in	transducer frequency	
	G, H ft	K, M, P ft
11.8	39	19
19.7	104	52
39.4	413	206

## Connection Systems

### Connection System NL

transducer frequency (3rd character of transducer order code)	G, H, K			M, P			Q			S			
cable length	ft	x	y	l <sup>1</sup>	x	y	l <sup>1</sup>	x	y	l <sup>1</sup>	x	y	l
		6	9	≤ 82	6	6	≤ 82	6	3	≤ 82	3	3	≤ 65

<sup>1</sup> > 82 to 328 f on request



x, y - transducer cable length  
l - max. length of extension cable

## Transducer Cables

### Technical Data

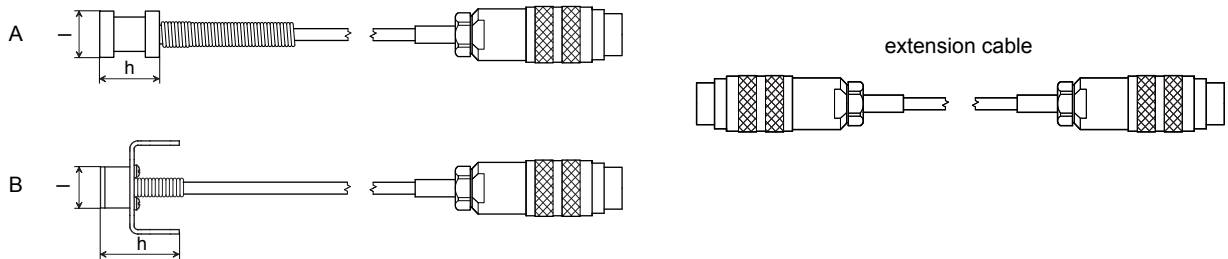
		transducer cable		extension cable
item number		1699	6111	2551
standard length	ft	see table above	see table above	16 10
max. length	ft	-	-	see table above
temperature	°F	-67 to +392	-148 to +437	-13 to +176
sheath				
material		stainless steel 304 option OS: 316L	stainless steel 304 option OS: 316L	-
outer diameter	in	0.31	0.31	-
cable jacket				
material		PTFE	PFA	TPE-O
outer diameter	in	0.11	0.11	0.31
thickness	in	0.01	0.02	
color		brown	white	black
shield		x	x	x



## Temperature Probes (optional)

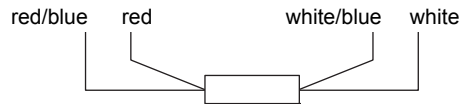
### Technical Data

order code		<b>670413-1</b>	<b>670412-1</b>	<b>670413-2</b>	<b>670412-2</b>
design				short response time	
type		Pt1000	Pt1000 matched according to DIN 1434-1	Pt1000	Pt1000 matched according to DIN 1434-1
connection		4-wire		4-wire	
measuring range	°F	-22 to +482		-58 to +482	
accuracy T		$\pm(0.27 \text{ }^\circ\text{F} + 2 \cdot 10^{-3} \cdot (T \text{ [}^\circ\text{F]} - 32 \text{ }^\circ\text{F}))$ , class A		$\pm(0.27 \text{ }^\circ\text{F} + 2 \cdot 10^{-3} \cdot (T \text{ [}^\circ\text{F]} - 32 \text{ }^\circ\text{F}))$ , class A	
accuracy $\Delta T$		-	$\leq 0.1 \text{ K}$ ( $3\text{K} < \Delta T < 6 \text{ K}$ ), more corresponding to EN 1434-1	-	$\leq 0.1 \text{ K}$ ( $3\text{K} < \Delta T < 6 \text{ K}$ ), more corresponding to EN 1434-1
response time	s	50		8	
housing		aluminum		PEEK, stainless steel 304, Cu	
degree of protection		NEMA 4		NEMA 4	
weight (without connector)	lb	0.6	1.1	0.7	1.4
fixation		clamp-on		clamp-on	
accessories		-		plastic protection plate, isolation foam	
<b>dimensions</b>					
length l	in	0.59		0.55	
width b	in	0.59		1.18	
height h	in	0.79		1.06	
dimensional drawing		A	A	B	



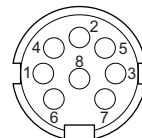
### Connection

#### Temperature Probe



#### Connector

pin	cable of temperature probe	extension cable
1	white/blue	blue
2	red/blue	gray
3, 4, 5	not connected	
6	red	red
7	white	white
8	not connected	



#### Cables

		cable of temperature probe	extension cable
type		4 x 0.25 mm <sup>2</sup> black or white	LIYCY 8 x 0.14 mm <sup>2</sup> gray
standard length	ft	9	16/32/82
max. length	ft	-	656
cable jacket		PTFE	PVC

### Wall Thickness Probe (optional)

The pipe wall thickness is an important pipe parameter which has to be determined exactly for a good measurement. However, the pipe wall thickness often is unknown.

The wall thickness probe can be connected to the flow transmitter instead of the flow transducers and the wall thickness measurement mode is activated automatically.

Acoustic coupling compound is applied to the wall thickness probe which then is placed firmly on the pipe. The wall thickness is displayed and can be stored directly in the flow transmitter.

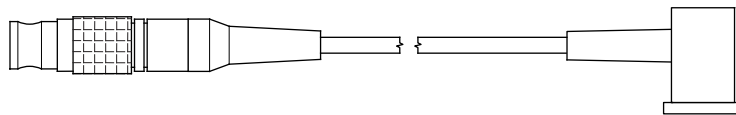


Wall thickness measurement

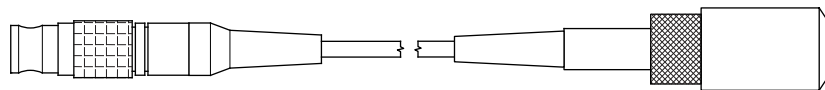
### Technical Data

technical type		DWQ1xZ7	DWP1EZ7
		reverse polarity protected	
measuring range <sup>1</sup>	in	0.04 to 7.9	
resolution	in	0.0004	
linearity	in	0.004	
operating temperature	°F	-4 to +140	-4 to +392, short-time peak max. 1004
cable length	ft	4	3

<sup>1</sup> The measuring range depends on the attenuation of the ultrasonic signal in the pipe. For strongly attenuating plastics (e.g. PFA, PTFE, PP) the measuring range is smaller.



DWQ1xZ7



DWP1EZ7



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